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Can a CO_2 Tax Be Socially Just? Analysis of the Social Distribution Effects of the German CO_2 Taxation

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Abstract: Rising energy costs have led to increased discussion about the social impact of the energy transition in Germany in recent years. In 2021, a gradually increasing CO_2 tax was introduced. This paper analyzes the question of whether a CO_2 tax can be socially just. Using data analysis and desk research, correlations between income and energy consumption in Germany are shown. In a short analysis, it is investigated which additional burdens different types of private households have to expect in the coming years due to the introduction of CO_2 pricing on energy. In particular, the introduction of a per capita flat rate fed by CO_2 tax revenues could be a suitable way to reduce the burden on low-income households.

Keywords: energy policy; energy transition; carbon pricing; carbon taxation; social sustainability; distributional effects; climate dividend; climate bonus

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1. Introduction

Against the background of an accelerating climate crisis, there is a growing urgency to reduce climate-damaging emissions such as carbon dioxide. The idea of putting a price on CO_2 appears attractive, as it provides a financial incentive to reduce emissions and at the same time generates state revenue that can in turn be used for climate protection measures or for social compensation. The latter can avert a situation where the poorer population cannot satisfy their basic needs due to rising energy prices as a result of CO_2 pricing. Safeguarding livelihoods is an essential goal, because if not achieved, acceptance of climate protection measures and a transformation of the energy supply risks suffering. Energy poverty is an important social issue in many member states in the European Union and has led to a broad discussion regarding indicators to measure the scope of the problem correctly [1]. Even in a rich country such as Germany, energy poverty is significant, as evidenced, for example, by a large number of meter disconnections, which mainly occur in socially disadvantaged neighborhoods as a consequence of numerous problems rooted in the low income of families [2,3].

The debate in Germany regarding the distributional effects of the political actions of the energy transition (the so-called German Energiewende) on households is as old as the introduction of the Renewable Energies Act in 2000, which financed the expansion of renewables by a levy on the electricity prices of end consumers [4]. In other countries, there is much more experience in this respect and a tradition of linking distributional issues with energy taxation issues. Sweden is a good example of this. There, the restructuring of the energy system is financed from the revenues of a CO_2 tax introduced in 1991 and energy taxes on diesel, gasoline and heating fuels that have been levied since the 1930s and 1950s. The CO_2 tax was designed neither tied to a specific purpose nor as revenue neutral and was introduced at the same time as tax cuts in other areas, e.g., on labor, which ensured a broad acceptance of the measure. In Switzerland, a CO_2 tax has been in place since 2008, with one-third of the revenue (albeit limited to the equivalent of a good USD 510 million) dedicated to a program subsidizing energy-efficient building renovation. An additional state technology fund promotes technical innovations contributing to climate protection [5].

After lengthy discussions in the past, the German levy on the electricity prices of end consumers was effectively abolished from July 2022 as part of the German Government's so-called "Easter Package" [6]. The expansion of renewables is now financed entirely from tax revenues, relieving private households. However, it is to be expected that the latter, in turn, will be burdened not only in terms of electricity consumption but also in terms of their other energy costs as part of the energy transition measures or decarbonization, for example, in terms of heating and mobility under the Fuel Emissions Trading Act [7]. In the meantime, the Russian invasion of Ukraine has led to a significant increase in energy prices separate from any changes in climate policy [8]. However, [9] suggests that the high prices only affect the amount of carbon emissions in energy importing countries but do not translate to a global reduction in carbon emissions as these are merely relocated. A global carbon emission tax would, however, reduce the trade network down to 50% of its size, with an analogous effect on emissions.

Although the distributional effects of rising energy prices can already be observed in the current situation, there is a broad consensus on CO_2 pricing being sensible and highly necessary; at the same time, there is concern about a further aggravation of the existing distributional effects. The question of how the energy transition and decarbonization will affect distribution policy has therefore become much more complex, and socially just ways to implement carbon pricing have to be found. Can a CO_2 tax *be* socially just? In a first approach, this study tries to analyze the social distribution effects of the German CO_2 taxation, as well as already implemented and planned or recommended compensation mechanisms in order to answer this central question. It can thus represent a first step into deeper analyses, which is also necessary in view of the increasing importance of social aspects for transformation processes. Using analysis of the literature and statistical data, we will investigate income and primary energy usage, as well as their possible correlation. We will then illustrate the share of energy-related expenditures on respective incomes, taking a closer look at the costs of electricity, heating and mobility. Using different types of households as examples, we will then show and compare the effects of the current CO_2 taxation, including the relief provided by different amounts of possible per capita refunds.

2. Materials and Methods

As mentioned above, this paper analyzes the distributional effects of CO_2 taxation in Germany and aims to answer whether a CO_2 tax can be socially just. For that, we examine the distributional effects of the CO_2 tax burden on the one hand and the distributional effects of possible relief instruments on the other. In order to investigate the correlations, we use (1) data analysis and (2) desk research.

