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# Opportunities for financing sustainable development using complementary local currencies

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**Abstract.** Financing building retrofit projects that contribute to climate change mitigation has always represented a significant barrier. With 28% of global emissions coming from existing buildings, it is of paramount importance to carry out retrofit measures that lead to significant reduction of these emissions. Whilst this is perfectly possible to achieve with current methods and current technology, there is no sufficient conventional finance to carry out zero carbon retrofit at scale required for climate change mitigation. The article introduces an alternative and sustainable business model that creates new opportunities for financing zero carbon retrofit of buildings. It demonstrates that the value of solar energy falling on roofs of buildings can become a driver for new local economic systems, and discusses the requirements for practical application.

## 1. Introduction

Every radical intervention on an existing building that aims to achieve a retrofit to zero carbon emissions is faced with the same problem: how to raise the finance? But can we create a world in which finance is not a problem?

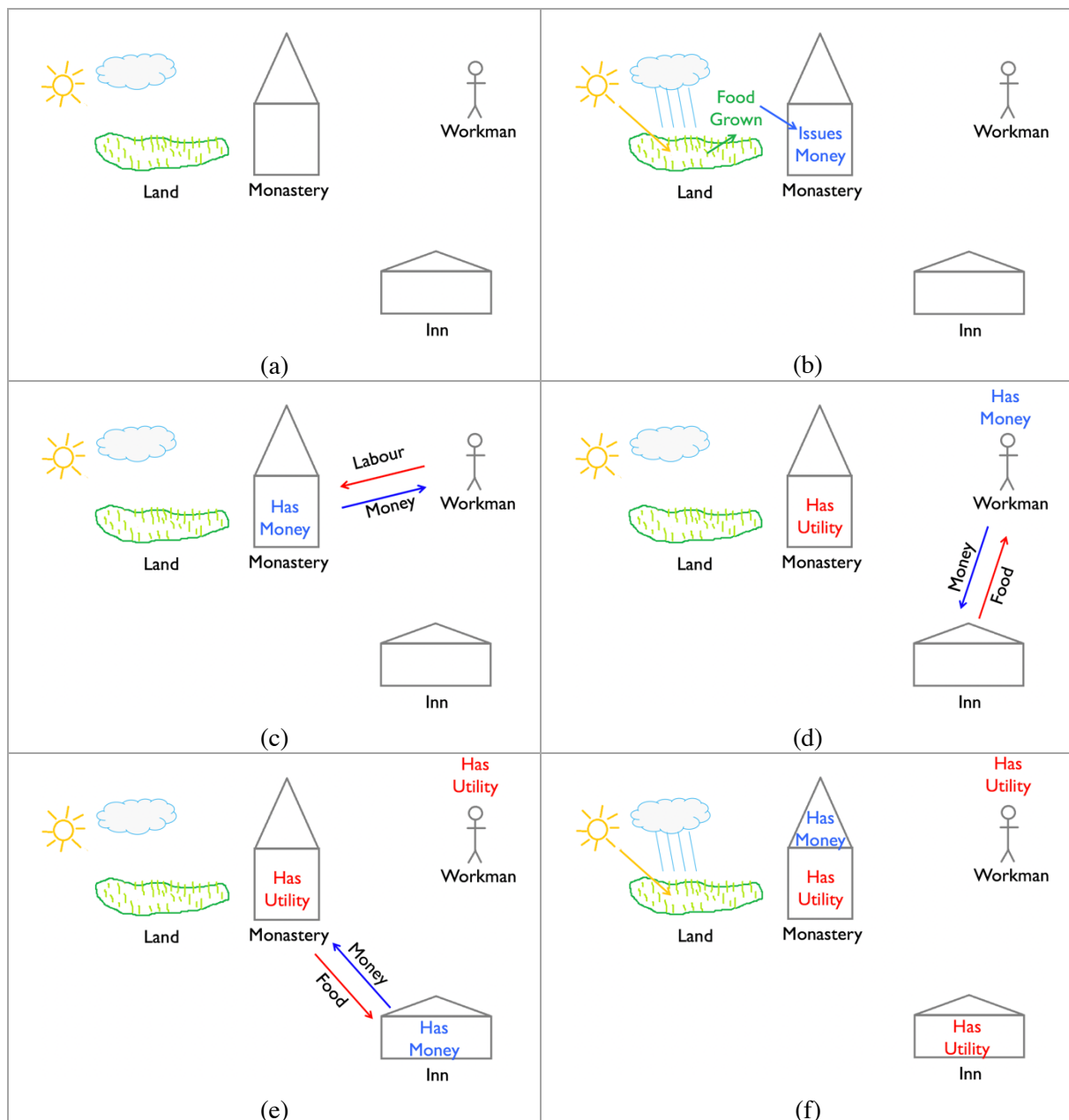
A recently published report on global warming by the Intergovernmental Panel on Climate Change [1] has strengthened our awareness for global responsibility and the urgent need for controlling and minimising carbon emissions within the next decade. With 28% of global emissions coming from existing buildings [2], it is of paramount importance to carry out retrofit measures that lead to significant reduction or complete elimination of these emissions. Whilst this is perfectly possible to achieve with current methods and technology [3], conventional financing methods represent a significant barrier for zero carbon retrofit at scale and for climate change mitigation. Simply, there is not enough of conventional money to carry out zero carbon retrofit of buildings at sufficient scale, and this epitomizes strategic sustainability interventions. Some researchers suggest that the barrier to sustainable development is the capitalist mode of production, and that an alternative social organization that transcends capitalism is a social requirement for sustainable development [4]. However, a much simpler and quicker solution to this problem may be achieved through regional complementary currencies, which were predominant in Western Europe for a thousand years to 1800 AD and beyond [5].

