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Creating Monetary Collaborative Spaces for Social and Ecological Transformation

Christian Gelleri

Faculty of Law, University of Würzburg, 97070 Würzburg, Germany; christian.gelleri@uni-wuerzburg.de

Abstract: Complementary currencies have spread to many places around the world at the beginning of the 21st century. Creating sustainable economic cycles and short transport routes are often the goals of introducing them. Due to their manageability, regional currencies can be embedded in debates of regional economics and sustainability. Above all, they are suitable for democratic experiments that can show in real environments whether currency designs work as examples of collaborative communities and research. One of these monetary experiments is the climate bonus, which is linked to the local currency Chiemgauer. The research path goes into the daily routine of a real laboratory to find out which methods would be effective enough to deliver carbon savings. The climate bonus creates a monetary network where people can try out new behaviors in a protected space. As a result, three years after the initiation of the project, carbon reductions are above expectations.

Keywords: carbon footprint; complementary currencies; collaborative research; real laboratory; sustainable lifestyles

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1. Introduction

Our civilization is technologically based on the principle of combustion and is organized through monetary and financial systems capable of coordinating a worldwide division of labor. The financial systems programed for growth also allow resource consumption and CO_2 consumption to increase steadily [1]. A decoupling between economic growth and CO_2 consumption has not yet been achieved [2].

Faced with the challenges posed by climate change, a 1.5 °C strategy will succeed if it also targets monetary and financial systems [3–5]. Conversely, the question arises for the design of any monetary and financial system as to how it can make an active contribution to sustainable development. How can such systems help reduce CO_2 emissions?

In order to increase resource efficiency, small-scale adaptation strategies are required that are integrated into an overall strategy [1] (p. 379). This includes social innovations that, as bottom-up initiatives, enable greater participation among the population [1] (pp. 42–43). Money is not only to be understood as an economic technology, but also as a collaborative means of communication and "social technology" [6] (p. 508). Monetary systems are always also a network of human relationships that influence the way we do business. This social capital can be used for good and bad.

The latest report to the Club of Rome proposes new economic models and a re-regionalization of trade [3]. Complementary currencies are recommended to strengthen local economic forms [3] (p. 209). This would be compatible with further approaches of a degrowth strategy, which would be particularly appropriate in countries with quantitatively large economic output and correspondingly high CO_2 consumption [7].

A strategy of regionalization would have two major advantages [8]: the first advantage is that the CO_2 consumption per currency unit is, due to the shorter transport distances [9], lower compared to that of the euro and thus offers a better starting point. The second advantage is that the GDP required for a job in the region is smaller. A stagnation of the economy would therefore not result in job losses, but the purchasing power of employees

would be lower compared to employment in large companies. Accompanied by a shift in sales to smaller economic structures, it would be possible to cope with a decline in sales while maintaining the same satisfaction level; however, if success were to be measured only in monetary terms, this development would be assessed negatively. Therefore, alternative measurements of economic performance should be used instead of the traditional measurement of gross domestic product [9,10].

The strategy of regionalization becomes particularly effective when it is combined with complementary currencies that have been designed to be particularly sustainable. Complementary currencies, like monetary systems, are not automatically geared towards ecological goals. The issuer defines which production methods and needs are financed and which are not. Therefore, great importance must be attached to the fact that complementary currencies are organized democratically and participatively from the ground up, because this creates a protected space among equal participants who can directly influence the values, rules, and behaviors [11].

Within the spatial and social boundaries defined by participants, a free space is created that enables people to move outside of business as usual [12]. By pointing out alternative courses of action, people can grow with the challenges. Complementary currencies that are placed in the context of social–ecological transformation thus offer people spaces for their personal development, which can lead to changed lifestyles, cultural techniques, and the ability to build community [12,13] (p. 281).

One of the oldest regional complementary currencies is the Chiemgauer [14]; the author founded the initiative together with six students at a school in 2003. From this initiative, an association supported by citizens and a cooperative were developed [15]. In 2018, a process was started that began with a visualization of a future target state and that has developed a sustainable project, the climate bonus [16]. The author's dual role as researcher and practitioner resulted in several years of intensive cooperation between research project on the one hand and practice on the other.

2. Background and Literature Research

According to Bernard Lietaer, a complementary currency is "an agreement within a community to create its own currency to link unmet needs with unused resources. These currencies do not replace but rather supplement (i.e., complement) the national monetary system and provide greater functionality to money" [17] (p. 238).

At the beginning of 1980, there was only a handful of complementary currencies, like the Swiss WIR, a mutual credit system with more than 60,000 members at the time [18]. After the founding of the first local exchange trade system (LETS) in 1983, the number rose rapidly during the 1980s and 1990s to about 2500 in 1999 [17]. In 2013, there were already almost 4000 complementary currencies in 23 different countries [19]. Since then, the number has continued to increase, with dynamic developments in countries all over the globe, such as France, Brazil, Kenya, and Japan [20,21]. This dynamic indicates that, beyond existing monetary systems, there is an increasing variety of monetary tools that serve the needs, goals, and purposes of citizens [13].

Complementary currencies stand in a natural polarity between idealism and pragmatism. Communities provide complementary currencies for a variety of reasons and based on a wide range of monetary designs. Complementary currencies can be seen as social innovations that respond to economic, social, and environmental challenges [22].

They must be distinguished from parallel currencies, which primarily pursue the goal of maximizing profits [23]. Due to their "complementarity," they are among the reform-oriented approaches that aim at working experimentally on improvements within existing systems and practicing better-functioning examples in the largest-possible niches [24].

Complementary currencies are not unique in this regard: there is a variety of approaches, such as ecovillages, solidarity agriculture, productive cooperatives, sharing approaches, and others in civil society, that can be considered related [25]. For transformation effects to occur, it is important that these initiatives intensively work together

with political actors and researchers to take collaborative actions [12]. Complementary currencies are potentially able to connect these approaches by making money the common medium of communication [13].

What motivates communities to introduce complementary currencies? A common motivation is, for example, a sustained economic shock such as the one in Argentina in 2002, which led to lower sales and unemployment [26]. A complementary currency offers the possibility of self-help for the participants, who handle the exchange of goods with each other with a supplementary unit of account [17]. In this case, it serves to close a gap in supply or demand by local capacities and resources.

Communities that create complementary currencies often have further ambitions: they dream of a fair exchange, of a sustainable way of life, and criticize the making of money for its own sake [27]. These desires led to different complementary currency designs that reflected different visions of their founders and different economic realities [23].

The founder of the American time banks, Edgar Cahn, spent his life fighting against poverty and the privations associated with it. Cahn had the vision that a "time bank" could mitigate differences in work value and thus strengthen the community [19] (p. 9). Other visionaries in the field of complementary currencies were Margrit Kennedy and Bernard Lietaer, who dreamed of a resilient economic system that was not subject to the compulsion to grow [4]. For them, money should serve people and the environment, which can be achieved by designing money according to human needs and integrating principles such as the commitment to a constant circulation of currency [14].

