

## An Incentive-Based Novel Framework for Carbon Footprint Reduction Using Blockchain and Cryptocurrency

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### Abstract

In this research work, we are proposing an incentive-based mechanism that rewards the users with crypto tokens for reducing their carbon footprint, either by using carbon-efficient devices, planting trees or using eco-friendly transportation modes like cycling or walking. The whole concept is based on the fact that if one can be rewarded for green (eco-friendly) living, it will encourage many to follow the same & this will, in turn, not only reduce the overall individual carbon footprint but will also reward the “good doers”. This concept relies on blockchain-based proof of work that gets validated through crowd-sourcing. We intend to propose a framework that can be worked on further to be developed as an application based on blockchain that ensures decentralised credentials storage and rewards crypto tokens for completing a particular task. This paper deals with incentivising individuals to reduce their personal carbon footprint, and the same model may be scaled to organisations for taking up the same task.

**Keywords:** Carbon Footprint, Blockchain, Cryptocurrency

### Introduction

The term ‘save the environment’ recently saw a spike in Google searches, as evident from Figure 1. This clearly indicates an ongoing mass awakening related to the concerns governing our life here on planet Earth. The environment is fragile. Hence, it’s crucial for humans, the strongest species, to be aware of their role in the conservation and reinforcement of the ecosystem of this planet. Also, there seems to be missing a technological framework that can connect conscious individuals and reward them for carrying out eco-friendly activities, which

will, in turn, lure many to follow eco-friendly activities consciously. This will aid in shifting behaviours towards a more sustainable future. With the advancements in Blockchain technology and the alluring prices of cryptocurrencies, one can think about integrating all these into a consolidated framework that connects with nature and revolutionize the ongoing undercurrent where individuals are willing to do their bit towards the conservation of this planet's ecosystem. We need to note that until or unless we shift the environmental concerns to individuals and give them a platform to participate, we will not be able to engage in a fruitful dialogue or, better to a fruitful scenario that favours the sustainability of this planet as a giant living organism.

### **About Carbon Footprint**

The issue of climate change stands as a paramount global concern, captivating the interest of scholars, policymakers, and various experts worldwide. Its repercussions, including global warming, ecological disruption, technological and economic challenges, and societal impacts, have intensified further. The escalating levels of greenhouse gas emissions are widely regarded as a central contributing factor to this multifaceted dilemma. [1] Our carbon footprint encompasses the cumulative emissions of greenhouse gases, such as carbon dioxide and methane, generated through human activities. Consequently, the international community has prioritised the reduction of greenhouse gas emissions. According to the Kyoto Protocol, which identifies six primary greenhouse gases with significant environmental impacts—CO<sub>2</sub> (carbon dioxide), CH<sub>4</sub> (methane), N<sub>2</sub>O (nitrous oxide), HFCs (hydrofluorocarbons), PFCs (perfluorocarbons), and SF<sub>6</sub> (sulphur dioxide)—carbon dioxide emerges as the predominant contributor among them. [2]

Cities are responsible for 80% of global carbon emissions due to human activities. These activities, such as burning vehicle fuels and generating power, release significant amounts of carbon dioxide into the atmosphere. Additionally, construction and industrial operations contribute substantially to carbon emissions. Consequently, the global academic community has focused on developing strategies to mitigate carbon emissions. Carbon emission monitoring at various levels—product, organisational, municipal, and national—has emerged as a valuable tool for informing environmental plans and policies to reduce carbon emissions. [3]

### A. Low Carbon Lifestyles

Various methods and practices can aid an individual in reducing carbon emissions.[4] These different practices are tabulated in Table 1. These activities will calculate the reward points through the attached weightage. Weightage is calculated on a per-day basis to ease the mining of reward points or crypto currency. The individual carries out these activities and submits a claim that can later be verified as proof of work. Also, an individual can collect reward points to verify someone else's POW claim.

