Redesigning Economics

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Abstract

The world is currently facing incredible challenges; at the same time we are experiencing economic and ecological crises; interestingly, the cause of both these problems can be solved in one stroke, with a hack in the way we handle money.

1. Introduction

The economic recession is a buzzword in today's media-centred world. Many experts say they have been surprised by the money system's instability. They mention the high risks the mortgage banks have taken, lack of transparency and financial products nobody understands as causes of the financial crisis. Other experts, like the Dutch journalist Willem Middelkoop, have forecast this fall down several years ago. Middelkoop identifies deeper causes [13], such as:

- The pile of debts has risen to enormous proportions (over $ 220.000 per US citizen).
- In order to avoid instant mass bankruptcy central banks need to keep interest rates at a minimum.
- Pension funds can no longer guarantee future payments to keep up with inflation.
- The only reaction from political and financial leaders is to "invest" (read: create) more money. This may postpone the problems but will not solve them, due to inflation [19]

According to the European think tank LEAP/E2020, the international monetary system's break down is coming [6]. The world's oil production is at its all-time peak and will from now on slowly decrease [24], unable to keep pace with the expected demand. To aid to the world's problems, we also have an ecological challenge to meet. Currently the planet is facing enormous problems, such as:

- Mass deforestation in entire continents.
- More than 50% of the world's lakes are threatened by pollution, waste and drainage. [1]
- 40% of the worlds organisms are of an endangered species [2].
- In the Pacific, plastic has piled up to the size of half the Indian subcontinent. The plastic is only degrading very slowly. The plastic is

entering and blocking the food chain [14]. The plastic continent has only recently been discovered. No particular country is responsible for this: we all are; the United Nations are.

In the rest of this article, we are taking the challenge to do something about the causes of all of these problems with a single solution. We will unroll the design of an economic system which meets ecological, financial and social goals at the same time. First, we will establish these goals in more detail. Then, we will discuss several important models which are currently is use. Third, we will present the main requirements of the system. The core of this article presents the designed economic system and its unit of currency. Finally, we will discuss its current status and the availability of documentation and software.

2. Problem Definition

The problem in today's world is that we strongly rely on a economic and financial system which is totally unreliable [20], unstable [21], unfair [22] and which enables ecological disasters. It lacks built-in responsibility for the participants to the consequences of their actions. Money and greed cause wars, poverty and starvation. Furthermore, units of currency have deliberately been decoupled from well-established units of measurement. There is most certainly not a SI-defined [5] unit for money. The financial-economic system is the world's largest and most important information system, but ever since the gold standard was abandoned, money has been left undefined and floating, subjected to symptoms such as inflation, deflation and speculation.

3. Related topics

We may be designing an economic system with a new unit of currency but we are not reinventing the wheel. We will be looking at three related topics which have some "wheels" for us: Cradle to Cradle, Permaculture and the Global Ecological Footprint.
We will introduce each subject in short.

3.1 Cradle to Cradle.

The idea of Cradle to Cradle (or C2C for short)[3] is to design business processes in a cyclic manner from the grounds up. Any step in a production process that would traditionally leak waste, including end-consumer and post-consumer waste, is an opportunity to revitalise the original materials required to produce this very same type of product. Waste is considered a symptom of bad design - of both the product and the production process. Waste is stupid: it's worth a lot less than the original materials. Waste often costs money to get rid of. And you have to pay for new materials from limited resources as well. Nature does not produce waste, so why would we make it? What C2C does is simply challenge all imperfections in a process as opportunities for improvement. It has turned out to make commercial sense as well: major

corporations such as Ford, Nike and Herman Miller turned into adepts after seeing C2C in action.

The inventors of C2C, Michael Braungart and William McDonough, also introduced the concepts of upcycling and downcycling. It often occurs that products are recycled into a lower-grade product. This is usually caused by small pollutions with other fabrics or by other irreversible chemical processes. An example of this is the recycling of plastic bottles in the form of hectometre poles. This is called downcycling: a form of recycling to a material of lesser quality. Its opposite is upcycling: a form of production that removes small pollutions from materials which allow a higher quality of the original product.

3.2 Permaculture

Permaculture is a way to imitate nature in agriculture. Permaculture design aims for low energy impact as well as optimal use of waste. It has since developed to include technology and social aspects, but its core is still agricultural. Its main message is that most energy is spent on our food and we can do a lot about it if we grow our own. Today's industrial agriculture requires 10 times the energy in the food, for automation, transport, industrial processing and cooling. Smaller scale organic growing with permaculture practises can largely reduce this energy overhead. Permaculture is used in home and community gardens, and even on balconies.

