Energy Proceedings
2022
ISSN 2004-2965

Local Currencies in the Context of Climate Protection: A Circular- and Decentralized-Economy Approach Based on Real Experiments

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ABSTRACT

Despite numerous appeals, agreements and political measures, greenhouse gas emissions continue to rise worldwide. Increases in GDP are closely correlated with increases in resource consumption. Local currencies can be used to ensure sustainable cycles with a low carbon footprint. The research path goes into the daily routine of a real laboratory to find out which methods and incentives would be effective to deliver carbon savings. The climate bonus consists of a double mechanics of payment for using ecological goods and incentives to reduce them sparingly. As a result, after three years of the project, carbon reductions are clearly above expectations.

Keywords: climate change, local currencies, real laboratory experiments, intelligent carbon saving

NOMENCLATURE

Abbreviations	
CO2e	Carbon dioxide, e as equivalent to CO2
Carbon	Used as CO2e
to	Tons of carbon dioxide
FEA	Federal Environment Agency Germany
IPCC	International Panel on Climate Change
a	Per annum

1. INTRODUCTION

Regional currencies have spread to many places around the world at the beginning of the twenty-first century [1]. Sustainable economic cycles and short transport routes are often set as goals. Due to their manageability, regional currencies can be embedded in debates of regional economics and sustainability [2]. Above all, they are suitable for democratic experiments that can show in real environments whether currency designs work, without the risks and side effects being particularly high [3]. However, there is no proven quantitative evidence on the effects of sustainability [4].

2. ECOLOGICAL CHALLENGE

In the Paris Climate Agreement, Germany committed itself, along with the global community, to limiting global warming to 1.5°C and to remaining well below a 2°C increase [5]. This requires increased efforts at all levels of government, the economy, and society, especially at the regional level [6]. The IPCC's and FEA's forecasts do not currently coincide with the objectives agreed to within the framework of the Paris Agreement [7]:

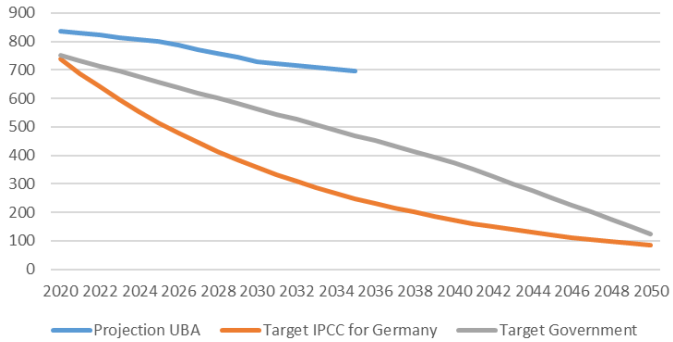

Figure 1: Pathways CO2 reduction CO2, data sources: IPCC, FEA

With more than 800 million tons of carbon dioxide emitted in Germany alone, there is great need for action in all areas of consumption, especially in the areas of housing, mobility, and nutrition. Without changes to lifestyles and production patterns, the reductions in greenhouse gas emissions necessary to limit global warming to no more than 1.5°C will not be achieved.

3. CARBON TAX AND DISTRIBUTION

The most often discussed strategy for reducing greenhouse gas emissions is a carbon tax. Some argue that a carbon tax should be proportional to carbon consumption [8]. The more CO2-intensive products and services are consumed, the more you have to pay for them. As a result, prices are being structured and then include incentives to reduce emissions of greenhouse gases.

Because the carbon tax is a source of revenue for the state, questions of distribution arise. It is often proposed

This paper was presented at the 14th International Conference on Applied Energy - ICAE2022, Aug. 8-11, 2022, Bochum, Germany.

that the revenues generated by the carbon tax be distributed uniformly, per capita, in the form of a carbon dividend [9]. This would benefit those who consume relatively little. However, a refund can create rebound effects that lead to greater carbon emissions and slow the reduction in emissions [10]. Experience from Sweden shows that even a carbon price of 140 US-dollars does not produce the necessary reductions in greenhouse gas emissions. Besides, some aspects of life are relatively resistant to carbon taxes. In the transport sector, for example, a carbon tax has made no significant contribution to a real reduction in production over the last twenty years [11]. The study also considered hidden shifts when, for example, palm oil from Indonesia was used as a substitute for petroleum.

A climate bonus has recently been proposed as an alternative to a per capita distribution of revenues from carbon taxes or even generous rebates on carbon taxes for energy-intensive industries. The idea of directing the flow of money to preserve resources has been experimentally tried in a few localities, such as in Curitiba, which used bus tickets as an incentive to reduce and separate waste [12]. Funding programs aimed at saving CO2 also go in the same direction, but disbursements in euros generate rebound effects which must then be minimized.

4. CONCEPT OF CLIMATE BONUS

The basis of the climate bonus project is the complementary currency "climate bonus", sectoral currencies aimed at ensuring a cycle in a particular sector, namely climate protection, consistent with the mitigation of carbon emissions [13]. A climate bonus system requires transparency concerning the greenhouse gases emitted by the parties involved. Opportunities are sought to improve the balance of global warming, compared to the status quo.