Inspired by these principles, many founders of complementary currencies have been thinking about how a sustainable monetary system could be built [28]. Geographical areas are limited to keep transport routes short [29] (p. 24). Regional incomes are increased so that all suppliers can afford goods of high quality and low resource consumption [7]. The currency unit itself could be covered by renewable energies or carbon units [28].

This also creates a conscious demarcation from previous modes of civilization, as Dennis Meadows describes it very aptly in a foreword to a report to the Club of Rome: "Our earliest ancestors finally did manage to develop a technology based on fire. But they had to emerge from the ocean to do it. Our descendants will no doubt develop a technology based on sustainability. But they will have to emerge from the current financial system to do it" [5].

At a certain point, maximizing economic output leads to an overabundance of human activity. This is reflected in a CO_2 release that is far above Earth's capacities [30]. The main driver is economic growth, which has an extractive effect on almost all ecological areas [31]. Georgescu-Roegen has worked out theoretically that economic growth will always consume energy, and therefore a solution to ecological problems cannot be found through economic growth [32]. The relationship between economic growth and CO_2 emissions is empirically clear at the global level [33,34]. The influence is even more clearly demonstrated in reports by the Intergovernmental Panel on Climate Change (IPCC) [2]:

In all the decades up to 2010, the increase in gross domestic product per capita had the strongest influence on the increase in greenhouse-gas emissions, in addition to population growth (see Figure 1). Although energy efficiency—i.e., fewer units of energy used per dollar or euro of value added—has increased over the last decade, absolute CO_2 emissions have continued to rise sharply worldwide [2] (p. 5), and the rebound effects of overall growth have been greater. By combining unbridled economic growth and increasing energy intensity, the path to the 1.5 °C target and the 2 °C compromise can hardly be achieved [2] (p. 46).

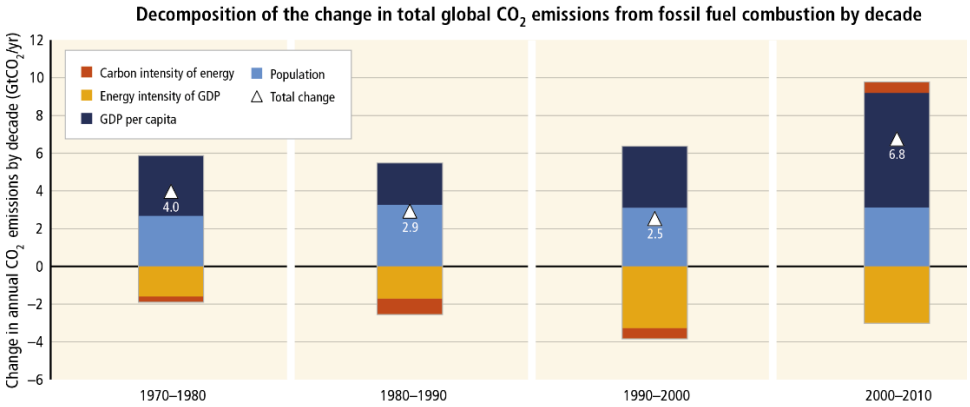

Figure 1. "Decomposition of the change in total annual carbon dioxide (CO_2) emissions from fossil fuel combustion by decade and four driving factors: population, income (gross domestic product, GDP) per capita, energy intensity of GDP and carbon intensity of energy. The bar segments show the changes associated with each individual factor, holding the respective other factors constant. Total emission changes are indicated by a triangle. The change in emissions over each decade is measured in gigatonnes of CO_2 per year ($GtCO_2$/yr); income is converted into common units, using purchasing power parities" [2] (p. 47); graph by IPCC, AR5 WGIII SPM.

The major challenge for sustainable complementary currencies is to link the state of research on CO_2 emissions, on necessary greenhouse-gas reduction pathways, with money creation and circulation. In the diverse world of complementary currencies, there already exist many conceptions of such a link [5,35]. One of the earliest proposals came from Shann Turnbull, who wanted to secure the value of regional currencies with kilowatt hours from renewable-energy sources [36] (p. 188). He also presented his idea at an event about the Chiemgauer in Traunstein and thus exerted influence on the activists of the Chiemgauer. Of the many concepts proposed, only a few have been put into practice. One idea was implemented in the city of Curitiba by rewarding citizens for collecting garbage with bus vouchers from the municipal-transport companies [17]. In Ghent, Belgium, social and ecological behavior is rewarded with the Torekes, with which, for example, small garden areas can be leased [5] (p. 13).

In the field of cryptocurrencies, there is also a number of concepts to reward decarbonization and use decarbonized goods as backing for currencies. For example, the installation of solar power is rewarded with SolarCoins [37]. This possibility of additional financing has been mentioned for various projects [38]. The reward is provided in cooperation with cooperation partners such as SMA, which manufactures inverters for solar-panel systems in Germany. So far, 17,000 users have received SolarCoins [39]. For one kilowatt hour of solar power produced, 0.001 SolarCoins are distributed, i.e., 1 SolarCoin for one megawatt hour [40]. SMA considered accepting SolarCoins at the current exchange rate. In 2018, the issuers of SolarCoin listed the market value of one SolarCoin as USD 0.05 [37]. At the moment, the SolarCoin is no longer listed at any crypto exchange, so it is not possible at this time to sell them. Due to a lack of acceptance, no affluent demand could be developed; therefore, the hope of an additional income cannot be fulfilled at the moment. Further sustainable cryptocurrencies remain in the conception stage [41].

When incentivizing on a global scale, there is a lack of social relationships between network participants, as virtual relationships cannot replace personal relationships [42] (p. 56). The region can be understood as an entity and structure of meaning that can support the development of a collaborative space [43] (p. 16). The higher the quality of social relations and the more NGOs that are active in a region, the more likely the success of local policies becomes [44] (p. 25). Local approaches like bus vouchers in Curitiba and Torekes show that municipal institutions, in cooperation with local civil-society initiatives, have found sustainable paths that work well on a small scale; therefore, a transformation path is searched for in the regional context.

3. Method and Transdisciplinary Approach

The methodological basis for the case study is a transdisciplinary real-world laboratory approach. In a world that is characterized by complex contexts and increasingly eludes causal patterns of interpretation, research methods are needed that reflect knowledge generation and recognize their interaction with practice. Real-world laboratories are a methodological component of transformative research [45]. They go back to the approaches of real experiments [46].

Real-world laboratories oscillate as "real experiments" between knowledge generation and knowledge application [47]. They resemble modern action-oriented learning models, which are used directly in everyday life as transdisciplinary pilot research. Based on experience with these research methods, the findings of business education are integrated. Additionally, the author has been shaped by this form of transdisciplinary approaches and has developed his own approaches to action-oriented learning [48].

