

GreenCoin

Abstract:

GreenCoin is a peer-to-peer, cryptographically secure digital asset generated by a distributed, network of miners, integrated with a compulsory sharing mechanism with certified, renewable commerce providers. The base value of GreenCoin assets is the aggregate carbon¹ sequestered by these renewable producers. GreenCoin offers a unique and fungible digital asset that captures the environmental and public policy value of carbon-reduced human productivity.

Mission:

Carbon emissions currently have no open market value though it is generally becoming well understood that human life on Earth may be perilously tied to cumulative, human based CO₂ emissions. Various government entities around the world have attempted to mandate the trade of carbon credits to limited success and utility. A primary opposing argument to Cap and Trade is the potential drag on the economy that may be effectuated by such intervention. However, critical to the understanding of carbon emissions is the concept that the “economy” is justifiably a wholly-owned subsidiary of the environment; that is, without the existence of a nurturing environment in which humans thrive, no economy would exist, or certainly not a healthy one. The magnitude of this problem and the fact that no real, viable solution currently exists cannot be understated. The punitive nature of Cap and Trade and/or Carbon Tax systems are a poor way to address the problem for a number of reasons. First of all, governments at all levels and nationalities need to work together which is essentially a non-starter. Secondly, carbon emissions are a difficult “pollutant.” Carbon has no acute toxicity and the burning of fossil fuels is critical to maintaining our current way of life. Also, not everyone believes the carbon-is-a-problem story either, and they vote for government representatives that share this view. Carbon trading systems run by governments to date have therefore been mostly unsuccessful. What is needed is a for-profit way to incentivize low carbon emission forms of productivity. The advent of social, networks and more recently of peer-to-peer tradable digital assets in combination with social networks, has allowed for the ability to properly implement a free-market carbon asset trading program for the first time. Since the market sets the price, and not a consortium of governments with questionable motives, the “real value” of carbon can now be determined.

The goal of GreenCoin is to greatly accelerate the global utilization of renewable processes for production, and to effectively “solve the carbon issue.”

Background:

What is proposed herein is the release of a new digital asset (“cryptocurrency”) called GreenCoin, the mechanism of which is closely related to Bitcoin, Litecoin and other cryptocurrencies. The coin will have one key twist, however. Every block award will send 50% of the coins to a predetermined address owned by a Foundation, which will be mandated to deliver the coins to renewable providers pro-rata to the amount of carbon that was effectively sequestered daily. The amount of carbon sequestered is a calculated value and is a core concept to the project. As an example, currently the global average amount of carbon emitted to generate 1 kWh of electrical energy is approximately 527 g.² A renewable

¹“Carbon,” “CO₂,” and “CO₂e” are used interchangeably throughout this document, and are singularly defined as an amount of gaseous carbon dioxide, by weight, that is available to the global atmosphere.

² These numbers are calculated and reported by a number of governments and non-profits worldwide. The foundation will make careful use of these values, and make its best effort to ensure accuracy.

energy source such as PV solar releases 46 g CO₂ per kWh produced.³ Therefore, every kWh produced by PV solar that otherwise would've been produced by the aggregate-average grid reduces the amount of carbon emissions into the atmosphere by 481 g. If a PV-solar renewable energy provider generated 100 kWh of electricity in one day, they would be credited with 48.1 kg of carbon. All of the producers' carbon sequestration values are then aggregated and each producer is issued GreenCoins exactly *pro rata* to their individual carbon amount. This distribution occurs at regular intervals, for example, the GreenCoin founders are anticipating this would occur daily.

Electrical energy production is only one example of how GreenCoins could be distributed to commerce providers. For example, biofuel producers could receive GreenCoins for effectively lowering transportation emissions. The only two required mathematical inputs are:

- 1) The global average for all types of emissions of particular useful activity, and
- 2) The effective emission for the same productivity of the single producer in question

The Foundation will be tasked with determining these values and applying the formula for benefit of the renewable providers. There is great focus in the remainder of this document on electricity providers because it is anticipated to be an area of initial and simplest adoption, however it must be stressed that the GreenCoin ecosystem is applicable to all emission pathologies.

What is Carbon Worth:

One of the more recent government implementations of a carbon program has occurred in California which gives a starting point to look at what carbon might be "worth." They priced carbon at \$10 per tonne. This price is also conveniently one penny (\$0.01) per kilogram.

| Amount of CO ₂ | | Value | |
|---------------------------|----------------|-------|-----------------|
| 1 Tonne | 1 | \$ | 10.00 |
| 1 Gigatonne | 1,000,000,000 | \$ | 10,000,000,000 |
| US Release (2008) | 5,461,014,000 | \$ | 54,610,140,000 |
| Global Release (2008) | 29,888,121,000 | \$ | 298,881,210,000 |

Table 1: The value of carbon?

A gigatonne (GT) is a billion tonnes, and is a common unit applied to CO₂ release on large scales. For example, the US released 5.46 GT of CO₂ in 2008. At \$10 per tonne, a GT would be worth \$10B. That puts the "value" of the entire US's 2008 release at \$54.6B, and the entire global release at *ca.* \$300B. Considering that the global GDP is *ca.* \$72.6T (or \$72,600B), this value for global CO₂ release is only about 0.43% of the global GDP (and 0.36% of the GDP for just the US). So the question becomes, is this the proper pricing for carbon? Consider for example that conventional wisdom is beginning to understand the drag to national economies directly resulting from weather changes associated with global climate change including the increasing regularity and severity of floods, droughts, forest fires and storms. Consider also that if warming effects were to truncate the GDP by \$10T, as an example (from \$72T to \$62T), that the current price of carbon as set by the government (in this case, the State of CA) is clearly not representative of its true value.