Table 1: Sample Carbon Footprint Reduction Tally for Claimers

(Claimer's ) Practice / Method	Annual CO2 Reduction (ACR)	Weightage = ACR / 365
Switch to CFLs	84 kg per replacement	0.23
Use a table lamp while studying	57 kg per change	0.16
Come out and play	62 (to 93) kg per person	0.17
Switch from a desktop to a laptop	205 (to 279) kg per person	0.56
Switch off lights and fans when they are not being utilized.	28 kg per household	0.08
Buy BEE 5 star rated appliances	36 kg on every fan	0.10
Opt for a frost-free refrigerator with a BEE 5-star rating, which consumes 269 kg of energy per unit, translating to 0.74 on the scale.	269 kg on every refrigerator	0.74
Utilize a split air conditioner with a BEE 5-star rating, boasting a capacity of 1.5 tons.	283 kg on every air conditioner	0.78
Install a solar water heater	687 kg on every installation	1.88
Use the geyser efficiently	344 kg per household	0.94
Reduce the temperature setting on the geyser (60 to 40 degrees)	172 kg per household	0.47
Gather for meals and heat food collectively to minimize unnecessary microwave oven usage, even if it's just for 5 minutes per day.	30 kg per household	0.08
Opt for the cold cycle setting on your washing machine, which consumes 98 kg of energy per cycle, equivalent to 0.27 on the scale.	98 kg per washing machine	0.27
Turn off appliances by unplugging them from the power source, resulting in energy savings of 106 kg per household, equivalent to 0.29 on the scale.	106 kg per household	0.29
Utilize paper sparingly and only when necessary.	87 kg for every user	0.24
Opt for electronic statements whenever possible.	5.22 kg for every user	0.01
Avoid using new paper for rough work; instead, utilize one side of previously used paper for rough drafts.	870 kg for every 100 students	2.38
Utilize textbooks responsibly and pass them on to juniors after maintaining them well; imagine if 100 students did this with their 10 textbooks each.	870 kg for every 100 students	2.38
Engage in tree planting efforts as one tree can absorb between 3.66 to 10 kg of carbon dioxide annually. Consider planting and nurturing 50 trees to amplify the impact.	183 (to 500) kg	0.5
Carpool to work	1321 kg	3.62
Take a bus to school	477 kg	1.30
Get driven to work in a bus	1194 kg	3.27
Opt for walking for short distances instead of driving.	11 (to 48) kg per vehicle	0.03
Turn off your vehicle's ignition while waiting at red lights.	48 (to 64) kg per vehicle	0.13
Ensure to keep vehicle tires properly inflated on a regular basis.	150 kg per vehicle	0.41
Incorporate the use of pressure cookers into your daily cooking routine.	125 kg per household	0.34
Adopt cooking techniques that are fuel-efficient.	62 kg per household	0.17
Implement kitchen waste composting at home.	68 kg per household	0.19

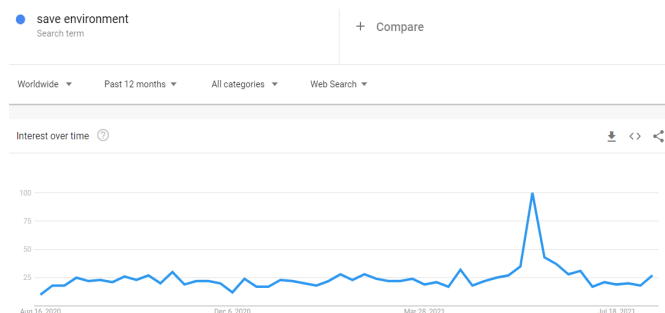


Fig. 1. Google trends results for the term 'save environment'.

## About Blockchain

Cryptocurrencies and blockchain technology appear to be among the most popular and widely used technologies today. They quickly become the most significant trend in the modern world and appear suitable for many uses. This technology is growing increasingly popular day by day. Blockchain technology, the backbone of cryptocurrencies, is often regarded as the primary disruptor of global corporate systems. Bitcoin is a cryptocurrency application that functions as an international, peer-to-peer, entirely decentralised payment and transaction system with no centralised control or power. Thousands of computers worldwide run blockchain apps cooperatively maintained and supported by regular people and computer experts (collectively called miners). Bitcoin transactions are carried out between interested persons via a peer-to-peer network without intermediary banks or individual participation, obviating the need for a middleman. Satoshi Nakamoto, the developer of Bitcoin, created it in 2009. The popularity of blockchain technology has skyrocketed, and the number of applications has exploded. Blockchain is a decentralised ledger that is used to track transactions. It is a comprehensive, open-source technology with numerous encryption methods behind it. Proof of Work (PoW) is a decentralised consensus mechanism where network participants must utilise their energy to solve it. [5]