Due to their manageable size, complementary currencies offer researchers the opportunity to actively participate in their development. Researchers become part of a community that has a transformative effect. For the operation of complementary currencies, knowledge is required across several disciplines, as well as a wide range of practical knowledge. Expertise includes knowledge of monetary theories, regional development, applicable law, business theories on leadership, organization, accounting, marketing, market and organizational psychology, sociology, economic geography, climate sciences, political economy, engineering, statistics, and more. The practical knowledge is about developing skills, statutes, and regulations in joint processes; forming institutions; drafting and concluding contracts; discovering and applying techniques for banknotes and digital forms of payment situationally, appearing in a high-profile manner; designing and disseminating comprehensible materials; and many thousands of other aspects around such an initiative.

If feedback from the social and ecological environment is considered in these processes, a scientifically reflected competence context is created, which is also referred to as "environmental literacy" [47] (p. 233). The design of the living lab was based on a scheme for real experiments as shown in the following Figure 2 [46] (p. 19):

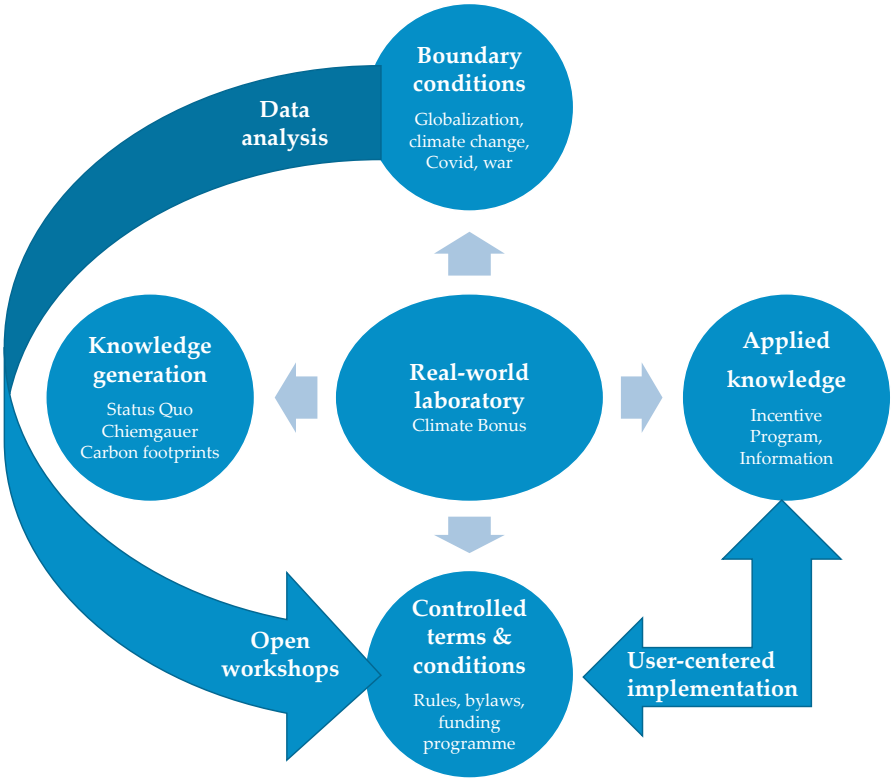

Figure 2. Design of climate bonus as a real laboratory; graph compiled by the author.

Since its foundation, the Chiemgauer has been able to be understood as a real-world laboratory. In line with the above-mentioned research question on the contribution to sustainable development, the Chiemgauer has been part of a research project at the University of Würzburg since mid-2018. Since then, the concept of the real-world laboratory has been used consciously and explicitly. Based on boundary conditions in the regional network, the initial situation is analyzed. For this purpose, classical methods such as statistical and econometrical analysis were used to analyze the regional currency Chiemgauer [49]. The data analysis shows an extensive network of regional acceptance points, which goes hand in hand with a certain depth of value creation [15]. One finding is that one euro that enters the Chiemgauer network generates the added value of three Chiemgauers before it is exchanged back into euros [15] (p. 83). In contrast, a euro would only circulate a maximum of 1.37 times in the region [50] (p. 22).

Knowledge generation should present itself as a work-sharing process in which all participants optimally contribute their respective expertise and at the same time are open and willing to learn from other specialized expertise [51]. With regards to applying knowledge, practitioners are gatekeepers, because only they can implement it in practice as innovators [52] (pp. 282–283). Knowledge generation with perfect expertise does not work if it is not understood, chosen, and implemented in practice. Conversely, the effectiveness of knowledge application can suffer if high-quality expertise is ignored.

A high degree of participation of practitioners and researchers is sought, because early involvement increases the likelihood that jointly generated knowledge is more likely to be accepted and implemented than externally generated knowledge presented in the form of external reports and recommendations [51].

In open workshops, an attempt was made to bring together the knowledge of practitioners and researchers. Discussions in three open workshops raised the question of how the goal of sustainability formulated in the statutes could be made measurable and feasible [16]. Visions and long-term strategies were worked out, and a concept for an expansion of the Chiemgauer with a carbon-based component was developed in several steps. Members of the Chiemgauer also took part in the development of the climate concept of the city of Traunstein [53]. There was an intensive exchange on what the initiative could contribute to the city's reduction targets.

In addition to the open workshops, there are working groups, board meetings, and general meetings, but also scientific workshops and conferences with the goal of finding rules for the sustainable climate currency sought [16]. Such a process would hardly have been possible without the existing social capital created by the many years of building up the Chiemgauer network [54]. This social capital also made it possible to organize a consortium together with two other regions in Germany (Hesse and Saxony-Anhalt), which has applied for funding from the German Federal Ministry for the Environment. A program of climate bonuses was proposed for implementation to the German Federal Environment Ministry as an innovative pilot project in 2018. Once approved, the Climate Bonus project was launched in mid-2019 as a three-year pilot program. Financial support plays an essential role: whereas researchers are paid salaries, activists often work voluntarily in complementary-currency projects. If it takes a short amount of time, this can be solved via the payment of lump sums or recognition for volunteers; however, if a large-scale project is to be developed and accompanied, volunteers are overwhelmed by the time requirements that arise in addition to their existing commitment. With the publicly funded project of the climate bonus, ideas can then also be implemented professionally and paid. This creates a balance in the real-world laboratory between researchers and practitioners. During the application itself, the author, as part of the research team, was able to play an active role in ensuring that the time-consuming application could be prepared in such a way that it met the quality requirements.

Strong support for the development of the climate bonus also came from a network of research partners—on the one hand in the research association ForDemocracy, and on the other hand with research institutions and universities, which were contacted di-

rectly by the Climate Bonus team. This led to the user-centered development of software applications [55] and to the determination of CO_2 emissions of products and services [56].

If the Chiemgauer is to become more sustainable, the existing knowledge, i.e., about regional multipliers [50], helps with the redesign of the Chiemgauer itself or the design of a new sustainable complementary currency. In addition to knowledge of the status quo of the existing network, new knowledge must be generated in order to assess whether a transaction is more sustainable compared to the previous status quo.

For this purpose, CO_2 balances for companies, municipalities, and products must be collected according to current standards like the Greenhouse Gas Protocol [57,58]. According to the protocol, emissions are divided into three categories, i.e., emissions from directly released combustion processes (Scope 1); from purchased energies and substances that are directly assignable, such as electricity and refrigerants (Scope 2); and, as a third area, all purchased products and services that arise upstream or downstream for own value creation (Scope 3).