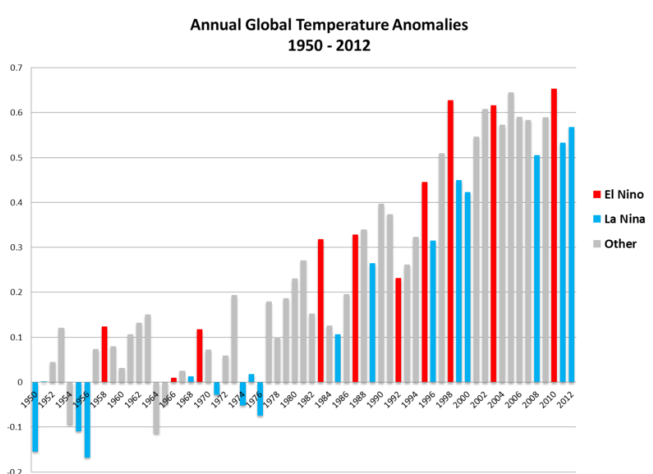
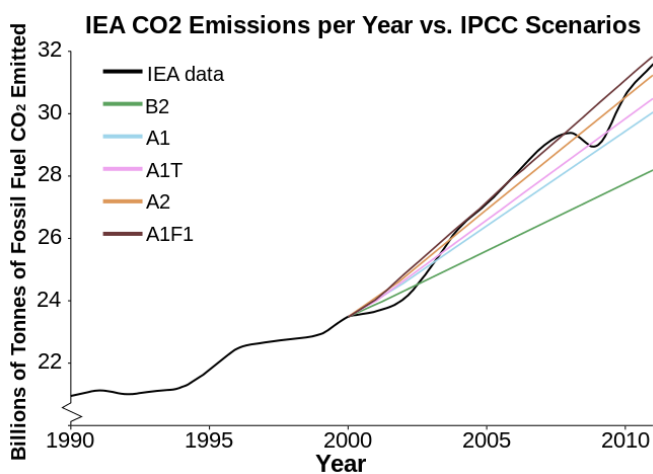
³ It may seem odd that passive, photovoltaic solar "releases" CO₂, however, this value is a calculation that takes into consideration the lifecycle emissions of the device, such as manufacturing, shipping, servicing and disposal and amortizes this over the device's anticipated service lifetime.

GreenCoin presents a mechanism by which the open market price of carbon is set by creating an appreciating asset that is “priced in carbon.” It does so in the scalability of a single individual all the way to a multinational energy producing conglomerate. By creating market demand where individual players decide the worth (or not) of purchasing a digital asset secured by carbon, the aggregation of these individual decisions formulate a true free-market price for carbon. The decisions to purchase and hold GreenCoins are purely voluntary. Therefore, the believability of the “carbon story” is not an issue (or at least, this mechanism provides a way for an affirmative general consensus to prevail). A cross country flight with 200 others puts the carbon responsibility at ~200 kg per person. Imagine being able to quickly and effectively “sequester” the carbon emissions from your flight simply by buying GreenCoins. Also, consider that as an asset, it is actually an investment, not just a donation to some “green” non-for-profit. Effectively this system works because it aligns incentives (profit). There is a growing demand by the general public to “do something” about the carbon problem. By purchasing and holding GreenCoins they create a social carbon value that differentiates useful production (such as energy) by its carbon emission intensiveness.

The Problem⁴:

Global warming is the unequivocal and continuing rise in the average temperature of Earth's climate system. Since the early 20th century, the global air and sea surface temperature has increased about 0.8 °C (1.4 °F), with about two-thirds of the increase occurring since 1980. Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.

Scientific understanding of the cause of global warming has been increasing. In its fourth assessment (AR4 2007) of the relevant scientific literature, the Intergovernmental Panel on Climate Change (IPCC) reported that scientists were more than 90% certain that most of global warming was being caused by increasing concentrations of greenhouse gases produced by human activities. In 2010 that finding was recognized by the national science academies of all major industrialized nations. Affirming these findings in 2013, the IPCC stated that the largest driver of global warming is carbon dioxide (CO₂) emissions from fossil fuel combustion, cement production, and land use changes such as deforestation.



Carbon emissions and global temperature anomalies for the last two and six decades, respectively.

⁴ Source for this section and image credits: http://en.wikipedia.org/wiki/Global_warming

The Solution:

Peer-to-peer digital assets secured by a brute-force Proof-of-Work and/or Proof-of-Stake blockchain are also known as “cryptocurrencies”. These fungible digital assets are experiencing high growth and somewhat interesting levels of adoption. They reflect a next-generation form of fungible asset that relies on the globally ubiquitous and seamlessly interconnected computing capability that has arisen since the development of widespread Internet infrastructure.

Cryptocurrencies address the continuing need for digitally secure storage-of-value and, among other benefits, a reduction in real-money transaction fees. Much of their appeal derives from removing the influence of government or other central authority on the asset supply, or their interference with the free transaction of these assets. Bitcoin is a popular example of a cryptocurrency.