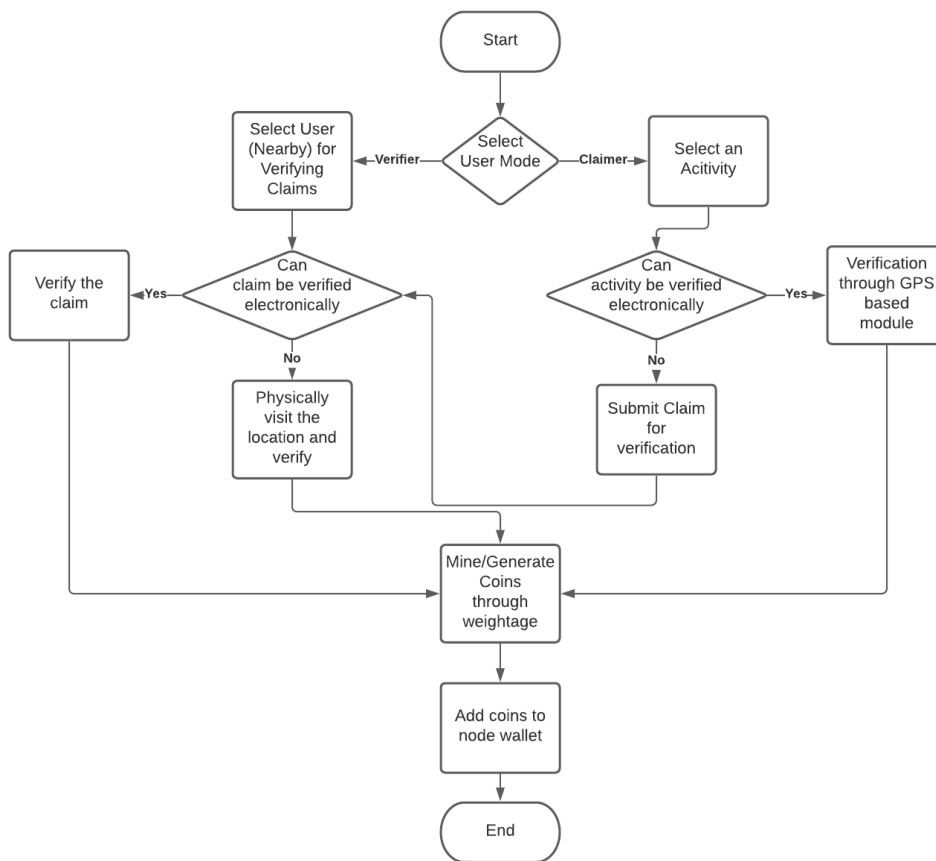


Fig. 2. Flowchart of Proposed Mining & Reward Mechanism.

### Coin Mining & Reward Mechanism

The proposed mechanism will work through an application that runs on a node, which can be either a mobile phone, desktop, or laptop, and tracks daily activities undertaken by a user of this application. The user everyday selects an activity (but is not restricted to) from Table 1 and fulfils it, and furthers a claim. This claim can then be verified through another user who takes up the task of ascertaining the Proof of Work by another user or the claim can be verified electronically through submission of digital data like Coordinates and photographs. Every user is a claim maker and a verifier by default, and every verification per day will lead to the mining (generation) of reward points in addition to all claims settled. The whole data resulting out of everyday activities can be stored on a blockchain and will lead to mining of Reward Coins upon verification. The Mobile App must also have enabled a GPS mechanism to track user activity like travelling and physical verification of assets like Trees, solar power panels or windmills. Figure 2 represents the process flowchart of the proposed mechanism. The user works by selecting a user mode, which can be a Claimer or Verifier. Then, the user selects an activity and performs it; the system, by default, catches the coordinates in the GPS

Module and time duration to make calculations in displacement activities like walking or driving to verify claims. Hence, if there are  $n$  number of claims and  $m$  number of verifications, then the total number of coins mined per day will equal the weightage of every verified claim activity and the number of verification rewards.