At the end of the research process, robust knowledge was generated [47] (p. 232), which is based on the state of empirical–analytical research and becomes usable knowledge in the collaborative space of researchers and practitioners.

4. Case Study of Climate Bonus

The basis of the Climate Bonus project is the complementary currency "climate bonus." This currency can be operated independently or combined with existing local currencies, depending on regional conditions. There is no local currency initiative in the city of Marburg, so the climate bonus is pursued as an independent concept. In the Chiemgau, the climate bonus is integrated into the Chiemgauer currency—for example, as a special series of the Chiemgauer.

The climate bonus is one of the sectoral currencies aimed at ensuring a cycle in a particular sector—namely, climate protection consistent with the mitigation of carbon emissions [52]. A climate-bonus system requires transparency concerning the greenhouse gases emitted by the parties involved; therefore, the CO_2 footprint is first measured with a calculation tool (see Figure 3). Opportunities are sought to improve the balance of global warming compared to the status quo. To this end, the Climate Bonus Initiative offers information materials and advice to reduce the CO_2 footprint.

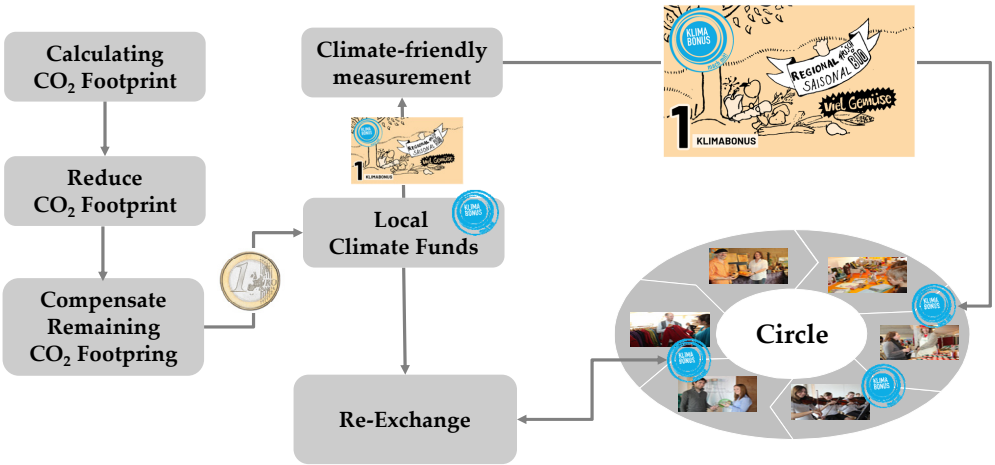

Figure 3. Concept of the climate bonus; graph by the author, design climate bonus by Friederike Boock.

The remaining carbon footprint is addressed through donations to regional climate projects ("climate funds"). Some climate funds are invested in regional climate projects to bind CO_2. Other funds are invested in reduction and prevention measures designed to incentivize the reduction of greenhouse gases. A climate bonus equivalent to one euro corresponds to the value of at least 10 kg of CO_2. The climate bonus can be issued in both

cash and digital currency. Ideally, companies use climate bonuses to pay for other climate-friendly products and services. If euros are needed, climate bonuses can be exchanged for euros at a discount. The required euros are taken from the climate fund.

The climate bonus was used at two locations during the three-year project period. In the city of Marburg, the climate bonus is issued as a paper voucher. The vouchers are valid for one year, and a return is possible at a fee of 5%.

In the Chiemgau, the issuance takes place in the form of a second series of the Chiemgauer currency, which also works with limited maturities and a redemption fee of 5%. The climate bonus is thus a convertible regional currency that is structured in the same way as the Chiemgauer itself; the difference lies in the issuance of the currency, which is only done as a reward for climate-friendly activities. Whereas in the Chiemgau area all existing acceptance points of the Chiemgauer also accept the climate bonus, in the city of Marburg acceptance is limited to climate-friendly companies.

The innovative nature of the Climate Bonus project lies in the networking of the various elements and dynamization through the common climate currency. Paying in climate bonuses draws attention to further CO_2-avoiding consumption offers that can be purchased with the climate currency.

The currency acts as a common communication medium and creates a cycle of information and discussion about climate-friendly behavior. The currency's local connections enable participants to meet and engage with familiar organizations and to become familiar with other organizations that are committed to climate protection. Once participation exceeds critical mass, it becomes increasingly attractive to individuals and organizations.

The image and reputation of the region play an important role in this: climate-committed municipalities, companies, and citizens are perceived positively. One challenge to the implementation of climate bonuses is behavior that prevents taking climate-friendly measures. This can often be due to small factors, such as lack of time and information or misjudging the economic effects of the measure, especially problems associated with short-term thinking. With the help of behavioral economics, the incentives necessary to earn a carbon bonus can be determined [59].

4.1. Determining the Goal of the Climate Bonus

GDP in Germany has risen by an average of 2.7% per year since 1990 [60]. Carbon emissions have been reduced by 1.7% annually in the same period [61]. Although Germany has managed to achieve a certain trade-off between economic growth and CO_2 reduction, the reductions fall short of what was agreed in Paris in 2015 [62].

The German Federal Government's Council of Environmental Experts has calculated that the reduction in CO_2 emissions in Germany by 2030 compared to 1990 must be 92% to achieve the 1.5 °C target, with a probability of 50% [63]. For the 1.75 °C target, which is still compatible with the Paris Agreement, the required reduction would only be 62%; however, this would significantly increase climate risks, so the 1.5 °C target should be targeted at least in the range of a mean probability, so the 1.75 °C remains a worst-case scenario [64].

By falling behind the required reductions, the remaining carbon budget has fallen sharply. According to the German Council of Economic Experts, Germany still has 3.1 gigatons at its disposal. With an annual consumption of 0.8 gigatons, this remaining budget does not last long. Based on the base-year 2021, the German Council of Economic Experts has set a linear target of 10.8% in relation to the base-year 2021 [63].

For the city of Traunstein, carbon emissions will be determined by 2021 [53]. Starting in 2022, nationwide targets for the region will be implemented; these define the goals for the city as a reduction of at least 18,288 tons per year (see Figure 4).