Cryptocurrencies require significant electrical power to perform the Proof-of-Work necessary to ensure the security and integrity of the digital asset. Additional electric power is used for managing the usual and customary transactions between users of the asset. Currently, 70% of US power production is sourced from coal and natural gas. Globally, the use of fossil carbon sources for electric power is higher. As a result, cryptocurrencies are having a significant aggregate impact on the environment through pollution and carbon emissions. A digital asset representing renewable energy is needed for this reason alone.

A digital asset (or cryptocurrency) that has the desirable environmental and public policy benefit of being produced by, and promoting the use of, renewable-only power sources endows that asset with a “real” base value. Unlike other conventional cryptocurrencies, the renewable GreenCoin asset presented herein has a tangible base value as measured by the aggregate carbon emissions reduction that results both from the production of the asset and the day-to-day management of these digital assets.

GreenCoin:

A GreenCoin is a cryptographically secured digital bearer instrument, with all rights being fully owned by, and completely transferrable between, the bearers. GreenCoin integrates the Proof-of-Work based cryptocurrency concept with renewable providers. For energy providers, sources such as solar, wind, fuel cells, geothermal, hydroelectric, tidal power and human power, among others, will qualify. The natural alignment of renewable production and public policy goals provides an opportunity for recognition of this form of digital asset by Federal and/or State authorities as a means of trading carbon emission credits. This ability of GreenCoin to promote legitimate public policy goals is unique and desirable in light of the scrutiny that cryptocurrencies have received recently from US and European financial regulatory authorities, among others. GreenCoin will provide the open market “carrot” needed to accelerate adoption of renewable energy sources at a time when governments are struggling to provide new incentives or even honor existing incentives.

GreenCoin seeks to address several issues that are perceived to be barriers for widespread use and large scale adoption of cryptocurrencies, while retaining key elements, such as fungibility and fee-based transactions, needed for monetizing these digital assets. Of primary concern for large scale adoption are potential regulatory efforts to curtail use and availability of the digital assets. Only GreenCoin addresses this matter by offering a digital asset that is aligned with and promotes public policy goals. Adoption of GreenCoin as an approved and/or certified means of managing carbon emission credits would necessitate very large scale adoption of the digital asset.

Any new digital asset requires a user base and a group that is prepared to create the asset by an intensive, often massive, collective computing effort commonly known as “mining.” Initially, miners comprise the majority of the user base, which is a barrier to widespread adoption. Establishing a user base is an important challenge for digital assets and one that GreenCoin is well suited to meet. There are approximately 100,000 residential solar installations in the US alone. Residential solar customers represent a natural early user base for GreenCoin and their number is of the same order of magnitude as the user base of Bitcoin.

To capture the public policy value of point of use renewable energy production and to establish a substantial user base, GreenCoin production is a two-step process that rewards both producers of renewable energy that is fed to the grid and miners that produce the digital asset. Each new block produced by the miner creates new GreenCoins. Exactly 50% of the newly minted coins are owned by the miner who discovered the block. The remaining 50% are sent to pre-determined address.

A Non-Profit organization, the GreenCoin Foundation (GCF), is the beneficiary of the remaining 50% of the block award. The GCF will certify renewable energy (RE) systems for use in creating GreenCoins. The RE systems can be anything in output size from a small home solar array to a multi-gigawatt hydroelectric facility that pushes renewable power to the grid. The GCF also determines the carbon footprint coefficient for each particular RE system, based on widely published international standards. Finally, the GCF delivers GreenCoins to the renewable energy provider pro rata to the amount of carbon sequestered. The GCF will distribute all of its awarded coins each day. The foundation will not accumulate or own more than one day’s worth of GreenCoins.

GreenCoins have a maximum production limit that is established by the algorithm. That limit will be set to 10,000,000,000 (ten billion) GreenCoins. Initially, the reward for solving for a block will be 2,000 coins. Of these coins, 1,000 will be sent to the address solving that was awarded the block and 1,000 will be sent to the GreenCoin Foundation. The reward for the block will be halved approximately every 5 years (every 2,500,000 blocks). The production target will be about 1,369 blocks per day (about one block every 63 seconds).

| Year # | Year End | Coins issued | Aggregate Coins | % of all Issuable Coins |
|--------|----------|---------------|-----------------|-------------------------|
| 5 | 2019 | 5,000,000,000 | 5,000,000,000 | 50.00% |
| 10 | 2024 | 2,500,000,000 | 7,500,000,000 | 75.00% |
| 15 | 2029 | 1,250,000,000 | 8,750,000,000 | 87.50% |
| 20 | 2034 | 625,000,000 | 9,375,000,000 | 93.75% |
| 25 | 2039 | 312,500,000 | 9,687,500,000 | 96.88% |
| 30 | 2044 | 156,250,000 | 9,843,750,000 | 98.44% |
| 35 | 2049 | 78,125,000 | 9,921,875,000 | 99.22% |
| 40 | 2054 | 39,062,500 | 9,960,937,500 | 99.61% |
| 45 | 2059 | 19,531,250 | 9,980,468,750 | 99.80% |
| 50 | 2064 | 9,765,625 | 9,990,234,375 | 99.90% |
| 55 | 2069 | 4,882,813 | 9,995,117,188 | 99.95% |
| 60 | 2074 | 2,441,406 | 9,997,558,594 | 99.98% |
| 65 | 2079 | 1,220,703 | 9,998,779,297 | 99.99% |
| 70 | 2084 | 610,352 | 9,999,389,648 | 99.99% |

Table 2: Overview of coin production

The potential public policy impact of GreenCoin is compelling. Initially a surge in renewable energy production will come online in response to the ability to create value through GreenCoins. Once created,

GreenCoins can be traded between any two parties. The carbon capture value has already been integrated into GreenCoin through RE provider certification. The absolute price (for example, in terms of US dollars) is set by the open market. No third party affiliate or government agency, including the GCF, has any ability to set the absolute price for GreenCoins.