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 CO2. 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 ten kilograms of CO2. The climate bonus can be issued in both cash and digital currency. Ideally, companies using 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 innovative nature of the climate bonus project lies in the networking of the various elements and dynamization through the common climate currency. Paying climate bonuses draws attention to further CO2-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 implementation of climate bonuses is behavior that prevents taking climate-friendly measures. This can often be due to small things, such as lack of time and information or misjudging the economic effects of the measure, especially problems associated with short-term thinking. Bonini and others (2018) used behavioral economics to determine the incentives necessary to earn a carbon bonus. The measures themselves were determined in a democratic process and based on scientific methods of CO2 calculation (Hickmann, 2017).

A program of climate bonuses was proposed to the German Federal Environment Ministry in 2018 as an innovative pilot project for implementation. Once approved, the Climate Bonus project was launched in mid-2019 as a three-year pilot program.

4.1 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 became better able to distinguish 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 result in very large carbon savings potentials.

A third target group were 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.

4.2 Reduction as the most important measure

Reduction in emissions came first. The project developed funding programs 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' [14]. 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.

4.3 Compensation

Participants were not able to eliminate their carbon footprints, but they could partially offset their carbon footprints by participating in climate protection compensation projects. Compensation projects consistently followed a regional approach, using prices calculated by the FEA according to a polluter-friendly equity approach considering income ratios. [15]. Participants could offset their carbon emissions through natural carbon sinks, such as bogs, forests, and meadows. Difference compensation also proved to be promising. For example, the City of Traunstein used a subsidy program for solar systems to award credits for reductions in carbon emissions, which were compared to the administration's CO2 emissions.

4.4 Obstacles and suitability of measures

Obstacles to implementing a climate bonus program include a lack of information and the aura of negativity around climate protection, which leaves many people hesitant to act. As a result, people continue in their daily routines, despite continued high consumption and resultant high emissions. Additionally, programs to reward reductions in greenhouse gas emissions are perceived as non-transparent and ineffective.

A greater focus on positive examples of reductions in greenhouse gas emissions that have been rewarded with climate bonuses could counter the negative perception of climate action. The climate bonus informs with its wide range of incentives. Citizens often learn about climate bonuses by chance, for example, because they have bought a cleaning product that reduces carbon emissions by three quarters and is therefore rewarded. The simplicity and accessibility of these programs can motivate consumers to learn more about possibilities for reducing emissions and for compensation for doing so.

5. METHODS

The structure of the climate bonus is complex with the different target groups and the variety of approaches to CO2 reduction. This article focuses on methods for determining CO2 values. The comparison between the actual and the target state is in turn the basis for determining the incentives, which are paid out in climate bonuses. The Federal Environment Ministry offers a work aid in which CO2 savings are listed and which have been evaluated elsewhere [16]. Values can be taken for photovoltaic systems, green electricity, car sharing, insulation, pellet heaters, and refrigerator replacements. In the case of gaps, studies were used and, in individual cases, a life cycle analysis was carried out. The parameters result from the average saving value in tons of CO2 and the duration of action in years.

Measurement	years	to/a	to
Solar panel	20	4.050	81.000
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 Cafe	1	0.024	0.024
Jeans repair	1	0.011	0.011

There are carbon studies on repair cafes [17], which are based on repair lists with devices such as toaster, radio, vacuum cleaner, and many others. If these devices are purchased new, CO2 emissions are generated, which are avoided by the repair. An average value is formed, so that the reward does not have to be differentiated according to the type of device. The quoted study considers the remaining useful life and the success rate of the repair. The situation is similar with bicycle repairs, which demonstrably extend the useful life of a bicycle. A

reduction of one quarter of the emissions from new production with 198 kg CO2 per bike is assumed [18].

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 pants if they have minor damage. The production of jeans needs 33.4 kg CO2 [19]. In the case of a repair, an extension of the service life and one third is assumed, which corresponds to the avoidance of 11.1 kg of CO2.

According to a life-cycle analysis, the CO2 emissions for a cleaner amount to 462 grams of CO2 per liter compared to a conventional cleaner, which requires an average of 3,500 grams [20]. Although the reduction per liter is only around three kilograms of CO2, the quantities sold are in the tens of thousands.

In addition to the avoidance of CO2 emissions, which are clearly in the foreground of the climate bonus project and are pursued with the above-mentioned products and facilities, there is another possibility developing natural sinks that bind CO2. 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 on the basis of the tree species, the soil condition and corresponding estimates from studies [21].

Now that a number of reduction potentials have been identified, it is now time to evaluate them. The FEA estimates the damage caused by CO2 at 195 euros per ton, if 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, even 680 euros per ton are to be set. Since future generations should be treated equally for legal and ethical reasons [22], the following calculation examples take the higher approach. A new pair of jeans would thus be associated with CO2 costs of 22.71 euros. 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 kilowatt hours per year releases 4.2 tons of CO2 based on the average German electricity mix, which contains about 42% fossil fuels [23]. After 20 years, it is 84 tons of CO2. This corresponds to a damage of 53,760 euros. A photovoltaic system, on the other hand, would only release 3 tons of CO2 in the same period. The reduction amounts to 81 tons of CO2 per plant over its entire service life. The damage would therefore only amount to 1,920 euros. The ecological damage would be 51,840 euros lower. If we now know that the installation of a solar system with a nominal output of 10 kilowatts costs only 10,000 euros and the saved electricity costs are at least 30,000 euros, one wonders why not all roofs in Germany are yet covered with solar systems. In this case, action for the environment would correspond to a financial personal benefit.