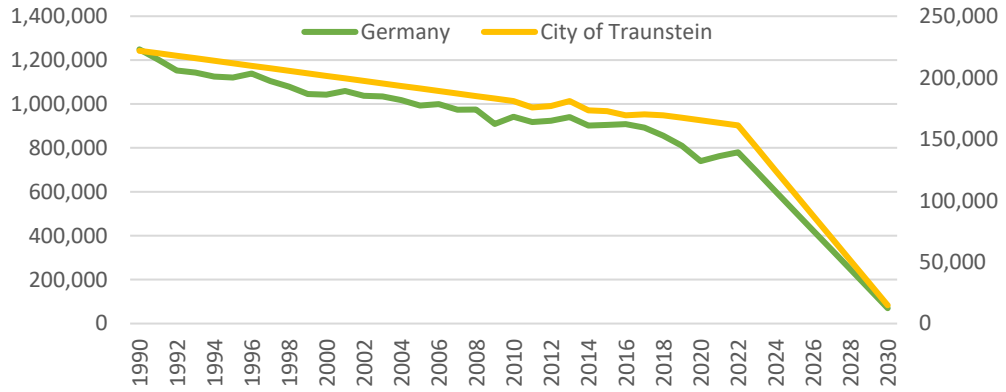

Figure 4. CO_2 reduction path; data: German Environmental Agency [65] and City of Traunstein [53]; graph by the author.

The climate plan of the city of Traunstein lists a large number of measures that address structures, facilities, institutions, and behavior. The climate bonus is part of this package of measures, which is embedded in the overall strategy. For the Climate Bonus project, the urban model provides a clear guideline and orientation.

4.2. Field of Action and Target Group

The groups targeted for climate bonuses were of very different kinds. Citizens in the region were already sensitized to climate protection. The Climate Bonus program steered residents toward purchasing more climate-friendly alternatives. Through the reward system and information events, residents improved at distinguishing between products that protected the climate and those that did not.

Companies, especially large-scale energy consumers, were also targeted. Here, the focus was on accounting and consulting, which can potentially result in very large carbon savings. A third target group was municipalities and associations in the region. Local administrations and associations act as role models and must lead by example. Municipalities had a great interest in ensuring that carbon bonuses remained in the region.

4.3. Carbon Reduction and Compensation

Reduction in emissions comes first. The project developed funding programs in cooperation with cities and municipalities, which were combined with climate bonuses to realize large potential reductions in emissions. Climate-change plans with territorial balance sheets served as tracking instruments at the municipal level. Energy consultants were enlisted to work with companies in the region to achieve large reductions in carbon emissions.

In the household sector, the greatest incentive was the promotion of a lifestyle that urged less consumption and a culture of "repair, not replace" [66]. For example, those who could switch to a green electricity provider or who could prove that they had significantly reduced their consumption through energy-efficient renovations received climate bonuses in line with the savings. Participants were not able to eliminate their carbon footprints, but they could partially offset their carbon footprints by participating in climate-protection compensation projects. Neither the municipalities nor the individual citizens or companies were obliged to pay the CO_2 compensation; it was a voluntary levy out of the awareness that action must be taken today to avert greater damage in the future [67].

Compensation projects consistently followed a regional approach, using prices calculated by the German Environmental Agency according to a polluter-friendly equity approach considering income ratios [68]. Participants could offset their carbon emissions through natural carbon sinks, such as bogs and meadows. Difference compensation also proved to be promising.

4.4. Measuring Carbon-Dioxide Reduction

The comparison between the actual and the target state was the basis for determining the incentives, which were paid out in climate bonuses. Under the guidance of the author, the climate-bonus team drew up a list of climate-friendly measures. Where available, CO_2 values from existing studies were used; in some cases, the CO_2 values were determined separately to determine the reward values. When the term "CO_2" is used, it always refers to CO_2 equivalents, i.e., also including other greenhouse gases that are converted into CO_2 units [69]. A selection of measures is presented below, which could be embedded in comprehensive strategies for urban and rural development (see Table 1).

Table 1. Effects of measurements for one year (tons of CO_2 per year as "to/a"), duration of action (years), and overall effect ("to"); data compiled according to the references in the text by the author.

Measurement	Years	to/a	to
Solar panel	20	3.550	71.000
Renewable electricity	8	1.130	9.040
Humus build-up	30	15.000	450.000
Insulation	25	2.000	50.000
Pellet heating	15	4.000	60.000
Car sharing	5	0.280	1.400
Bicycle repair	1	0.050	0.050
Orchard	20	1.000	20.000
Replace refrigerator	10	0.140	1.400
Organic cleaner	1	0.003	0.003
Repair café	1	0.024	0.024
Jeans repair	1	0.011	0.011
Balcony solar panel	20	0.122	2.430

The Federal Environment Ministry offers a work aid in which CO_2 savings are listed and that have been evaluated before using scientific standards [70]. Values can be taken for photovoltaic systems, renewable electricity, car sharing, insulation, pellet heaters, and refrigerator replacements. In the case of data gaps, studies were used by the author, and in individual cases a life-cycle analysis was carried out. The parameters resulted from the average savings value in tons of CO_2 and the duration of usage in years.

There are carbon studies on repair cafés [71], which are based on repair lists with devices such as toasters, radios, vacuum cleaners, and many others. If these devices are purchased new, CO_2 emissions are generated, which are avoided by repair. An average value is formed, so the reward does not have to be differentiated according to the type of device. The quoted study considered the remaining life cycle and the success rate of the repair. The situation is similar with bicycle repairs, which demonstrably extend the life cycle of a bicycle. A reduction of one quarter of the emissions from new production with 198 kg CO_2 per bike is assumed [72].

A project that was started in cooperation with the climate bonus is the "Jeans Hospital." The idea is to use jeans for as long as possible and to repair them if they have minor damage. The production of jeans produces 33.4 kg CO_2 [73]. In the case of a repair, an extension of the service life by one third is assumed, which corresponds to the avoidance of 11.1 kg of CO_2.

According to a life-cycle analysis, the CO_2 emissions for an organic cleaner amount to 462 g of CO_2 per liter compared to a conventional cleaner, which requires an average of 3500 g [74]. Although the reduction per liter is only around 3 kg of CO_2, the quantities sold are in the tens of thousands.

In addition to the avoidance of CO_2 emissions, which are clearly in the foreground of the Climate Bonus project and are pursued with the above-mentioned products and facilities, there is also the possibility of developing natural sinks that bind CO_2. In the experimental phase, two smaller projects were implemented: on the one hand, an orchard with a private-property owner who has developed a fallow area, and on the other hand, a humus construction project with a farmer. The carbon-storage values for the orchard

were determined by the author on the basis of the tree species, the soil condition, and corresponding estimates from studies [75].

4.5. Assessing Carbon-Dioxide Damage

Now that a number of reduction potentials have been identified, it is time to evaluate them. The German Environmental Agency estimates the damage caused by CO_2 at EUR 195 per ton when a time preference rate of 1% is used. If the welfare of future generations is valued just as highly as the welfare of today's generations, EUR 680 per ton would need to be set. Since future generations should be treated equally for legal and ethical reasons [76], the following calculation examples use the higher number. A new pair of jeans would thus be associated with CO_2 costs of EUR 22.71. These costs are reduced by a long service life. When determining the value of a jeans repair, these opportunity costs can be considered.