Table 3: Example of elevated renewable electrical production adoption through the use of GreenCoin and its potential underlying value in terms of carbon and USD:

| Year End | Coins/yr | Aggregate Total Coins | Aggregate Grid g CO2 per 1 kWh | Renewable | | % of tot. World Grid | Seq. carbon GT | Aggregate | | Coin Value at given \$/kg: 0.05 |
|----------|---------------|-----------------------|--------------------------------|-----------------|------------------------|----------------------|----------------|-----------|-------------|---------------------------------|
| | | | | Power Online GW | Total RE online TWh/yr | | | GT | MT CO2/coin | |
| 2015 | 999,370,000 | 999,370,000 | 527 | 5 | 222 | 1.1% | 0.11 | 0.1 | 0.11 | \$ 7.48 |
| 2016 | 999,370,000 | 1,998,740,000 | 522 | 257 | 1,540 | 7.3% | 0.73 | 0.8 | 0.42 | \$ 29.41 |
| 2017 | 1,002,108,000 | 3,000,848,000 | 490 | 279 | 1,677 | 8.0% | 0.75 | 1.6 | 0.53 | \$ 36.98 |
| 2018 | 999,370,000 | 4,000,218,000 | 461 | 303 | 1,817 | 8.6% | 0.75 | 2.3 | 0.58 | \$ 40.93 |
| 2019 | 999,370,000 | 4,999,588,000 | 433 | 329 | 1,973 | 9.4% | 0.76 | 3.1 | 0.62 | \$ 43.45 |
| 2020 | 499,685,000 | 5,499,273,000 | 407 | 357 | 2,143 | 10.2% | 0.77 | 3.9 | 0.71 | \$ 49.36 |
| 2021 | 501,054,000 | 6,000,327,000 | 383 | 388 | 2,333 | 11.1% | 0.79 | 4.7 | 0.78 | \$ 54.41 |
| 2022 | 499,685,000 | 6,500,012,000 | 360 | 421 | 2,527 | 12.0% | 0.79 | 5.5 | 0.84 | \$ 58.77 |
| 2023 | 499,685,000 | 6,999,697,000 | 338 | 458 | 2,744 | 13.0% | 0.80 | 6.3 | 0.89 | \$ 62.60 |
| 2024 | 499,685,000 | 7,499,382,000 | 318 | 497 | 2,980 | 14.1% | 0.81 | 7.1 | 0.94 | \$ 65.99 |
| 2025 | 250,527,000 | 7,749,909,000 | 299 | 540 | 3,246 | 15.4% | 0.82 | 7.9 | 1.02 | \$ 71.27 |
| 2026 | 249,842,500 | 7,999,751,500 | 281 | 586 | 3,515 | 16.7% | 0.83 | 8.7 | 1.09 | \$ 76.28 |
| 2027 | 249,842,500 | 8,249,594,000 | 264 | 637 | 3,817 | 18.1% | 0.83 | 9.5 | 1.16 | \$ 81.03 |
| 2028 | 249,842,500 | 8,499,436,500 | 248 | 691 | 4,146 | 19.7% | 0.84 | 10.4 | 1.22 | \$ 85.56 |
| 2029 | 250,527,000 | 8,749,963,500 | 233 | 751 | 4,515 | 21.4% | 0.85 | 11.2 | 1.28 | \$ 89.88 |
| 2030 | 124,921,250 | 8,874,884,750 | 219 | 815 | 4,889 | 23.2% | 0.85 | 12.1 | 1.36 | \$ 95.30 |
| 2031 | 124,921,250 | 8,999,806,000 | 206 | 886 | 5,310 | 25.2% | 0.85 | 12.9 | 1.44 | \$ 100.59 |
| 2032 | 124,921,250 | 9,124,727,250 | 194 | 962 | 5,767 | 27.4% | 0.85 | 13.8 | 1.51 | \$ 105.76 |
| 2033 | 125,263,500 | 9,249,990,750 | 182 | 1,044 | 6,280 | 29.8% | 0.86 | 14.6 | 1.58 | \$ 110.80 |
| 2034 | 124,921,250 | 9,374,912,000 | 171 | 1,134 | 6,801 | 32.3% | 0.85 | 15.5 | 1.65 | \$ 115.69 |
| 2035 | 62,460,625 | 9,437,372,625 | 161 | 1,232 | 7,386 | 35.0% | 0.85 | 16.3 | 1.73 | \$ 121.22 |
| 2036 | 62,460,625 | 9,499,833,250 | 151 | 1,338 | 8,021 | 38.0% | 0.85 | 17.2 | 1.81 | \$ 126.65 |
| 2037 | 62,631,750 | 9,562,465,000 | 142 | 1,453 | 8,735 | 41.4% | 0.84 | 18.0 | 1.89 | \$ 131.98 |
| 2038 | 62,460,625 | 9,624,925,625 | 134 | 1,578 | 9,460 | 44.9% | 0.83 | 18.9 | 1.96 | \$ 137.16 |
| 2039 | 62,460,625 | 9,687,386,250 | 126 | 1,713 | 10,274 | 48.7% | 0.82 | 19.7 | 2.03 | \$ 142.19 |
| 2040 | 31,230,313 | 9,718,616,563 | 118 | 1,861 | 11,157 | 52.9% | 0.81 | 20.5 | 2.11 | \$ 147.54 |
| 2041 | 31,315,875 | 9,749,932,438 | 111 | 2,021 | 12,150 | 57.6% | 0.79 | 21.3 | 2.18 | \$ 152.74 |
| 2042 | 31,230,313 | 9,781,162,750 | 104 | 2,195 | 13,159 | 62.4% | 0.77 | 22.0 | 2.25 | \$ 157.75 |
| 2043 | 31,230,313 | 9,812,393,063 | 98 | 2,383 | 14,290 | 67.8% | 0.75 | 22.8 | 2.32 | \$ 162.57 |
| 2044 | 31,230,313 | 9,843,623,375 | 92 | 2,588 | 15,519 | 73.6% | 0.72 | 23.5 | 2.39 | \$ 167.16 |
| 2045 | 15,657,938 | 9,859,281,313 | 87 | 2,811 | 16,900 | 80.2% | 0.69 | 24.2 | 2.45 | \$ 171.78 |
| 2046 | 15,615,156 | 9,874,896,469 | 82 | 3,053 | 18,304 | 86.8% | 0.65 | 24.8 | 2.52 | \$ 176.12 |
| 2047 | 15,615,156 | 9,890,511,625 | 77 | 3,315 | 19,878 | 94.3% | 0.61 | 25.5 | 2.57 | \$ 180.15 |