3.3 Global Ecological Footprint

The Global Ecological Footprint [4] (or the Footprint for short) is a method to estimate the required footprint on the Earth's surface with what would be a fair share of it. Every product or activity requires a certain area to grow crops, transport, decomposition or produce energy. Footprint tests have been developed for persons, cities, countries and business. The available biocapacity on the planet is only 1.8 ha (hectare) per person. The average Footprint of the World's citizen is 2.2 ha. The normal Dutchman uses 4.4 ha and an average US-citizen has a Footprint of 9.4 ha.

Using inspiration from C2C, Permaculture and the Footprint, we will now propose the core of our solution.

4. Outline of a Solution

Economists and scientists have tried to solve problems one at a time. For example, some have made changes to the monetary system, to taxation, to legislation. We do not believe we can solve all of the above problems by making changes to the existing system. The system is already about to collapse. How can we make rigid changes to it, solving required ecological problems, without causing its full stop? If the money system was a computer program, programmers would say the system needs to be rewritten from scratch because it simply contains to many bugs to be fixed, causing new bugs in one part of the while making changes

to another part of the system. We need to design a better alternative from the start, meeting the challenges we are facing in today's world.

In the previous section we have seen several methods to improve sustainability. Our aim is to select the outline of these models and design an alternative unit of currency around this. C2C and Permaculture focus on recycling and energy, whereas the Footprint focuses on area as a metaphor for energy. Our solution will be to design a economic system with built-in recycling and a low energy impact. First, we will need to look at another question. How does our current economic model count for recycling and energy?

4.1 To Cycle or Not to Cycle

Schoolbooks explain the original economic model where a factory works raw materials, sells an intermediary product, and on to other factories until finally the consumer buys the product. The consumer uses the product and after having used it, he discards it. There is a money flow in the direction opposite to the flow of goods. After the consumer, this flow stops, because consumers do not get money in return for handing in used products. There are exceptions to this rule but the main principle is to throw away and even pay extra for throwing away.

A key point of our alternative monetary system is that this cycle of materials should be closed whenever possible. This will prevent avoidable mining of more materials and an extra flow of unusable materials into the incinerator. Stimulating users to recycle requires the money flow to continue after the consumer has ended the use of the product. Also, it is necessary that companies can no longer compensate such losses by earning more money elsewhere. This requires the introduction of a second dimension to the money unit. A second dimension of money is a mathematical trick to avoid interference from one with the other. It's like the size of a paper sheet: it has a width and a height, and you can adjust either one without influencing the other.

So we now have a monetary system consisting of two measured values, one for materials in their own cycle and one for materials which have been downcycled or have been let out of their cycles.

4.2 Solar Energy Income

Obviously the cyclic flow of materials is essential, but life cycles of products are also built with energy. It is energy that binds particles together and which will be released when the particles are taken apart. Food and fuels are important energy containers, but we often forget life itself as a form of energy. Finally, the Sun has been identified as the source of all energy on Earth. According to the fathers of C2C, McDonough and Braungart, we should not use more energy than we can obtain from the Sun - which may be interpreted broadly, ranging from crops to clean energy sources.

With a few minor exceptions, energy is not exchangeable with materials. For that reason, we introduce a third dimension to our unit of currency: energy. This unit can be used for energies within products such as food, fuels and labour. It shows the required energy to produce the product, allowing consumers to make energy-efficient choices and allowing producers to make production both economically attractive and energy-efficient.

Let's summarise what our economic system looks like so far. We have now a unit of currency consisting of three dimensions. One for recyclable material, one for non recyclable materials and one for energy. To make this a little more accessible to humans, we will call these dimensions 'colours': Red, Green and Blue. In the next session we will elaborate this unit.

5. Rainbow Trading

In this section we will introduce the concept of Rainbow Trading and its core, the RGB unit of currency.

5.1 The RGB Unit of Currency

In the previous section we have introduced three dimensions which will form the unit of currency. But what is a quantity without a unit ? A unit requires the definition of a 'one'. For example, the Meter is a yardstick in a vault in Paris with the length of exactly one meter. This yardstick is the starting point for all future measurements. We will now define our 'one' and we will add some symbolic sugar to the dimensions of value.

We will be using 100 grams of sunflower oil [15] as the main index for all three dimensions of the unit.

