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2.1.0 Statement of purpose

The pressure facing societies from climate change makes the connection between individual action and large scale change apparent and critical, but there are not clear actions and behavior patterns which can be effected individually that will work to alleviate the problem. It is necessary to have a clear picture of the problem, in detail, at the individual level so that people can participate and make decisions which reduce carbon footprints and direct energy use and disposal costs. Creating a map of carbon costs and energy costs makes climate change apparent at the local and individual level, allowing action and planning.

Objects, flora, fauna, structures, and environments are part of the daily experience and interactions of people. Large parts of the CO2 and energy costs that are within the economic interaction and activity of individuals are embedded in these factors, particularly buildings[1], roads, products, and plant and animal life.

In other areas, UN agencies have moved toward providing this type of data at the macro scale. For example, the International Civil Aviation Organization (ICAO) has developed a CO2 calculator for air travel [2].

The economy is Co2

The economy is Co2, because we export much of our entropy in that form. While the consolidation of energy toward a goal is the process which attracts the attention of economic planners, the symmetric divestiture of entropy which occurs in the same process should be of concern to living creatures.

Economic activity often produces CO_2, in the process of power generation and storage for example, in electricity, in the construction of convenient molecular bonds, and in initiating motive force. In the changing of chemical and physical forms CO_2 is often generated.

In a bounded system entropy production is limited by the container.

life is an entropy generating process at least in the biochemical regime.

It is the limit to entropy production that is the containing border of life. economy.

To the degree that entropy is encoded in CO_2, the limits of CO_2 are the limits of economy. If there is too much CO_2, humans cannot survive because of the effects of Co2 on the biosphere,

CO_2 levels have increased 1/4 since approximately 1900, this is the largest fastest change known historically[3]. Climate change is anthropogenic, primarily due to economic human economic activity and its impact on flora, fauna, in the biosphere. CO_2 levels are beyond historical average values, which may impact humans and their environment. Mammals have survived for approximately the past 1M years in an environment which contains between 180 and 300 ppm CO_2, it is unknown if mammals can survive outside of that range long term, if not because of direct metabolic effects but because of environmental reactions to higher CO_2 levels. Changing CO_2 density has been proposed to drive climate change. CO_2 is a driver of metabolism for much of life on Earth and so changing CO_2 levels will cause metabolic changes. Considering metabolic changes with CO_2 changes, food chain structures and evolutionary processes will be affected.

The means through which mammals are affected may be immediate effects as in metabolism or more distant reactions like climate change or disease. It is not reasonable to compute the problem with current technology and so we should assume there will be additional unknown vectors of disruption of mammalian life.

If we assume these constants,

1] CO_2 levels rise at their current rate
2] Mammals do not change significantly
3] Humans do not move to other environments

one or more must change.
If CO_2 levels rise beyond what mammals can survive in then the process ceases. If humans move to other environments then the process ceases. If mammals change,

possibly
for the system to maintain its process, if there is no change then the process will cease. If CO_2 levels continue to rise at their current rate, after a period of time the present metabolism and life functions and behavior

2.1.1 Carbon Cost Estimator

Eco2 undertakes an investigation into defining objects as an encoding in a neural network, so that a network identifies objects and contains the definitive model of the object. What is a spoon? A network recognizes the spoon from data (image data), and so the spoon is present when the neural network detects the spoon.

This is in comparison to previous definitions of objects, in which they are defined in terms of language, and by the work of human agency where a person physically acts on an object, or by a social and legal framework. For example, one may buy a spoon at a store because people agree that it is a spoon, and it has a label of "spoon", and a tax category of spoon. None of these definitions are complete and are not separate from human agency. Eco2 begins from observer independent definitions of objects which do not require the previous human or social agency.

In the first stage of the development of Eco2's neural networks and technological framework, a database contains carbon and energy cost data for classes of objects. Eventually the carbon cost data will be embedded in the neural networks themselves, and combinations of networks may compute carbon content for composite objects or larger spatial regions.

Main implementation

Eco2 develops:

1] A method and system called a 'carbon cost estimator' which can detect recognize and classify objects and to calculate their energy and/or carbon footprint as: creation or production cost, existence or equilibrium cost, or destruction or disposal cost.

2] A library of components of the objects so that the costs and implications of the objects is available.

The system is to use neural networks to accomplish [1], and a database for [2].

~~*The energy and carbon relationships instantiated by the development and operation of the system (itself) might also be calculated.*~~

<u>Logic and functioning of the Eco2 Cost Estimator</u>

We develop a carbon cost estimator. Development of the estimator occurs in stages, each stage requires several months of engineering work, the early stages are simple. The estimator is a software tool, which takes sensor input data, and processes it though a neural network, the result is a classification of the object found in the data, into a category which describes its carbon content. In the first stage of development, the category is retrieved from a database which lists all known objects, and each object is recognizable by a neural network which has been trained to recognize the object from visual data.