The problem of not having enough conventional finance to carry out sustainability interventions is not new. In 1813, after the Napoleon wars, the island of Guernsey was at a brink of a natural disaster and under a heavy debt. Due to the defective state of its sea banks the great extent of the island was threatened to be overflowed by the sea [6]. ‘The States’ of Guernsey had a debt of almost twice the amount required for the repairs of the sea defences, and were burdened by paying 80% of its annual revenue of £3,000 as interest. There was no trade, no income, no attraction for visitors, and a market



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building was needed as market traders had to stand outside in rain and wind. Under the pressure to redevelop its infrastructure, including the sea banks, roads and the market, and with practically no conventional money left from the annual revenue, the States came up with an innovative solution in 1816 and issued £6,000 of new local currency, accompanied by the following commentary: “*In this manner, without increasing the debt of the States, we can easily succeed the works undertaken, leaving moreover in the coffers sufficient money for the other needs of the States*” [6]. The money had a withdrawal date in 1817 and 1818, and could be exchanged at that point for conventional money. The States were able to honour that exchange, having earned in the meantime enough income from the rents in conventional money on the new market building.



**Figure 1.** A historic example of an economic system based on a local currency.

Looking into this issue deeper, Thomas Greco in his seminal book ‘The End of Money and the Future of Civilization’ [7] introduces three prerequisites for the creation of complementary currency:

- 1) Money can be issued by anyone who offers goods and services for sale in the market
- 2) The basis for issuing money are the goods on the market or on their way to the market
- 3) Each issuer is entitled to create as much money as they are able to redeem by selling.

However, there is more to it than just these three prerequisites. The goods and services for sale in the market need to be generated somehow, suggesting natural resources and human labour inputs into the system.

This can be illustrated in an example of a medieval trading system in the French city of Saint-Omer [5](Figure 1), where a monastery required building work to be done and used the value of food and wine production from its land to create its own currency. Thus, the structure of this financial system consisted of the land, the monastery, workmen, and local inns (Figure 1a). Solar radiation and rainfall enabled food production and gave the monastery the opportunity to create their own currency in the form of lead coins (Figure 1b). The monastery then used the lead coins to pay the workmen (Figure 1c), who in turn used the money to buy food and wine in local inns (Figure 1d). The local inns then used the same money to pay the monastery and replenish the food and wine supplies (Figure 1e).

Thus, every actor in this system had some utility: the monastery had the building work done; the workmen were able to sustain themselves; and the local inns had paying customers (Figure 1f). Ultimately, the money ended up with the monastery as the original issuer. The external inputs into the system and the ultimate drivers were solar radiation and rainfall, which enabled food and wine production on monastery's land with labour supplied by the monks. The local currency and the utility for each of the three actors (monastery, workmen and inns) moved in opposite directions, as shown in Figure 1, and created a local economic system.