The table above highlights important facts about how this system works and what is represented by a GreenCoin at any given time or in aggregate time:

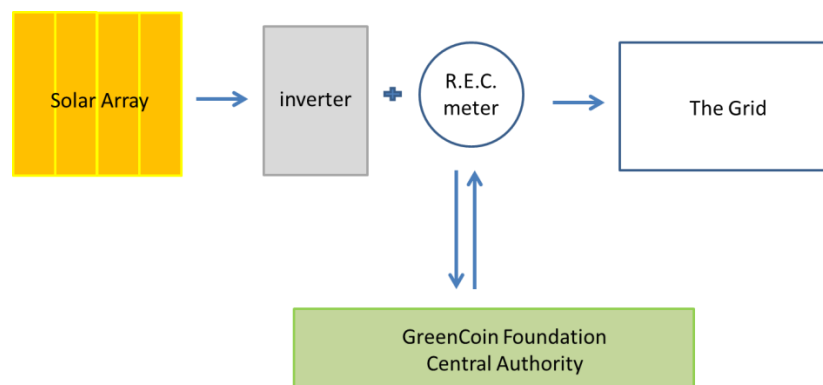
- The IEA estimates that about 10% of world marketed energy consumption is from renewable energy sources (hydropower, biomass, biofuels, wind, geothermal, and solar), with a projection of 14% by 2035. This increase is too slow! It is assumed herein that with the release of GreenCoin the onlining of renewable energy production will greatly accelerate. The table above assumes a quick ramp of less than several years to bring all existing providers into the ecosystem, and then a growth rate of 8.6% for renewable energy. This is not much of an increase in the annual rate when compared to the IAE report but the result is drastic – by the mid-2040’s being over 90% green is a probable outcome.

- The g CO₂ / kWh value reflects also this acceleration. Note that one of the curious consequences of the idea can be seen here: as more renewable energy comes online to capture GreenCoin distribution, it gets “harder” to produce GreenCoins (as awarded by the Foundation). This is because the formula: [World Average] – [Individual System] decreases as the world average CO₂ emissions per kWh decreases. Some types of “slightly-dirtier” renewable energy will fall off the table as a GreenCoin recipient as the world average falls lower, and only “cleaner” renewable energy systems will be eligible to receive GreenCoins as this progresses. This effectively adds a scaling value to renewable systems dependent on their true carbon impact.
- The growth of the amount of renewable power online has two distinct phases. Early on, in the first couple of years, what looks like extremely high growth is simply the GreenCoin Foundation bringing existing renewable producers into the GreenCoin ecosystem. It would be assumed this would occur somewhat quickly because renewable energy producers are getting something for free for basically doing nothing more than what they are already doing. The figure of renewable electricity generation reported by the EIA can be seen in Year 2 at 10%. Note that the EIA’s prediction of 14% by 2035 has been greatly accelerated to 38% as a result of the GreenCoin ecosystem coming into existence.
- It is not unreasonable to forecast that a GreenCoin produced in as little as 3 years from now will represent more than 500 kg (1/2 a metric ton) of CO₂ sequestered. This is about 1-2 weeks’ worth of emissions for the average American.
- At a forecasted price of \$0.05 per kg carbon, the price of GreenCoin could easily be \$7 in year one alone and over \$100 by 2031.

The GreenCoin Foundation:

The GreenCoin Foundation will be a non-profit organization run by government representatives, corporate parties, non-profits and private individuals. The exact make-up and Foundation Charter are still being formulated. The Foundation will be tasked with operating the coin technically and fairly distributing the coin to producers (operating the producer database/website and paying coins, auditing the renewable energy producers, etc), developing and applying the carbon calculation, evangelizing the carbon benefits, and working with governments worldwide, among other duties. The Foundation will keep a list of certified renewable producers and collect their meter readings on a daily basis. The Foundation will likely run a website for this purpose. Users can login and update their account with the payment address and see all sorts of useful information like how much impact their renewable energy system has had in terms of carbon sequestration and so forth.