The RGB unit is a unit consisting of three coins:

- 1 Red represents the energy of 3400 kJ, i.e. the energy of 100 gram sunflower oil [16]. 100 gram of oil is about half a cup. 3400 kJ equals 810 kcal. Although a bit loose, this provides an easily recognised unit of measure, enabling statements like "A car consumes 1 Red per kilometre" or "A regular person requires 2 to 3 Red per day for food" and "All work is paid for in Red". Red is present in living objects, food and fuels.

- 1 Green represents the material in 100 gram of materials which are being recycled. Green is present in food, manure, compost, water and anything that is an essential part of an ecosystem.

- 1 Blue represents the material in 100 gram of materials which are not being recycled or which are being down cycled. Everything that is piled up, exhausted into pipes or drained into sewers, is Blue.

Every product or service will have a value consisting of a Red, a Green and a Blue

component. Coins of different colours are not interchangeable, neither are coins of single-dimensional currencies such as Euro or Dollar. It will however be possible to use RGB coins and Euro coins in a complementary way.

The colours of red, green and blue also form the RGB colour model [17]. Using the light of these colours, it is possible to form millions of colours perceptive by the human eye. Cameras, scanners, beamers, televisions, computers and web pages all use the RGB colour model as a way to represent value of colour. A difference with the RGB unit of currency is that the colours operate on a limited range, whereas the values of the RGB unit of currency can be of any positive number.

We will now illustrate the interaction of the coins during cyclic trade with multiple producers and reducers.

5.2 Ecosystem of Producers and Reducers.

C2C teaches that closing the cycle usually occurs in a model where the main producer of a product takes responsibility for the collection of used products. After he collected them, he can take the products apart and if necessary return part materials back to their original producer.
Taking the complete cycle of production and destruction into account, the flow of materials, energy and coins is as follows:

- Every step in the production chain costs energy and yields more Red.
- Every step in the production chain adds parts to the product, but the total weight of all parts in the system remains constant. Because the materials are recyclable, they're worth Green.
- Every step in the reduction chain reduces the energy in the product. Biodegradable products such as manure will produce energy during reduction. Products in the technosphere will cost extra energy during reduction. The manufacturer adds this cost of Red to the consumer price.
- Once an actor in the system breaks the cycle using a process which makes the material non recyclable, the value of the material is no longer Green but Blue.
- The drawing line between Green and Blue is drawn by the market itself. If there is no reducer who want to buy the product for Green, all that's left is to sell it for Blue.

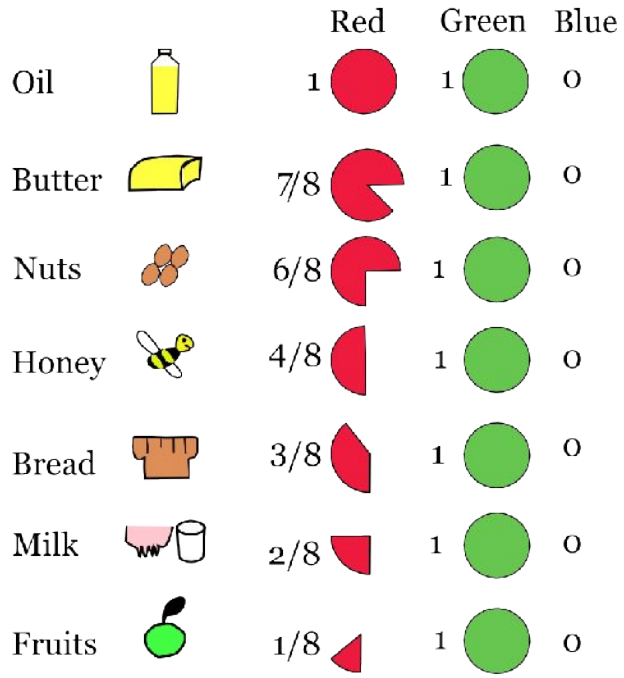
For more details of the inner workings of this system, see the publications in the final section of this article. In the next chapter we shall look at the social system the RGB unit is part of, Rainbow Trading. But first we will present some pricing examples.

5.3 Comparison of prices

Although the standards of 1 Red, 1 Green and 1 Blue have been set, users will need to get accustomed to pricing in Red, Green and Blue. In this section we will introduce the prices of everyday food and energy products.

Food contains energy. The more energy food contains, the more energy has been put in its initial creation. Apples contain less energy than milk. We have energy tables [18] made by diet experts telling us the energy in the product. But they never tell us how much energy the production cost. That's hard to estimate either, because the extra cost largely depends on the manufacturer, the transport, cooling and the time before usage.