The technique used to create the estimator is deep learning neural networks. The networks, when receiving image data, activate if the image data contains an object or feature to be recognized. For networks to recognize objects or features, they must be developed and trained from large amounts of data that describes the object or feature to be recognized.

Networks which are created in a computer with modern technology run on specialized hardware 'Processing Unit' generally GPU or TPU, which process the neural networks as large and numerous matrices, with the 'G' or 'T' specifying the organization and format of the processor (T means tensor, G means graphics, which describe their intended market).

With current techniques, the GPU processor is widely available as a commodity item. However in the current state of technology, GPU based neural networks consume a great amount of electricity in the training of models. Once a model has completed training, the model consumes a smaller amount of energy as it processes data.

In the future other types of networks may function on an optical processor, or using biological components. Future biological networks may process the same information and achieve the same result as a GPU but with only a fraction of the required energy, while optical networks may also function with an even lower energy requirement.

<u>System development execution</u>

[Edit Required] *The system will be available for mobile devices, primarily phones and in-vehicle cameras which can easily collect data from video. Drones, robots, and glasses will be technically supported from the same technology. It will primarily run on a device's GPU while the database will be accessed via CPU. The system is packaged via a web application, which is platform agnostic and can be deployed to various mobile operating systems without modifying application code. The system is encoded in Javascript and GLSL (Graphics Language Shader Language) which constitutes its logic and neural network parts.*

<u>First stage of Eco2 system initialization</u>

The energy impact and carbon footprint of detected objects is computed by matching the detected objects and environmental features with a database of production cost data for man-made products and physical estimates for natural items.

The estimator develops a dynamic map of energy and carbon use in environments which is produced from the spatial locations of recognized objects and places from images and video.

The function and correctness of the estimations that Eco2 relies on may be examined by evaluating the neural networks which perform detection and recognition. At the beginning of development, a database is necessary to make the system function. After long use, which includes re-training of neural networks to associate objects and regions to carbon values, the system may learn the details of objects and not require a database.

<u>Models</u>

<u>Model Training</u>

The networks are trained on wavelength (color), spatial structure, and other features and components which the networks may learn themselves. In later development, the networks may learn details and contexts from audio, GPS (position), 4g or 5g transmissions or other data which helps them to form a map.

Networks which can successfully detect, recognize, and describe real world objects, locations and features are called 'models': they model a neural network processor. The successful process will result in the detection or recognition of objects or features, from incoming data. For early development of Eco2, the data is video and images.

Each object is recognizable by a neural network which has been trained to recognize the object from visual data, and the initial training is an energy intensive process which occurs on GPU processors. The resulting networks describe carbon deposits, which we can call sequestration, or carbon content of an object or region. A carbon deposit which is recognized by a network, is categorized by the network as a number. The number is equal to the CO_2 equivalent contained in the recognized object or region of space, taking into account the estimated lifespan of the carbon deposit, which is from the start of the creation of the object or region being recognized. For example, a teaspoon is classified by the number "-27.5", which is the quantity of CO_2 in Kg. We can see from the negative value that the creation of the object emitted more CO_2 than it sequestered.

Object segmentation

For the purposes of Eco2 function, the segmentation of objects represents the three-dimensional mobility of the object in a milliseconds span. This means if two objects move independently within the span of about 10 ms, they are generally considered separate.

The system can detect and recognize only what is shown in the segmented image. For example, if the segmented image shows a "Ford F150" vehicle, then the average carbon cost of the matching model year F150 is retrieved, with appropriate disclaimer. This requires finding the appropriate specifications for an "F150". These specifications could be provided by the manufacturer (which we would hope) or provided by open-source contributors who build and train carbon / energy calculation models. For example, the "F150" neural network model would contain an image recognizer for at least an F150, and possibly also different model years and options packages.

It is not within the scope of the project to predict the carbon costs for operating machines or devices, only the unchanging creation cost for a recognized object based on the features captured at the moment of capture.

Multiple networks operating together

A recognition network can operate alone, as an encapsulated and isolated recognizer, or it may also be capable of working with other networks. Several networks together may operate to recognize more objects, and together can map a section of space.

Recognizing multiple objects

It is often efficient for a single network to be capable of recognizing hundreds to thousands of objects. Networks which recognize a larger quantity of objects may be larger and more complex (https://arxiv.org/abs/1409.1556 for example). Single networks may also recognize only a single object or region, which may make a model easier to train. Both of these methods may be used by Eco2, as deep learning techniques develop.

Objects which may be recognized

Products, roads, buildings may be the first objects and regions to be detected in Eco2. They can be cost-estimated using existing data for production methods and costs. The project may then continue to common plants and trees which have established data (for example https://www.plantsnap.com/)

2.1.2 De-monetization

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2.1.3 Non-Human Agents and the Frequency Range of Agency

Present economic systems are largely moved and effected by people and firms, but we can see examples now of non-human agents (NHA) having effect in the system. These non-human means of agency are presently coming from sources such as the tools that firms use to interact with markets, and production systems which have their own needs - for example artificial intelligence and algorithmic systems in high speed trading.