Translating this approach into the current time, this research investigates the opportunities for alternative financing zero carbon retrofit of buildings. It looks into how this approach could be made operational, and how diffusion into a wider economy could be achieved. This leads to two research questions:

- 1) How can a trading system be set up that enables retrofit of buildings to be carried out using a local currency equivalent to the value of energy received from solar radiation?
- 2) What would be required to connect such system into a wider economy?

In order to answer these questions, a model of a simple system will be set up in the Method section and analysed in the Results section.

If the method and results prove to be positive and conclusive, this work could lead to the discovery of new financing opportunities for zero carbon retrofit of buildings, and it could facilitate the creation of new economy of sustainable business models that help to mitigate the climate change.

## 2. Method

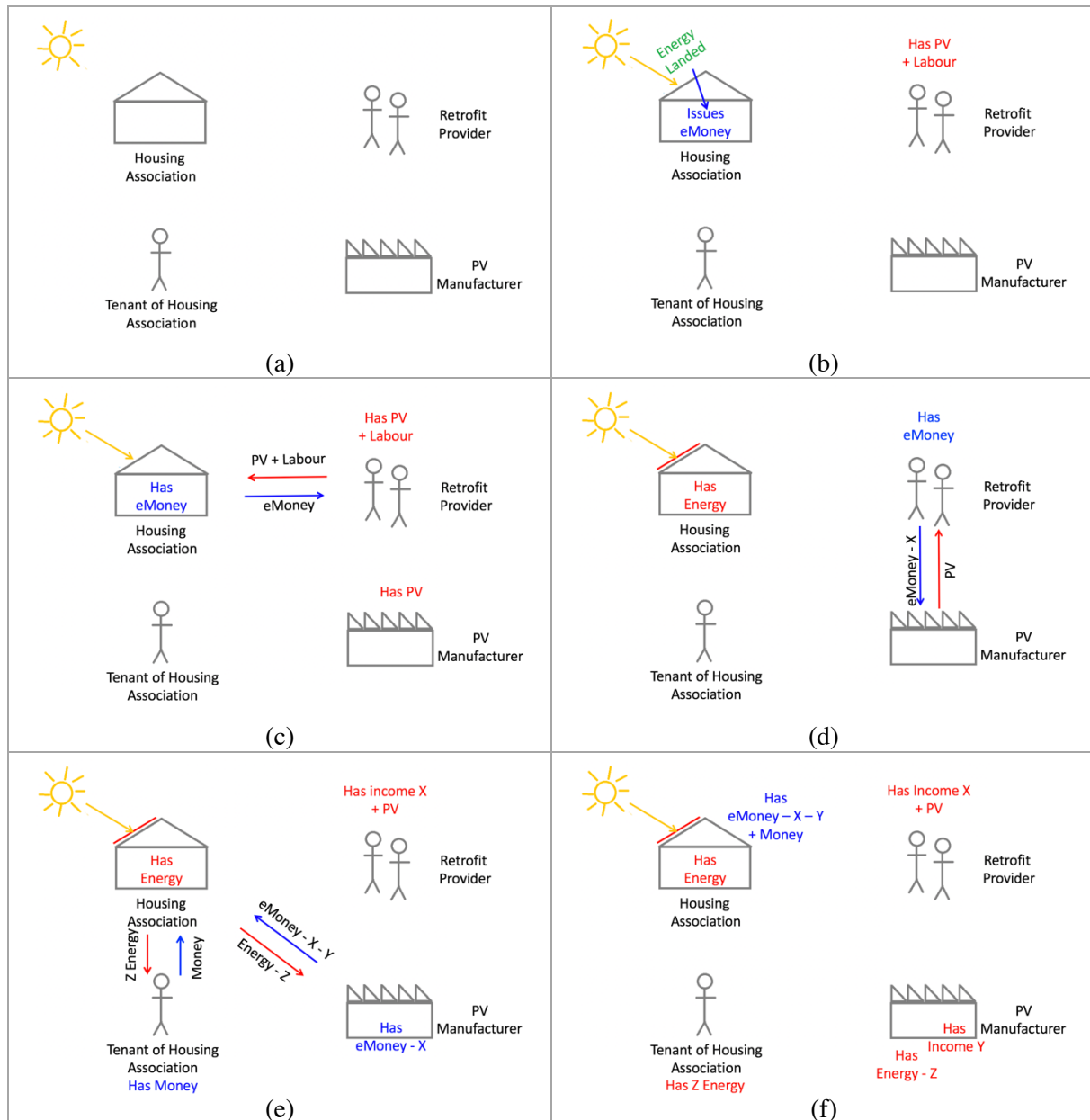
A model of a trading system consisting of a housing association that owns buildings, a retrofit provider, a photovoltaic (PV) system manufacturer, and a householder is created, as shown in Figure 2a.