Electricity generation of 10,000 kWh per year releases 4.1 tons of CO_2 based on the average German electricity mix, which contains about 42% fossil fuels [77] (p. 8). After 20 years, this kind of electricity generation produces 82 tons of CO_2; this corresponds to damage of EUR 53,760. A photovoltaic system with 10 kilowatts of nominal power, by contrast, would only release 11 tons of CO_2 in the same period [78]. The reduction amounts to 71 tons of CO_2 per plant over its entire service life; the damage would therefore only amount to EUR 7480. If it is known that the installation of a solar-panel system with a nominal output of 10 kW costs only EUR 15,000 and the saved electricity costs are at least EUR 30,000, one wonders why not all roofs in countries with electricity costs above EUR 0.15 per kWh hour have been covered with solar-panel systems by now. In this case, action for the environment would correspond to a personal financial benefit.

5. How the Climate Bonus Works in Practice

The climate bonus provides information on climate protection in the climate savings book and on the website www.klimabonus.info; there it is possible to calculate one's own CO_2 footprint and find tips on which small changes make a big difference. Example: With the help of the footprint calculator, a CO_2 emission of 17 tons was determined for a household of two.

5.1. Climate Bonus for Private Households

The next step is to reduce CO_2. With the mitigation measures in a "Climate Savings Book," the private household is trying to reduce its footprint. For individual measures, the Climate Bonus organization offers rewards in its own climate currency, the climate bonus. A climate bonus corresponds to EUR 1 and, at the same time, an average reduction of 10 kg of CO_2. With the climate bonus, one can buy climate-friendly products from 25 companies in Marburg and 30 companies in the area of Traunstein or donate the climate bonus to regional natural carbon-sinking projects.

A list of currently 30 reward promotions can be found at www.klimabonus.info. The list includes products and services of companies and organizations that have themselves embarked on the path to climate friendliness and strive for a continuous reduction of the greenhouse gases emitted by their activities. The selection of companies and reward actions is carried out by a local advisory board, which reviews calculations of the reductions and determines the additionality of the measure.

Example: If somebody repairs a pair of jeans at the Jeans Hospital, they save 11 kg of CO_2 compared to buying a new pair. For this, the person who brings the jeans to repair receives a climate bonus. Another example would be one person installing a balcony power plant and receiving 30 climate bonuses in return.

Thirdly, there is the possibility of compensating for the remaining footprint. Unfortunately, we cannot make our CO_2 footprint disappear completely, but we can compensate for it. To this end, the climate bonus offers regional solutions for offsetting CO_2. From a small proportion of the compensations, new climate bonuses are drawn, which flow into the incentive system for reduction.

Example shown in Figure 5: A private household has been able to reduce its footprint by two out of eight tons and wants to balance the remaining footprint of six tons. To this end, the budget pays EUR 100 for each ton into the Climate Bonus Funds. The price reflects the damage incurred and the investments necessary to avoid damage. In the example below, two balcony power plants are rewarded with 100 climate bonuses each. Further measures could be financed from the remaining EUR 400. The private household receives a certificate for its climate-friendly activities.

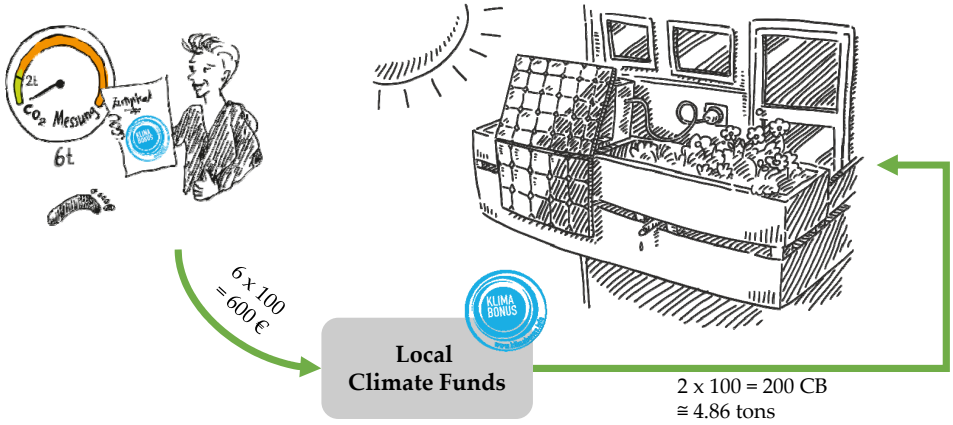

Figure 5. Measuring carbon balance and compensating into local funds; graph compiled by the author, design logo and illustration certificate by Chiemgauer eV/Friederike Boock, illustration balcony solar panel: istock.com/Frank Ramspott.

In addition to all citizens, companies, municipalities, organizations, and initiatives can also participate.

5.2. Climate Bonus for Companies and Organizations

The climate bonus helps companies with carbon balancing according to the Greenhouse Gas Protocol [58] and the selection of suitable reduction measures. These can be rewarded with the climate bonus. In addition, the climate bonus offers regional compensation projects with which companies can pursue climate protection that becomes visible locally. Companies with particularly sustainable products and services can become part of the Klimabonus network as issuance and acceptance points. In this way, they become visible as particularly sustainable actors—for example, in brochures or on the website—and benefit from the steering effect of the climate bonus, which repeatedly leads consumers to climate-friendly businesses.

Figure 6 shows the result of the carbon balance for a company that calculated carbon emissions from Scope 1 to 3 with 123.8 tons. The company decides to compensate its emissions with climate-bonus funds. For every ton of CO_2, the company donates EUR 100 to the local climate fund. In the compensation fund, money is now available to reward reduction activities or to finance, for example, the registration and use of car sharing instead of using one's own car. Car sharing reduces the number of cars by 89% [79]. The savings are estimated at 280 kg of CO_2 per person [70] (p. 11).

With the help of the compensation fund, the use of car sharing can be rewarded with up to 120 climate bonuses. Discussions with companies and private individuals have shown that regional implementation is preferred. Although it makes no difference to the climate whether the implementation of car sharing takes place in Beijing or in one's hometown, it makes a big difference for personal feeling and for the comprehensible transparency for the donor whether the measure takes place locally or far away from the respective region. In psychological studies, self-efficacy through local proximity and identity has been investigated and confirmed many times [80]. Both for the donor and for the person implementing the measure, local proximity increases the identification and the feeling of self-efficacy.