The Foundation will be required to certify a renewable energy producer:



A typical solar array is depicted above. It generally consists of PV solar cells, an inverter (to convert DC to AC power), a renewable energy credit meter (if they receive renewable energy credits) or at the very least a certified meter to measure production activity, and then finally a tie-in to the electrical grid. The GreenCoin certification will be tied into the inverter and/or R.E.C. meter. The GreenCoin organization will certify the system and could install a proprietary, inexpensive meter capturing device that integrates with the system. This board would communicate the data from the unit with the Foundation in exchange for the ability to have GreenCoins issued for the production of renewable energy.

The Foundation anticipates building the ability to accomplish the following tasks:

- Initially, the Foundation will certify the system and install, or contract out the installation of the proprietary hardware, if necessary.
- The Foundation will set the initial Coefficient of GreenCoin production. This varies depending on the type of renewable energy system and is set according to widely published carbon footprint data for different renewable energy types.
- The Foundation will communicate with the R.E.C. (and/or inverter) through an Ethernet connection, or other remote capability (or proprietary installed hardware, if necessary) to determine total kWh produced and issue production GreenCoins accordingly.
- The Foundation will audit systems remotely for anomalies (e.g., a solar producer operating at night, wind installations that are producing when the weather service indicates a calm wind, etc.)
- Update the user webpage where the provider can login to see all of their renewable energy activity in one place (instantaneous power production, total power production, total GreenCoins issued/owned, aggregate CO2 emissions sequestered, etc). This is also a “fun,” value-add feature that enhances the users’ experiences with their renewable energy system (especially small users, for example, the author has a solar array and would love to have it “web enabled” to see all this cool and interesting feedback online.)

The Foundation awards coins based on the following sequence, as an example when applied to renewable electrical energy production:

Payment Sequence:

- Certified RE providers create energy.
- The GreenCoin Foundation Central Authority is in two-way communication with the certified RE providers. The RE provider’s system automatically reports to the GCF the energy produced in the last 24 hour period.
- The Foundation calculates the amount of GreenCoins to distribute to each producer:
 - o For each producer, the Foundation has already applied the carbon value of that particular system. For example a PV solar installation is 46 gCO₂/kWh.
 - o This value is subtracted by the global average for the same productive activity, currently 527 gCO₂/kWh = 481 gCO₂/kWh, or, 0.481 kg CO₂/kWh for global electrical production.
 - o This value is multiplied by their meter reading (e.g., 0.481 kg CO₂/kWh * 10 kWh = 4.81 kg CO₂)
 - o This number is divided by the summation of all the producers’ values (e.g.: 4.81 kg CO₂ for Producer #1 divided by 876,456 kg CO₂ for all producers = 0.0005488).
 - o This fraction is multiplied by the number of coins generated by the miners (for the first 5 years: 50% * 2,000 coins/block * 1,369 block/day = 1,369,000. Producer #1 receives 0.0005488 * 1,369,000 = 751.3072 GreenCoins).
- The Foundation sends the coins to every producer’s respective address.

Since GreenCoin is a digital asset that is backed by a carbon value, producers will be required to sign an agreement that they only receive carbon-based digital assets from the GreenCoin Foundation. This would be an at-will agreement and they are free to terminate, however, it is critical for the Foundation to protect the integrity of the underlying carbon value and as such, no carbon can be “double counted,” and therefore, while the producer is receiving GreenCoins they will be required to be in affirmation of such.

Coin Deployment:

Once developed the coin will be advertised as being available for mining on the bitcointalk.org and reddit forums. The GreenCoin Foundation’s CTO will handle the technical aspects to ensure a smoothly running coin and troubleshoot those first few critical weeks. It is anticipated the coin will find its way onto exchanges that trade cryptos for other cryptos.

Growth:

GreenCoin is instantly and completely scalable on two independent axes:

Renewable Production Size: Anyone from home solar to multiple gigawatt facility ready for certification can participate. GreenCoin eliminates a *de minimis* production level for participation. Micro-power producers (e.g., 3 kW home-solar generators) all the way to multi-gigawatt facilities can be brought online in similar fashion.

User Base Size: GreenCoins produced by Certified RE providers are internationally available to everyone immediately. Coins can be traded, spent, or otherwise utilized by any single person or entity worldwide instantly for any purpose.

Growth Plan:

Electricity production represents a significant fraction of the total worldwide carbon emissions (about 25%), however other carbon intensive processes and industries include transportation (burning fossil fuels), materials, agriculture, recycling, and the like. Abundant information exists elsewhere on the carbon intensiveness in all of these areas. Our goal will be to provide a similar and integrated mechanism through GreenCoin to provide the same incentives to these focus areas as on-grid electrical production.

GreenCoin focus areas may include:

- 1 Green on-grid electrical energy production
- 2 Green off-grid electrical production
- 3 Green chemicals / materials
- 4 Green transportation
- 5 Green agriculture and reforestation
- 6 Conservation, recycling

1: Green On-Grid Electrical Energy Production:

The first focus area is the primary go-to-market strategy for the Foundation and is detailed throughout this document extensively.