The trading process starts when the housing association creates its own 'electric money' or 'eMoney' currency equivalent to the value of solar radiation falling on its roofs (Figure 2b) and uses it to pay the retrofit provider (Figure 2c). In return, the retrofit provider installs a PV system on the roofs of the housing association buildings (Figure 2c). This starts a circular movement between the actors, where the currency and the utility flow in opposite directions. Having run out of the PV systems, the retrofit provider purchases new PV system from the PV manufacturer, paying for it with eMoney, whilst retaining 'X' amount as its income (Figure 2d). Having sold the PV to the retrofit provider, the PV manufacturer needs energy for its production process, and purchases energy from the housing association using eMoney, whilst retaining 'Y' amount as its income (Figure 2e). The housing association also sells surplus energy to its tenants, and gets paid in conventional currency (Figure 2e). In the end of the cycle, all actors have had income and utility (Figure 2f).

At this stage, the housing association may choose to expand its PV installations, issue more eMoney and start the next 'spin' in the financial cycle, or may merely settle for income from energy sales.

In order for this system to work, an integration into a wider economic system is required. Thus, the housing association, the retrofit provider, and the PV manufacturer, need to be able to exchange their income in eMoney into conventional currency (Figure 3).

This approach will now be tested using sample calculations and the results will be presented in the next section.



**Figure 2.** An eMoney retrofit trading system.

### 3. Results

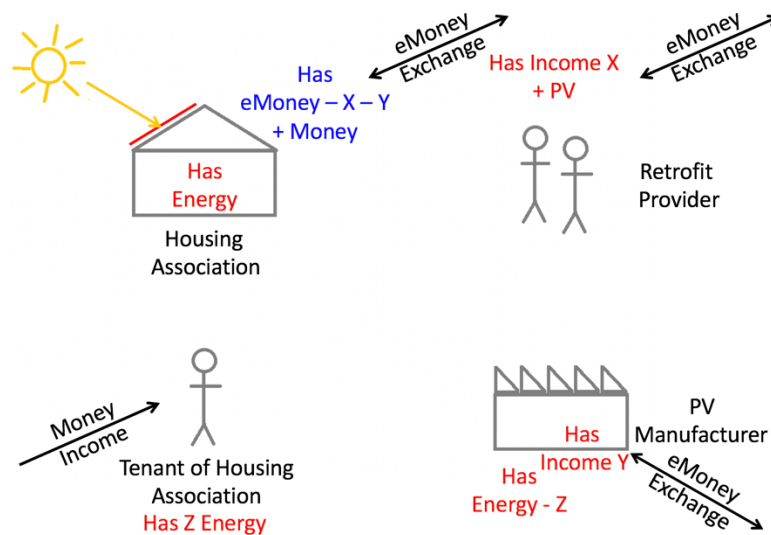
The trading system from Figure 2 has now been run through a series of calculations and the results are shown in Table 1. The results are presented in three separate categories: credit balances, utility balances and the total system balance.

In Step 1, the starting position has been set so that the housing association creates a 1000 credit balance of eMoney units, resulting from the solar radiation falling onto its roofs; and the tenant of the housing association has a 400-credit balance of the conventional money, equivalent to the same number

of eMoney units. The retrofit provider and the PV manufacturer have utility balances of 1000 units each, equivalent to the same number of eMoney units. The total system balance in the first step is 3400 eMoney units.

In Step 2, the retrofit provider fits PV for the housing association and gets paid 1000 eMoney units. Thus, the housing association credit balance becomes zero, and utility balance becomes 1000. The retrofit provider balances become exactly opposite; the credit balance becomes 1000 and utility balance becomes zero. The total system balance remains unchanged and stands at 3400 eMoney units.