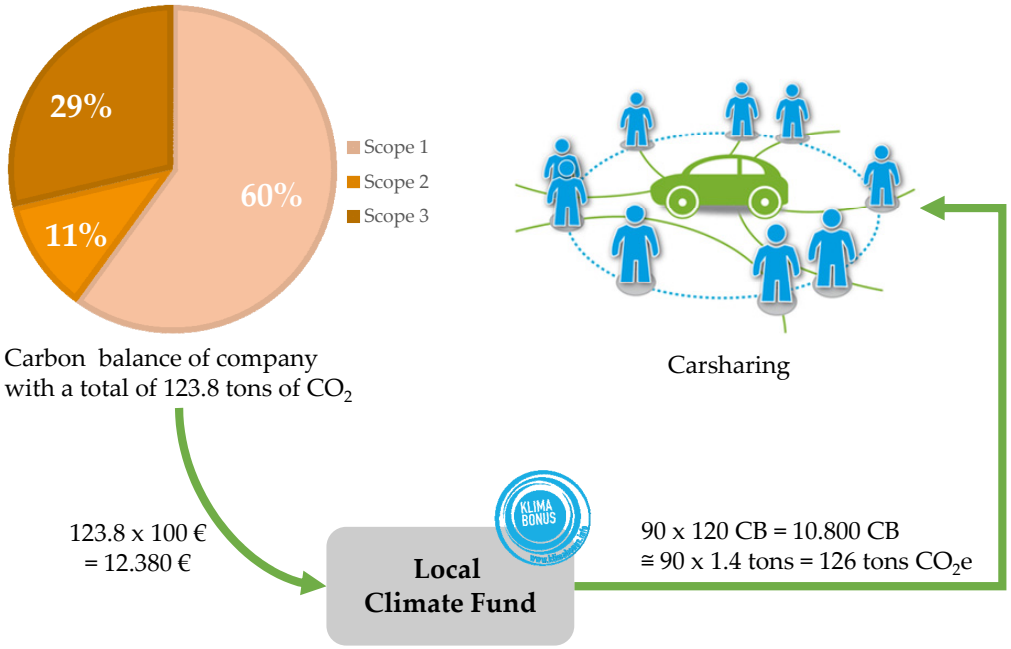

Figure 6. Measuring carbon balance of a company and compensation; graph by the author, design of logo climate bonus by Chiemgauer eV/Friederike Boock.

5.3. Climate Bonus for Municipalities

The climate bonus helps municipalities with the carbon balancing of the municipal administration and supports the determination of a territorial balance according to common standards [57]. In conjunction with energy consultancy, sustainability agencies, and the like, the climate bonus helps to improve the carbon balance.

In Bavaria, if municipalities have a residual footprint, they will be called upon by law to compensate for the administrative footprint by 2030 at the latest. For this purpose, the approach of the climate bonus is suitable to provide the not-yet-affordable reduction in other sectors in the same territory by offering rewards for the reduction.

A survey in the city of Traunstein among citizens who own a home but do not yet have a solar-panel system shows various concerns [55]: there is a lack of information on the advantages of a solar-panel system. Furthermore, it is difficult to get technicians. Often mentioned is the lack of investment capital and the unwillingness to take out a loan. Instead, citizens wait until the necessary capital is saved.

The Climate Bonus initiative, in cooperation with the city of Traunstein, has developed a program that helps citizens become information faster by providing advice and support from a municipal energy agency with a grant of up to 15% of the investment amount. For a 10 kW system, citizens receive 1000 Chiemgauers as shown in Figure 7.

With the climate bonus, the recipient can pay for climate-friendly services, such as the repair of jeans or the use of an environmentally friendly cleaner. The climate bonus is intended to provoke a chain reaction of environmentally friendly solutions to reduce rebound effects.

The city of Traunstein rewards the energetic renovation of existing buildings and the installation of solar-panel systems on house roofs with climate bonuses. For the installation of a 10 kW system, a private household currently receives 1000 climate bonuses.

From the city treasury EUR 1000 are donated to the Climate Bonus fund that makes it available for the reduction of CO_2. Citizens can prove a reduction by installing a solar-panel system. They receive a Regiocard, which is topped up with 1000 climate bonuses (equivalent value: EUR 1000). With the Regiocard, citizens can shop at climate-bonus acceptance points. In Traunstein, 71 businesses are participating. Four-fifths of the businesses spend the local currency again. This creates a cycle in the city.

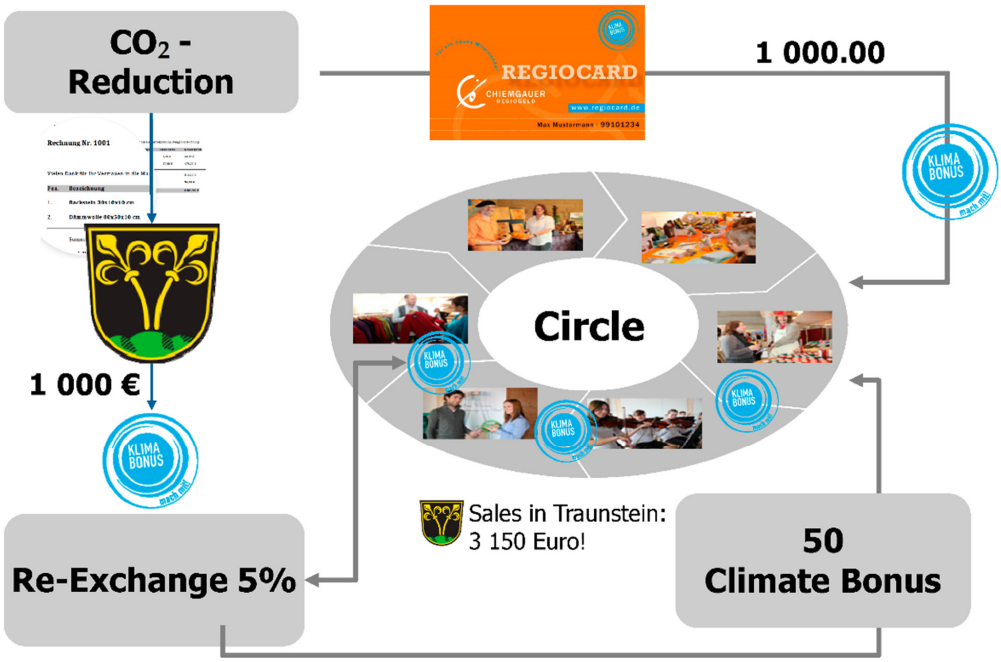

Figure 7. Currency circle of the climate bonus; graph by the author, design Regiocard and Logo of climate bonus by Chiemgauer eV/Friederike Boock.

If climate bonuses are exchanged back into euros, the business pays a 5% fee. This finances the issuance of another 50 climate bonuses, which also generate sales. The deposit of EUR 1000 thus generates 1050 climate-bonus units, which circulate an average of three times and generate a turnover of 3150 climate bonuses in Traunstein and the surrounding area.

In addition to strengthening local economic cycles, the main focus is on determining CO_2 effects. Installation of a solar-panel system achieves a reduction of CO_2. This improves the territorial balance of the city by the same amount, since the production at the same location is included in the carbon footprint according to the BISKO standard [81]. At the same time, the reduction can be seen as compensation for the carbon footprint of the municipal buildings because it is not obliged to award subsidies.

6. Results

The main factors for the difference between business cycles in euros and in climate bonuses are local supply chains in the organic-food sector, the purchase of green electricity, and short transport routes. Another major effect of climate bonuses is that their use creates questions and ideas on how to contribute to climate protection in one's own behavior. A savings of 5000 tons of carbon dioxide had been agreed on with the German Federal Environment Ministry for the first three years of the project. The expectations were more than met; the quantitative results are listed in Table 2.