2: Green Off-Grid Electrical Energy Production:

The first extension for GreenCoin is to represent power producers who do not have grid access. This is common in remote areas and for large scale projects, such as wind, where the power is available before the grid connection power lines are constructed. In one embodiment, GreenCoin could certify a remote power producer to generate GreenCoins as long as the power was being utilized (and stipulating internet connectivity of some sort). For example a remote wind-farm could power a GreenCoin mining operation. This gives the power producer an ability to earn revenue without a grid connection.

Operationally, there is little additional work necessary to extend the on-grid electrical production to the off-grid electrical production, other than to ensure the producer is actually utilizing the power generate.

Note that in any case, GreenCoin miners operating renewable energy production in tandem would be receiving benefit of the mining awards AND the renewable production awards. This fact greatly reduces the impact of the coin itself, by providing its own carbon reductive incentives by design.

3: Green Chemicals and Materials:

The Foundation could offer GreenCoins for documented, internationally accepted and agreed upon green processes. This mechanism is substantially different from the first two above and in doing so begins to change how GreenCoins would be distributed, however, the critical underlying basis will always remain the same: GreenCoin represents the amount of carbon NOT PRODUCED while providing something of human usefulness (a kWh or a gallon of biofuel, etc) versus the global average amount of carbon produced to accomplish the same usefulness. Green Manufacturers can pass the GreenCoin income off to their customers in terms of reduced prices, or, award GreenCoins “in the box” (a QR code inside the package perhaps), and share the carbon ownership directly with the consumer.

4: Green Transportation:

The direct burning of liquid fossil fuels such as gasoline, diesel and airline fuel obviously contributes significantly to global carbon emissions. Reductions in these emissions are a requirement going forward, should drastic climate change adversities be avoided. The GreenCoin issuance concept could extend to transportation fuel. Currently a gasoline powered vehicle emits about 9 kg of CO₂ per gallon of gas utilized (currently equivalent to ~17 kWh produced on the worldwide electrical grid). A car utilizing ethanol is 1.5X more efficient and a bus running biodiesel is 4X more carbon efficient than running on gas or diesel fuel, respectively, when measured in terms of total carbon footprint. Ethanol and biofuel producers could receive GreenCoins for the differential carbon savings that resulted from the production of the biofuel. For example, a gallon of biodiesel represents about 2.1 kg of emissions. A biodiesel producer could be included in the daily calculation at a rate of 6.9 kg CO₂ per gallon of biodiesel produced.

5: Green Agriculture:

Big Agriculture (BigAg) is significantly carbon positive and environmentally adverse (carbon emissions, run-off, soil erosion, etc). Providing certification processes to allow for GreenCoin applied to farming methods that are proven to reduce a carbon footprint could assist in the transitioning of environmentally proactive, organic farming that is otherwise not cost competitive with BigAg, assuming a finite and measurable amount of carbon savings can be calculated.

6: Conservation / Recycling:

Recycling could be driven by GreenCoins as opposed to government mandated bottle return fees and compulsory, non-compensated curbside recycling laws. For example, recycling a new aluminum can

versus making a new one saves about 2 kWh in total energy consumed (about 1 kg CO₂). The GreenCoin concept could essentially be utilized as an economic mechanism as compensation for recycling activities.

Exhibit A: RPS

RPS: The Renewable Portfolio Standard:

A Renewable Portfolio Standard (RPS) is a US regulation that requires the increased production of energy from renewable energy sources, such as wind, solar, biomass, and geothermal. The RPS mechanism generally places an obligation on electricity supply companies to produce a specified fraction of their electricity from renewable energy sources. Certified renewable energy generators earn certificates for every unit of electricity they produce and can sell these along with their electricity to supply companies. Supply companies then pass the certificates to some form of regulatory body to demonstrate their compliance with their regulatory obligations. Because it is a market mandate, the RPS relies almost entirely on the private market for its implementation.

In the United States it is clear that the norm is to differentiate support by technology type. **The varying degree and method by which state programs do this means that any move toward harmonizing existing RPS programs will be a difficult one.** Support for particular renewable technologies, either through credit multipliers or technology set-asides, poses challenges. The issue lies with how RECs are used to meet both state and federal standards. A technology-neutral federal standard would either have to accept RECs that have been generated on a multiplied basis (e.g. 2:1 for solar in MI or VA) or require that the REC origin is labeled and valued according, thereby reducing the fungibility of the REC itself. Another (opposite) problem arises with states' use of technology set-asides. Here a technology specific REC used to meet a set-aside requirement (e.g. a New Jersey S-REC) has a higher value in that state's program but would be treated equally in a federal program. While acceptable at the federal level, the market for S-RECs would be driven by New Jersey's demand and supply further reducing the pool of homogeneous tradable federal certificates.

GreenCoin instantly solves all of these issues upon complete adoption. GreenCoin allows the free market to decide between the nature of the renewable generation, size, and location as opposed to governments assigning credits (sometimes inefficiently) in an attempt to force the open market's hand. As individual participants gauge the economics of bringing renewable energy services into their particular locales (for example, how much sense does it make to bring solar into Michigan versus wind?), production of GreenCoins will provide a monetization mechanism to said renewable production, incentivizing participants to maximize economic efficiency, as opposed to gaming credit productions. The government (may) continue to maintain a critical high-level role of setting the total CO2 emission reduction targets. GreenCoin simply represents the most efficient mechanism to reward participants in their pursuit of these high-level goals.