The daily ledger will be created and stored for a maximum of days until it is verified and coins are added to the wallet. For the algorithm to work, there is a requirement of verifier and claimer mode of operations; the verifier can either verify through personal discretion the digital evidence submitted by the claimer or can travel to the place of claimer's physical spot to verify the physical assets as claimed by the claimer. An everyday ledger will only include all verified claims and verification reward points as per the weightage assigned. The claimer can submit scanned documents like bills or photographs for claiming reward points to certain activities mentioned in Table 1, and for certain activities which cannot be verified electronically, a verifier can be rushed to a spot, which will be rewarded through reward points.

$$\text{Per day Coins mined} = \sum_{i=1}^n \text{Verified Claim's Weightage} + \sum_{j=1}^m \text{Verifier Reward Weightage}$$

The verifier's activity can be weighed in two modes, electronic verification and physical verification, where the weightage of physical verification will be higher over electronic verification. Also, the verifier can earn more points by claiming one of the travelling activities, like cycling or sharing a ride or travelling through bus to the claimer's spot, that which can be verified electronically.

### Similar Work

ECO Coin is one such initiative that deals with rewarding cryptocurrency. Natural resources back ECO coins. A single tree backs each ECO coin. This establishes a new gold standard, tying every coin in circulation to a specific aspect of the environment. Unlike many other cryptocurrencies, using a backing for ECO Coin will also provide inherent value to each coin. Owners of trees can trade them in for ECO coins. The owner will receive one ECO coin for every ten trees. The trees are held in escrow, which means that the original owner retains ownership while the tree is in the care of the ECO coin foundation. A nominal price is charged to authenticate the tree's validity, existence, and ownership (s). This price is paid

every 100 years to preserve the tree's authenticity. This is one of the two ways an ECO coin can be created. Because each tree owner obtains one ECO for every ten trees, the remaining nine ECOs can be added to the system through sustainable actions or other means. Certain blockchains, such as Bitcoin, use a Proof of Work consensus algorithm to safeguard their networks. Though this technology is reliable, it is becoming obvious that the energy consumption of such a system is unsustainable. As of this writing, some reports suggest that Bitcoin mining consumes the same energy as Denmark. Eco-credits (ECOs) can be earned by opting for a meatless dinner, switching to a renewable energy provider, or commuting to work by bicycle. These eco-credits can be redeemed to purchase environmentally-friendly products, services, and experiences in our sustainable marketplace. This is a new way to track, measure, and reward sustainability so you may help others while also getting compensated. ECO coins are kept in a digital wallet that may be accessed via a mobile device. Inspectors, smart IoT integration (for example, a smart thermostat connected to your phone), certified vendors verify sustainable behaviours. [6]

### **An Initiative to Reduce Carbon Footprint**

The proposed mechanism will work through an application that runs on an individual node and shall make reducing carbon footprint very individualistic. This if gets popular, it can aid in the significant reduction of personal carbon footprint and can aid in reduction of Carbon Dioxide and other green-house gases in our atmosphere. Any initiative in this direction, if adequately publicised and regulated, can help in the betterment of our environment as the individuals who participate get rewarded for the same. The list of activities in Table 1 is tentative and can be expanded or reduced per the requirement. The weights can be calculated more boldly to compensate for more information when required. With the growing concerns of the world community towards the reduction of greenhouse gases, similar initiatives are expected from Individuals and Industries, and if such a mechanism is worked upon properly, it can lead to more significant outcomes in terms of reward-based natural mass mobilization towards fulfilling the millennial goal of reducing the Individual and Industrial Carbon Footprint.

## Future Work

The proposed mechanism is scalable and can accommodate industries with modifying Table 1 and adding new activities with new weightages to it. Presently, we are only calculating weights by dividing the Annual CO<sub>2</sub> Reduction (ACR) by 365, i.e. number of days in a year. This is being done to calculate everyday coin minting. The coins can be mined through a much more rigorous algorithm that takes in more inputs and verifies claims through machine learning and AI. In the future, physical claims can be verified by physically visiting the spot or using Remote Sensing and imaging techniques to auto-verify plantations and renewal energy logistics.

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