In Step 3, the retrofit provider purchases PV for 800 eMoney units from the PV manufacturer and retains 20%, namely 200 eMoney units, as income. Thus, retrofit provider's credit balance is reduced to 200 and PV manufacturer's credit balance is increased from zero to 800. Again, exactly opposite situation is with the utility balances for these two actors: the retrofit provider's utility balance has increased by 800, and the PV manufacturer's utility balance has decreased by 800. The total system balance remains constant at 3400 eMoney units.



**Figure 3.** Links to a wider economic system through eMoney exchange into conventional currency.

In Step 4, the PV manufacturer pays the housing association 600 eMoney units for energy and retains 20% of eMoney units as income. Thus, the housing association's credit balance increases by 600 and the PV manufacturer's credit balance decreases by 600 eMoney units. The change in the corresponding utility balances between these two actors is exactly opposite: the housing association's utility balance has decreased by 600 and the PV manufacturer's utility balance has increased by 600. The total system balance remains constant at 3400 eMoney units.

In Step 5, the housing association sells surplus energy to the tenant and gets paid 400 in conventional money units, equivalent to eMoney units. Its credit balance increases by 400, and the tenant's credit balance reduces by 400. The movement in the corresponding utility balances between these two actors is exactly opposite: the housing association's utility balance has reduced by 400 and the tenant's utility balance has increased by 400. The total system balance remains constant at 3400 eMoney units.

At this stage (Step 6, Table 1), the housing association may choose to 'spin' the financial cycle again, by issuing new eMoney on the basis of additional roofs that it wishes to retrofit with the PV. This would be equivalent to adding an impulse to this trading system's 'flywheel' in Figure 2, and the process could continue until all roof surfaces belonging to the housing association are fitted with PV systems. Alternatively, the housing association could merely continue to benefit from its renewable energy production capacity, and earn income from energy sales.

All actors with eMoney credit balance would need to convert to conventional currency at this stage, in order to connect with the conventional financial system and the rest of the world. This could be achieved by the housing association exchanging eMoney for conventional money, having earned enough conventional money from renting its accommodation. Alternatively, if or when more than one eMoney issuer emerges, a bank could be set up to facilitate the integration into the wider economy by providing exchange facilities between eMoney and conventional money.

**Table 1.** Transactions in the eMoney retrofit trading system.

|                                                                                                                              | Credit balances     |                   |                 |                        | Utility balances    |                   |                 |                        | Total system balance |
|------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------|-----------------|------------------------|---------------------|-------------------|-----------------|------------------------|----------------------|
|                                                                                                                              | Housing association | Retrofit provider | PV manufacturer | Tenant of hous. assoc. | Housing association | Retrofit provider | PV manufacturer | Tenant of hous. assoc. |                      |
| Step 1 - Housing association issues 1000 eMoney units                                                                        | 1000                | 0                 | 0               | 400                    | 0                   | 1000              | 1000            | 0                      | 3400                 |
| Step 2 - Retrofit provider fits PV for Housing association and gets paid 1000 eMoney units                                   | 0                   | 1000              | 0               | 400                    | 1000                | 0                 | 1000            | 0                      | 3400                 |
| Step 3 - Retrofit provider purchases PV for 800 eMoney units from the PV manufacturer and retains 200 eMoney units as income | 0                   | 200               | 800             | 400                    | 1000                | 800               | 200             | 0                      | 3400                 |
| Step 4 - PV manufacturer pays Housing association 600 eMoney units for energy and retains 200 eMoney units as income         | 600                 | 200               | 200             | 400                    | 400                 | 800               | 800             | 0                      | 3400                 |
| Step 5 - Housing association sells surplus energy to tenant and gets paid 400 conventional money                             | 1000                | 200               | 200             | 0                      | 0                   | 800               | 800             | 400                    | 3400                 |
| Step 6 - the process repeats...                                                                                              | ...                 |                   |                 |                        |                     |                   |                 |                        |                      |

#### 4. Discussion

What is new in this approach? The notion of complementary currency is certainly not new. It has been researched and reported extensively [7], and it has been implemented in numerous locations around the world (Figure 4). However, the novel aspect of this approach is in the application of complementary currencies to building retrofit projects, based on the production of renewable energy from the sun.

