

# Bitcoin Carbon Footprint and Energy Consumption

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## 1 Abstract

This is a descriptive report for Data Visualization Dataset to Scientific Data (Bitcoin Carbon Footprint and Energy Consumption (Original Data)). Assessing the environmental impacts of bitcoin appears difficult due to data limitations on bitcoin-related emissions. This data in the brief article presents a constructed daily frequency dataset on bitcoin's annualized carbon footprint from July 7, 2010, to December 4, 2021, spanning a period of 4,158 observations. The 12 data variables capture the annualized carbon footprint from coal, oil, gas, and the average of the three sources. The bitcoin carbon footprint data are measured in kgCO<sub>2</sub> using IEA World Energy Outlook emission factors for electricity generation. The data will help multidisciplinary cryptocurrency research from the environmental, energy, and economics disciplines.

## 2 Specifications Table

- Subject: Economics, Econometrics and Finance

- Specific subject area: Cryptocurrency and Fintech
- Type of data: Tables, and Figures
- How the data were acquired: Bitcoin energy consumption data were acquired from the Cambridge Centre for Alternative Finance. The raw data is processed and modeled to produce bitcoin carbon footprint.

### **3 Value of Data (how this data can help)**

- The collection includes several data points covering the period from July 7, 2010, to December 4, 2021, and comprises daily frequency observations on the annualized carbon footprint of bitcoin.
- The dataset can help empirical study on the energy and environmental sustainability of bitcoin, advancing the worldwide discussion.
- The information can be used in multidisciplinary economic, energy, and environmental studies of cryptocurrencies.
- Since the carbon footprint estimate for bitcoin is based on global factors, it may be used in all crypto-based studies that evaluate the sustainability of bitcoin.

### **4 Data Description**

Table 1 presents the data description of the 12 data variables constructed using 3 initial raw data from CBECI.

The dataset comprises daily frequency variables with their units of measurement.

Abbrev	Variable description	Unit	Source
BTCENEMAX	annualised BTC electricity consumption (maximum)	kWh	CBECI [1]
BTCENEMIN	annualised BTC electricity consumption (minimum)	kWh	CBECI [1]
BTCENEGUE	annualised BTC electricity consumption (optimal)	kWh	CBECI [1]
BTCEML_MAX	annualised BTC average emissions (maximum)	kgCO <sub>2</sub>	Authors
BTCEML_MIN	annualised BTC average emissions (minimum)	kgCO <sub>2</sub>	Authors
BTCEML_GUE	annualised BTC average emissions (optimal)	kgCO <sub>2</sub>	Authors
BTCOAL_MAX	annualised BTC emissions from coal (maximum)	kgCO <sub>2</sub>	Authors
BTCOAL_MIN	annualised BTC emissions from coal (minimum)	kgCO <sub>2</sub>	Authors
BTCOAL_GUE	annualised BTC emissions from coal (optimal)	kgCO <sub>2</sub>	Authors
BTCOIL_MAX	annualised BTC emissions from oil (maximum)	kgCO <sub>2</sub>	Authors
BTCOIL_MIN	annualised BTC emissions from oil (minimum)	kgCO <sub>2</sub>	Authors
BTCOIL_GUE	annualised BTC emissions from oil (optimal)	kgCO <sub>2</sub>	Authors
BTCGAS_MAX	annualised BTC emissions from gas (maximum)	kgCO <sub>2</sub>	Authors
BTCGAS_MIN	annualised BTC emissions from gas (minimum)	kgCO <sub>2</sub>	Authors
BTCGAS_GUE	annualised BTC emissions from gas (optimal)	kgCO <sub>2</sub>	Authors

Notes: The raw data were converted from the original measurements in TWh to kWh before constructing the emission dataset using IEA emission factors.

Figure 1: Table 1. Sampled data description.

## 5 Conclusion

The bitcoin carbon footprint [kgCO<sub>2</sub>] CF is calculated as:  $CF = EC \times EF$

Where,

EC: energy consumption [kWh]

EF: emission factor [kgCO<sub>2</sub>/kWh] that captures carbon

intensity of the energy mix 3/4 namely coal, oil, and gas. The following presumptions, which correlate to the above emission factors, are made in order to calculate the bitcoin carbon footprint:

First, regardless of the technology utilized, all energy required for data centers and mining equipment comes from coal.

Second, no matter what kind of hardware is utilized, oil is the only source of energy for data centers and mining equipment.

Third, gas is used specifically to generate electricity for data centers and all types of mining equipment.

Fourth, regardless of the hardware type, the energy utilized for data centers and electricity for mining equipment is derived from the entire energy mix.

Based on the four assumptions, each of the 3 scenarios of energy consumption namely minimum, maximum, and optimal power consumption are subsequently multiplied by the four emission factors to develop 12 daily frequency data variables of bitcoin's carbon footprint.

## 6 Schema

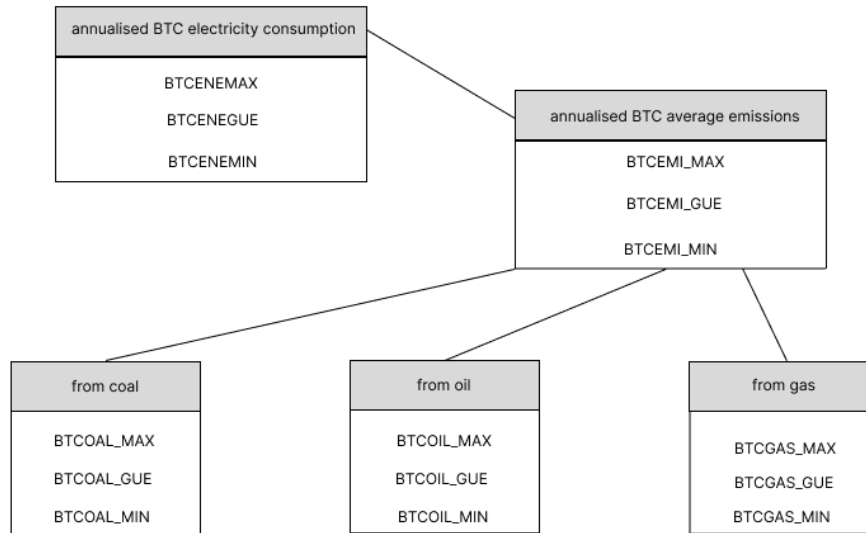


Figure 2: Schema of the attribute used

## 7 Reference

Cambridge Bitcoin Electricity Consumption Index (2021)

Retrieved from:

<https://ccaf.io/cbeci/index/>.

<https://www.sciencedirect.com/science/article/pii/S2352340922004541>