All prices per 100 gram,
containing energies only



As a consequence, Figure 1 shows us the energy in the product itself, not the energy that was required to produce it. To give an indication of for the energy loss during production: today's agro-industry requires ten times the energy it produces. This energy is largely used for heavy vehicles, chemicals, transportation and cooling. For meat, the cattle eats about seven times the food it yields.

This is the reason why RGB values are expressed in fractions of 8. Using decimal fractions such as R 0.125 gives a false feeling of accuracy. Computing with RGB values is about comparing factors, not fractions.

A list of values of fuels is shown in Table 1 (derived from [18]). Green and Blue have been removed from this because the colour depends on the origin and usage of the product.

Product	Red
Brown Coal	5/8
Methylated Spirits	5/8
Ethanol	6/8
Methanol	6/8
Alcohol	7/8

Charcoal	7/8
Natural Gas	9/8
Gasoline	10/8
Oil (reference TOE, [11])	10/8
Diesel	14/8

The list of fuels gives the RGB equivalent of the thermal energy that is released during combustion. Analogous to the list of food, the values do not take energy cost of production into account. This is called the Energy return on investment (EROI). The current EROI for oil is between 11 and 18 to 1 [12].

5.4 Spirit of Rainbow Trading

One of the culprits of today's society is the truth hidden under secrecy. But what is more beautiful than the truth? The RGB unit was not made for those who just wish to make money "no matter what". It was designed to enable a balanced, long-term sustainable lifestyle. We need more features in an economic system than a unit, to enable such lifestyle. Rainbow Trading has the following characteristics:

- **Openness and transparency.** All participants can see all the transactions of all other participants. They also have access to other statistics and overviews. This enables users to check on each other and help each other to reach a balanced, stable situation. This feature contrasts with the secretive nature of the current monetary system.
- **Personal responsibility**. Trade transactions transfer responsibility to the buyer, not the ownership. For instance, users of car fuels will be held responsible for certain amounts of Blue and Red, even though they are no longer the physical owner of these exhausted fuels.
- **Low Energy and recycling.** The three-coin system enables users to optimise for both low energy and recycling. Users will be rewarded for such behaviour with a stable, well-balanced economic profile.
- **Cooperation.** Communities where users cooperate will get access to products and services at a lower price level.
- **De-central publishing of the currency**. RGB-money is created by mutual-credit [23]. It does not require a central authority such as a central bank or the Federal Reserve for its creation.
- **Optional participation** in the system. People are free to participate or to choose not to.
- **Interest-free debts** are possible. By mutual-credit, users can get credit as long as others are willing to sell.
- **Annual reset of accounts**. All user accounts are set to zero every year. All transactions and the final scores of each year are archived for future reference. This gives insight in long-term situations and user efforts to gain stability, without the danger of users piling up money. Welfare is about getting into balance, not about piling up cash.

6. Current Status of Rainbow Trading

Rainbow Trading and its RGB unit of currency is the brainchild of a single person. Barry Voeten (Breda, The Netherlands, 1972) built websites in Dutch [7] and English [8]. In the summer of 2006 he published a book in Dutch [7], available for free download. In the spring of 2009 this book was translated to English by a volunteer. The raw text for this book is available on request, but its publication on the Internet is not expected before May 15th.

After the first release of this book, the main problem was to show people how it could be done. For this he wrote a web application, a market place where participants can place and read ads, plus a banking facility for the RGB unit of currency. Due to lack of scale the demo website at [9] is still in its infancy. The code for this system [10] is expected to reach version 1.0 in the summer of 2009.

7. Conclusion

Our current economic system is held responsible for a series of ecological disasters. This system is also suffering from instability and experts are awaiting its full demise. In this paper we have identified the root of these problems: the monetary unit that is floating and undefined, and economic system lacking optimisation for recycling and energy scarcity. Instead of proposing changes to the current system, we have unrolled the design of an alternative: Rainbow Trading and the RGB unit of currency.

The RGB unit of currency uses a three-coin currency, enabling natural qualities to form the price. Resource-efficient alternatives will become economically attractive. Users of Rainbow Trading are encouraged to cooperate instead of to compete. The unfair system of debts and interest has also been replaced by open and transparent marketing and banking.

This system is intended to be introduced bottom-up. There is no need to wait for authorities to decide for its introduction. Unsatisfied users of the current system are encouraged to add to the introduction of Rainbow Trading in their locality. Freely available documentation, data and code will come in handy, but do require extra support as well.

8. References

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