The results in the region of Chiemgau within three years are a reduction by more than 10,000 tons of carbon dioxide. The most efficient measures in Table 2 were the installation of solar-panel systems. A total of 98 plants were promoted between the second quarter of 2021 and the second quarter of 2022 with the climate bonus in cooperation with the city of Traunstein. All plants together have produced a reduction value of about 6958 tons of CO_2 over the estimated service life of 20 years. The second-largest savings were achieved by switching contracts for average energy production, including fossil fuels, to green electricity. A contract saves an average of 1.13 tons of CO_2 per year. All contracts together amounted to 1460 tons of CO_2, with an average contract term of eight years.

Table 2. Savings of CO_2 (sum) as a result of the effect of the individual measure and the quantity; data on quantity provided by Klimabonus e. V. and calculated by the author.

Measurement	to	Quantity	Sum (to)
Solar panel	71.000	98	6958
Renewable electricity	9.040	162	1464
Humus build-up	450.000	1	450
Insulation	50.000	3	150
Pellet heating	60.000	1	60
Car sharing	1.400	36	50
Bicycle repair	0.050	119	6
Orchard	20.000	1	20
Replace refrigerator	1.400	9	13
Organic cleaner	0.003	837	3
Repair café	0.024	157	4
Jeans repair	0.011	78	1
Other measurements			895
Total			10,074

About 80% of the savings would be achieved in the city of Traunstein, most of it in the third year of the project. The city of Traunstein has set a goal of an annual reduction of 18,288 tons of CO_2 per year. Three years after the start of the project, the Climate Bonus project could cover more than half of the reduction goals. The efforts are not yet sufficient, especially if it is considered that the measures will only achieve their full effect over a longer period of time. As a continuation of the project, the aim will be to link the goals and strategies of municipalities more closely with the Climate Bonus program. Several cities in Germany have declared that they will follow Traunstein's example, and the city itself would like to expand and intensify the program. The city of Marburg has already started with the first Climate Bonus programs for a climate-friendly transport transition.

7. Discussion

The incentives are set in a trial-and-error process. They rely on psychological thresholds that do not necessarily correspond to economic advantages; rather, the incentives often differ in terms of value and have more to do with a recognition of climate-friendly behavior. This research direction of a behavioral economic approach is receiving increasing attention under the keyword of "green nudging" [59,82]; however, the methods of the climate bonus cannot be reduced to a purely economic point of view. The Climate Bonus project uses the climate bonus as a communication medium, but information and social relationships in a city and in neighborhoods also play a significant role. Public figures are involved in the project, such as the mayor of the City of Traunstein. Together, the technical aspect of the currency cycle and the communicative and personal elements form a connection that works in its entirety.

Compared to the example of SolarCoin, the Climate Bonus project has succeeded in involving local actors who give value to the alternative currency. On the one hand, this is done through a reserve in national currency, which is distributed as needed. Furthermore, the regional institutions themselves are also available as anchors of trust. In the case of complementary currencies, it is therefore less about the technology and more about how social capital of the network is built [44].

The establishment of the climate bonus requires a relatively large amount of effort for the monitoring of CO_2 emissions, especially where there are still no data from studies. Through life-cycle analyses, more and more data are gradually being collected and compiled into publicly available databases. In view of the challenges posed by climate change, increased public efforts are needed at the local level. The carbon tax and the climate bonus can be seen as two sides of the same coin. Although the CO_2 tax provides incentives for lower consumption via price signals, these incentives alone are insufficient. The climate bonus starts on the reward side and picks up people locally where they stand.

The climate bonus creeps into everyday routines as a reward and highlights climate-friendly behaviors that are decoupled from material and energy expenditure [68]. Through the dynamic connection, attention is drawn, for example, from a technical efficiency measure such as a photovoltaic system to denim repair, without this being perceived as morally patronizing. Due to the playful nature of a climate currency, new behavioral routines can be tested in this protected monetary space. After a grant has been paid out and spent, some leave this monetary space, but at least the one-time effect of carbon savings remains. Others stay in this space and earn new climate bonuses again and again through new climate-bonus campaigns.

As has already been mentioned several times, the Climate Bonus project should never be seen in isolation, but always as part of a broader strategy of a municipality, a region, or an entire country. With a focus on CO_2, complementary currencies can align themselves as part of civil society with clearly defined goals and put themselves at the service of society. Government agencies, in contrast, find support and multiplication opportunities for their goals, which enjoy constitutional status in the case of climate protection.

Urban-planning activities that address infrastructure can be brought to life through the communicative power of the money medium. In the example of the reward for deregistering vehicles, free areas are created that can be used to rebuild a city. Visionary approaches speak of 15 min cities that promise a livable environment for residents and make all the needs of life accessible within a range of 15 min [83].

When measuring the results, it should be considered whether new value measurements should be used instead of the non-commensurable measurements in monetary units and CO_2 [10]. In addition, the measured values can be extended to an "environmental quality index" [84]. There is also much to be said for sticking to individual indicators such as CO_2, as the reduction is often associated with further positive consequences for the environment. Longer use of clothing requires fewer natural raw materials. Prolonged use of smartphones consumes fewer rare raw materials. Deregistering a car takes up less space and saves large amounts of energy-intensive raw materials.

In addition to sustainability, social cohesion and inclusion are important issues. Large subsidies are often given to homeowners who already have more in assets, whereas tenants often have few opportunities to adopt climate-friendly measures. In cooperation with associations in the city of Traunstein, low-income tenants were provided with a balcony power plant. There are negotiations with the city of Traunstein to equip city-owned homes with solar-panel systems and then offer the electricity cheaply to the tenants. If this idea is discussed more globally, aid in countries like Kenya could be linked to climate-friendly cycles [85]. At conferences of the Research Association for Monetary Innovations (RAMICS), one of which recently took place in Sofia, such ideas are exchanged between operators of complementary currencies. If grassroots initiatives demonstrate successful examples, scaling up at the national level [86] and even combining them with the issuance of central bank currencies would also be conceivable [87].

This results in a need for further research. For the climate bonus, the next research step is to collect carbon footprints from all acceptance points, including the issuing body itself, in order to obtain a complete picture of CO_2 emissions. By comparing the collected data with sales, CO_2 emissions per currency unit can be determined. Further analysis will consist of recording the CO2 emissions of the Climate Bonus monetary system and comparing them with other payment methods [88,89]. For this purpose, the CO_2 consumption per transaction could be used.

8. Conclusions

Due to its regional embedding, the climate bonus shows a high adaptability to requirements and a high efficiency in using funds. The transfer to other regions is relatively easy to accomplish. The question of whether local funding programs and incentives can be scaled up to the national level is more complex. The better option is to decentralize funding so that it can be used more effectively by local institutions [87]. A major source of funding could be

CO_2 taxes. Based on empirical results that show that the lump-sum payment is more likely to lead to CO_2-intensive expenditures such as travel [90], targeted spending on CO_2-reducing incentives would be the better option. The carbon savings of citizens have emerged as a decisive factor for success. If citizens can have a say in the design of the measures from the outset, they will be much more willing to actively support implementation later. These aspects of community building can be crucial in achieving the goals.

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