GreenCoin will seek certification to become a representative mechanism of, or eventually completely replace, the unnecessarily complicated RPS. By replacing the inefficiencies of multiple government entities issuing what is often conflicting mandates, and replacing the system with an open market based cryptographically secured asset, we increase efficiencies by allowing open markets to dictate prices and for individuals to control the digital assets.

Exhibit B: GreenCoin Technical Specifications

| | |
|--|----------------------------------|
| Script, Secure and Open Source | |
| Total coins | 10,000,000,000 (ten billion) |
| Block Time: | 63.1 seconds target |
| Initial coins per block: | 2,000 |
| Coins per block awarded to miners: | 1,000 |
| Coins per block awarded to Foundation: | 1,000 |
| Halving rate: | 2,500,000 blocks (about 5 years) |
| Difficulty Retarget: | Every 30 minutes |
| Confirmations on Transactions: | 5 (about 5 minutes) |
| Confirmations on Mined Blocks: | 60 (about 1 hour) |
| Ports: | P2P 11036, RPC 21036 |

Exhibit C: A note on Carbon Sequestration

Carbon neutral versus carbon negative (zero emissions versus actual sequestration):

Throughout this document, carbon-reduced productivity is the yardstick utilized to document GreenCoin distribution. As noted above, and specifically for electrical production, carbon sequestration is defined as the difference in amount of CO₂, by weight, that would have been produced on the generic global electrical grid versus the renewable source that produced it. In this sense, it is the amount of CO₂ that “wasn’t produced” to generate an equal amount of energy (kWh). An open question among climate scientists is whether CO₂ levels have risen beyond “a point of no return,” or may rise beyond such a point in the future. If so, merely producing energy with zero emissions may not be acceptable enough in the long run, that is, global energy use may be required to become *net carbon negative* in order to avoid associated climate change consequences. Materials and chemicals production has the ability to actively sequester carbon. For example, if a bioplastic is made from plant material grown in a “real-lifetime” for such purpose, the amount of carbon in that plant has been actively sequestered from the atmosphere. For every 1 kg of molecular carbon in the plastic, 3.67 kg of atmospheric CO₂ was sequestered.

In addition, GreenCoins could be awarded for any process, regardless of its productive value, that had a net-negative carbon impact. The GreenCoin Foundation can weigh the benefits of awarding for these activities against the agreed-upon urgency of the carbon effects being recorded.

Exhibit D: A Practical “User” Example

JoeUser flies across the country. An airliner will burn 5,000 gallons for this activity and if there are 200 people on board then 25 gallons of jet fuel were used per person (~200 kg CO₂). JoeUser decides to purchase and hold as an asset 200 kg of CO₂ worth of GRC. If, at the time, GRC represents 20 kg CO₂ per coin, then stipulate that JoeUser buys 10 coins. Due to the nature of how GRC operates, over some period of time, that asset appreciates to 50 kg CO₂. JoeUser now owns 500 kg worth of CO₂. If JoeUser decides to hold his cross country flight of 200 kg, he can sell 300 kg (6 coins) and still hold his 4 coins which represent the carbon output of his original flight. JoeUser participated in the ecosystem for carbon exchange in two distinct and meaningful ways:

- 1) At the time of purchase, JoeUser was a marginal market player that creates DEMAND for GreenCoins. This in turn creates additional demand for new clean energy to come online, which then offers more value (in terms of sequestered carbon) per coin in existence, further increasing its market value.
- 2) By holding the asset for a period of time JoeUser is essentially acting as a clean energy investor. The value of his coins increase as the total amount of sequestered CO₂ increases (divided by a limited number of total coins). When JoeUser decides to sell 6 coins representing 300 kg of CO₂ he is a market player offering someone else to participate in the same way. JoeUser can now sell 1.5 cross-country flights worth of GreenCoin to another individual. This allows JoeUser, or anyone else, to become a market player with regards to carbon. You do not need to be an energy producer or otherwise to become a market player.

Important notes to consider:

No government agency forced JoeUser to buy coins representing his flight, hold them for any period of time, or sell them (or sell more than the appreciation amount, holding the original flight’s worth, or what have you). This is an open-market priced system with total freedom to participate, or not. If some individuals out there care less about how much CO₂ they are responsible for emitting, it doesn’t matter. No one is forced to participate, however, they will also abdicate any benefits that said participation may have incurred. Also, JoeUser could’ve bought the GreenCoins for any reason, not just for personally “offsetting” a flight; he could simply be investing some extra money because he likes the concept or a giving a gift to a friend, etc.

Getting back to the price of carbon, is \$10/tonne (0.4% of the global GDP) the actual price? It certainly is not, but the “real” price in the opinion of the author, but also the correct price is currently indeterminable. This is an area where a “market price” is the real price and it certainly would be interesting to see what that price is. Let’s assume for now that one year’s worth of global emissions could potentially be worth \$10T (17% of the global GDP). This could certainly be the case if weather events continue to worsen due to warming. That puts the price 50X above where California priced carbon at \$10/tonne, or \$500/tonne (\$0.50 per kg). If JoeUser had been an early adopter, his GreenCoin purchase starting at 1 cent/kg would have cost him \$2.00 and the value of 200 kg at 50 cents/kg in the latter scenario would be worth \$100.00. *Because the problem itself is what is being valued, JoeUser can still fly across the country “without guilt” and effectuate global warming mitigation simultaneously. He also did it by profiting from the entire ecosystem.*