A survey in the City of Traunstein among citizens who own a home but do not yet have a solar system shows various concerns [24]. There is a lack of information on the advantages of a solar system. Furthermore, it is difficult to get artisans. Often mentioned is the lack of investment capital and the unwillingness to take out a loan. Instead, we 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 to get 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 1,000 euros. The bonus is paid out in climate bonuses. With the climate bonus, the recipient can pay for climate-friendly services, such as the repair of jeans or the environmentally friendly cleaner. The climate bonus is intended to provoke a chain reaction of environmentally friendly solutions to reduce rebound effects.

Individual citizens can also participate in the financing of incentives by offsetting their own CO2 footprint. One ton is offered at a price of 100 euros. This makes it possible to finance measures that contribute to damage prevention. The avoidance is much cheaper than the damage itself. Since neither the municipalities nor the individual citizens and companies are obliged to pay the CO2 compensation, it is a voluntary levy out of the awareness that action must be taken today to avert greater damage in the future [25].

The incentives are set in a trial-and-error process. They rely on psychological thresholds that do not necessarily correspond to the economic advantage. Rather, the incentives often move in terms of value, which 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” [26,27]. 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, social relationships in a city and in the neighborhood also play a significant role. Public figures are involved in the project, such as the Lord Mayor of the City of Traunstein. Together, the technical currency and the communicative and personal elements form a connection that works in its entirety.

6. RESULTS

The experience in Chiemgau suggests that climate bonuses are exchanged three times, with each exchange reducing the production of CO2 by about one third. The differences between business cycles conducted in euros and those in climate bonuses are attributable to local supply chains in the organic food sector, the purchase of green electricity and short transport ways. Another major benefit of climate bonuses is that their use creates questions and ideas about how one's own behavior can contribute to climate protection.

A reduction of 5000 tons of CO_2 was agreed with the German Federal Environment Ministry for the first three years of the project. Expectations for the project were more than met. The quantitative results are listed in the table:

Measurement	to	quantity	sum (to)
Solar panel	81.00	86	6966
Renewable electricity	9.04	162	1464
Humus build-up	450.00	1	450
Insulation	50.00	3	150
Pellet heating	60.00	1	60
Car sharing	1.40	36	50
Bicycle repair	0.05	119	6
Orchard	20.00	1	20
Replace refrigerator	1.40	9	13
Organic cleaner	0.01	837	5
Repair Cafe	0.02	157	4
Jeans repair	0.01	78	1
Other measurements			895
Total			10084

The Chiemgau region saw a reduction of more than ten thousand tons of carbon dioxide over three years. The most efficient means of reducing CO2 emissions was the installation of solar systems: each ten-kilowatt-hour system reduced emissions of CO2 by 4.1 tons per year. Under the climate bonus program, there were seventy-seven systems installed in the City of Traunstein between the second quarter of 2021 and the first quarter of 2022. Together, these systems are expected to reduce CO2 emissions by 7,052 tons over their estimated service life of twenty years. The second largest savings were achieved by switching contracts for energy production from fossil fuels to green electricity. Each such contract reduced CO2 emissions by an average of 1.13 tons of CO2 per year. Together, the contracts reduced CO2 emissions by 1,460 tons of CO2 over an average contract term of eight years.

7. DISCUSSION

Establishing a climate bonus program requires a significant effort to track CO2 values, especially because there is little data from which to do so. Through life-cycle analyses, more and more data is gradually being collected and compiled into publicly available databases. In view of the challenges posed by climate change, increased public efforts are needed to ensure successful implementation at the local level. Carbon taxes and climate bonuses can be seen as two sides of the same coin. Although the CO2 tax provides incentives for lower consumption via price, these incentives alone are not enough. Climate bonuses can be an effective local complement.

8. CONCLUSION

On a local or regional level, a program of climate bonuses can be a highly adaptable and efficient use of funds. Adaptation to other regions is relatively easy to accomplish. Whether local funding programs and incentives can be scaled to the national level is more complex. The better approach is to decentralize funding so that programs can be used more effectively with local institutions. Carbon bonuses have emerged as effective tools in reducing CO2 emissions. If citizens can have a say in the design of the measures from the outset, they will be much more willing to participate in the program [28]. These aspects of community building can be crucial in achieving the goal of reducing greenhouse gas emissions.

ACKNOWLEDGEMENT

This draft presents and discusses results of the research project "Democratization of Money and Credit". The project is part of the Bavarian Research Association on the Future of Democracy (For Democracy), funded by the Bavarian Ministry of Science and Arts. The paper represents the thoughts and opinions of the author alone.

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