Such NHA systems will increase in scope and complexity and can grow more quickly within and with alternative economic systems like Eco2, to which they have better access.

~~*There is the example of Bitcoin, and Etherium, which have autonomous agents interacting with those economies. Etherium supports autonomous agents by allowing NHA systems to connect efficiently and create complex transactions.*~~

~~*Another example is the use of auto-payment when a car passes through a toll gate onto a highway in Singapore or the US. In the current form, this payment is caused by the agency of the driver - but in the case that the vehicle is autonomous, the same payment is driven by the autonomous behavior of the vehicle, more when the vehicle is operating on a system like Uber where it autonomously picks up riders and earns money.*~~

~~*Because of the difference between money flows and physical flows, the speed is faster for monetary (information transmissions) than for physical mass flows. It is easier and faster to move money compared to heavy objects, and then it is even easier and faster to move data compared to money.*~~

~~*Using the concept of modeling reality and operating in an efficient, unconstrained, and low-cost model context instead of operating in the real context where energy and mass are constraints, we may accomplish more and at higher efficiency. This technique has been used in drafting, engineering, where it*~~

~~*is easier to design on paper than with masonry. In more recent times, computer aided design (CAD), computer aided engineering and simulations. Simulations in computers can give us short-cuts to goals in the real world which might be otherwise expensive.*~~

For example, in a mediated or computerized world like virtual reality or a game, it can be easier to implement designs and affect audiences or users over large distances while at lower carbon and monetary costs, as compared to using physical mass and real transport to accomplish a particular purpose.

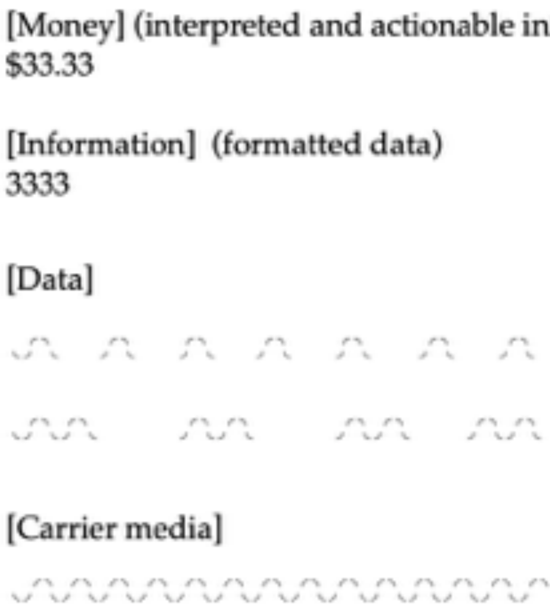
In our current era, an agent using the financial system doesn't have to move (much) mass or move as many people to accomplish results which affect other systems or people. Computers allow rendering, processing, modeling, manufacture, and implementation of logistics across large regions, without dealing with much of the teams, management and engineering which was once required when human agency was the only recourse. From a model of world, to world, is now a short distance, where physical matter implementation is no longer a long road.

The divergence of two economies, the human centered economy and the faster, electronic economy. The divergence and existence of two economies or two sections of economies should be noted because Eco2 is right between them.

Electronic systems will trend toward a faster and self-centric economy, while another slower human-centric economy continues. Developing 2 economies that are linked but quite distant in activity. This has already happened, as the financial economy and the physical economy are different sizes by orders of magnitude, and 1000s of time different in speed (milliseconds for machines vs seconds for people). These 2 economies are each concerned with their own transactions and don't interact much with the other economy. The electron as a unit is a physical means to connect these divergent areas (or divergent economies), at least as strongly as a monetary unit. We had a discussion about this one day, I wrote something about it I think.

The divorce of the material economy from the symbolic economy has always been present. This investigation allows a deeper divorce of the symbolic finance economy from the physical economy, and allows the physical world to operate on its own basis. It is similar to commodity trading, and barter, but we introduce a common unit which then unify a value basis in E and Co2 for diverse objects. The financial / monetary economy may then operate above this, with traditional gambling behaviors undisturbed except for feeling the effects of different pricing.

Financialization progresses as economic actions become encoded in data transmissions, which then allows increased speed as data processing becomes faster and more capable. Over time spans like years or decades, transactions among physical objects don't speed up as much as data transmission and processing have.



thermodynamic limits with financialization--
(Thermo-Limits can be formulas, and explanation.

<u>*Bitcoins: check, it might be useful to describe previous attempts to "de-monetization"</u>

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[1] Churkina, G., Organschi, A., Reyer, C.P.O. et al. Buildings as a global carbon sink. Nat Sustain (2020). https://doi.org/10.1038/s41893-019-0462-4

[2] https://www.icao.int/environmental-protection/Carbonoffset/Pages/default.aspx

[3] https://www.oxygenlevels.org/?theme=grid-light&pid=2degreesinstitute