The presented trading system is not perfect and is not complete: the PV manufacturer, in addition to purchasing energy, needs to purchase materials and equipment in order to produce PV systems. There is an entire supply chain involved in this type of operation, however, for simplicity, this supply chain

has been omitted from the analysis. Similar supply chain issues apply to the retrofit provider and the housing association.

Despite of these limitations, the point about complementary currency based on renewable energy has been made: the numbers add up and make sense in the simple calculation presented here and this can become the basis of an actual and more complex system.

What are the benefits of such system? First, the system provides finance opportunity where such opportunity is unavailable through conventional finance. Second, in this type of system, there is no debt, and no inflation. After the development process is completed, the complementary currency can be redeemed and the system users can revert to trading in the conventional currency.

Are there any negative taxation implications of this system – can it lead to tax avoidance? If there is no conventional finance for a retrofit project, and the project does not go ahead, there will be no opportunities for a subsequent taxation. If, however, the complementary currency creates opportunities for trading with the conventional currency after the complementary currency part of the project has been completed and the complementary currency is redeemed, that will create opportunities for taxation and full compliance with national financial systems.



**Figure 4.** Complementary currency world map (source [8]).

Why is this approach not used more extensively? The reason is that it takes time to set it up and it requires the involvement of a much higher number of actors than the example in this article. In order for such system to gain critical mass and ‘catch fire’, at least 100 diverse actors will be needed. If there is a sufficient number of businesses involved but all of them are for instance hair dressers, they will not need much from each other - there is no business diversity to make the system operational. The experience of the process of setting up the Brixton Pound in London shows that it took three attempts, until the required number and diversity of actors was reached to keep the system self-sustaining [9]. It is encouraging that complementary currencies are finding their use as policy instruments for environmental purposes in Europe, most notably in the Belgian Science Policy INESPO Project [10]. However, the coupling of the complementary currency to smart meters and the expected behaviour change in that project represents a somewhat missed opportunity and a limited scope of what could have been a much more radical approach. Although that system was based on rewards and loyalty points only, nevertheless a useful taxonomy for a complementary currency system was devised [10]. However, based on the experience of the research introduced in this article, for a complementary economy to ‘catch fire’ it is essential to have a driving resource, such as solar radiation in our example, diverse actors who need goods or services from each other, and a complementary currency that circulates through the system as the means of exchange.

## 5. Conclusions

What can we learn from this article? Despite the urgent need to mitigate climate change, to which energy use in buildings is a significant contributor, conventional financing of projects that aim to retrofit existing buildings to buildings with zero carbon dioxide emissions presents a significant barrier.

Inspired by historic precedents of complementary currencies created on the basis of a natural resource, such as land, solar radiation and rainfall, this research investigated the use of solar radiation falling on roofs of buildings as a value generator in a theoretical model.

Thus, solar radiation falling on the roofs of a housing association was the basis for creating a model of a complementary currency. The currency was subsequently used to create a circular movement of credit and utility between the main actors in the model: the housing association, the retrofit provider, the PV manufacturer and the tenant of the housing association. The analysis demonstrated that after the credit circulated through the entire system, the complementary currency ended up with the original issuer, and each actor in the system had some utility as result: income, energy, PV or a combination thereof.

At the end of the first cycle, the housing association, being the issuer of complementary currency, has an opportunity to either issue more complementary currency, thus giving an impulse to the system that drives it through the next cycle, or to continue benefiting from energy sales income based on its installed PV capacity. It is essential for this system to connect to the conventional financial system in the rest of the world through currency conversion, and provisions for such conversion are essential for making the system work.

Although, for simplicity, supply chains have been omitted from this analysis, the case for complementary currency based on renewable energy has been made.

The system diagram and the calculation of credit and utility flows can become the basis for a practical application of such system, providing that sufficient number and diversity of actors can be achieved, and that exchange facilities are made available for converting complementary currency credits into conventional currency.

This work therefore answers both research questions and paves the way towards a practical implementation of financing sustainable development using complementary local currencies. It creates new financing opportunities for zero carbon retrofit of buildings, and it could facilitate the creation of a new economy of sustainable business models to help mitigate the climate change.

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