Data analysis is a helpful and proven method to gain valuable and coherent information. It helps to develop a deeper understanding of the big picture and the interrelationships of different measures. As a first step, we examine the price development of electricity and diesel fuel in contrast to the increase in average net wages, unemployment benefits and pensions. As a second step, based on income and consumption sampling, we investigate the use of domestic electricity, heating and different means of transport for each of ten equally sized groups of household incomes (deciles) in terms of net equivalent income per capita in order to identify a possible correlation. At the examples of electricity and heating, we put the average expenditures in perspective with the average income of each decile to demonstrate the respective share of these energy-related costs. To investigate the social distribution effects of a CO_2 pricing using the example of the motorized individual transport, we then calculate the additional economic burden of a fixed price on CO_2 emissions for each decile based on the respective prime energy usage data for diesel and gasoline vehicles.

Next to data analysis, we conduct literature research to assess possible reimbursement mechanisms and their effects on different social groups. In a final step, different household types are used as representatives of the respective deciles in order to qualitatively illustrate the economic effects of the various relief measures in the context of a CO_2 tax. For this purpose, existing current studies are used as a basis.

3. Results

3.1. Income and Energy Consumption: How Are They Related?

3.1.1. Development of Energy Prices and Incomes

In 2021, a total of nearly 235,000 electricity disconnections and nearly 27,000 gas disconnections occurred in Germany, generally as a result of payment arrears [10]. It is quite obvious that there are low-income households in Germany that do not manage to pay their energy bills on time and (have to) accept considerable consequences for this. One can quickly draw the conclusion that the energy transition, which is motivated by climate protection, leads to rising prices and ignores social aspects. The idea of decentralized energy in Germany is by no means a new one. The historically developed central system was criticized at the start of the scientific discussion of the German anti-nuclear movement in the 1980s. Ref. [11], in particular, criticized the generation of fossil-fuel- and nuclear-based power by established energy companies and defined the term "energy transition" or "German Energiewende" as being one that is very closely related to decentralization and decarbonization. The rather negative impression was created by the financing of the expansion of climate-friendly power generation through the levy of the Renewable Energies Act, which resulted in rising electricity prices for households [4]. The connection becomes clear when looking at the development of electricity prices and the development of various types of income in comparison (see Figure 1). Since 2000, household customers have had to pay the Renewable Energies Act levy. It rose very slowly from 0.19 cents in 2000 to 1.16 cents per kilowatt hour of electricity in 2008 and 1.32 cents in 2009. After that, however, it increased significantly: between 2010 and 2014 it more than tripled. Since then, it has remained relatively constant at a high level.

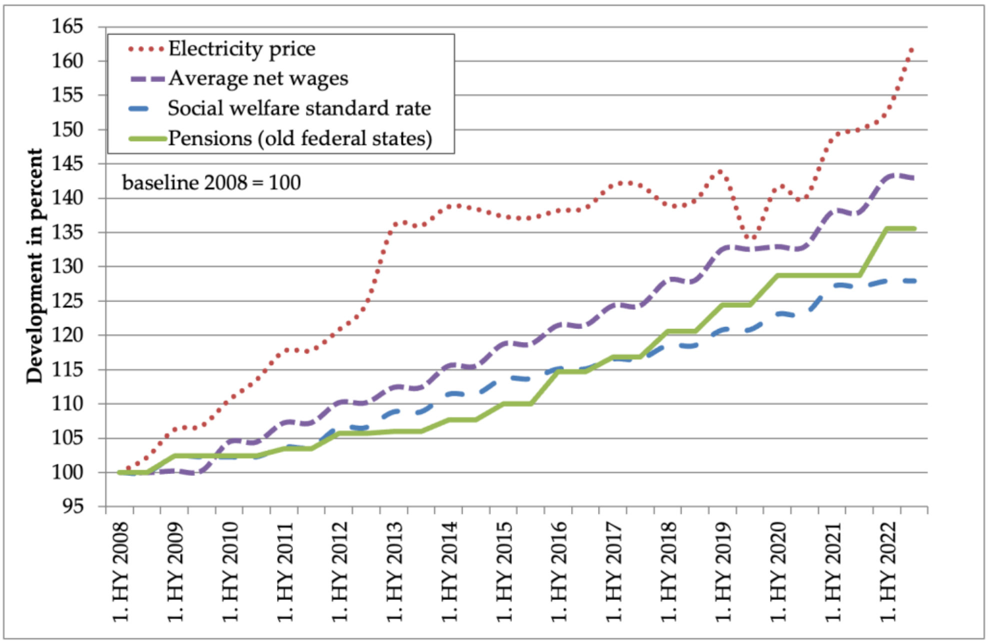

Figure 1. Development of electricity prices compared with various incomes since 2008 [12–16].

It is easy to see from Figure 1 that average net wages, pension benefits and the social welfare standard rate have developed differently and that the latter in particular has not been able to keep pace with the development of electricity prices. It was not until after 2014 that this development was halted and the gap between the development of social welfare rates and electricity prices closed substantially. With regard to the development, a connection with the level of the Renewable Energies Act levy for household electricity customers is unmistakable. Whereas this was still EUR 0.0115 in 2008 and thus accounted for around 5.4 percent of the total electricity price, it had risen very sharply to EUR 0.0624 by 2014 and has remained at around the same level since then, accounting for around 20 percent of the total electricity price (2020 = 20.5 percent). Although all households are affected by an asymmetric development in income and electricity prices, disproportionately rising gasoline and diesel prices are primarily a burden for people who travel long distances in their own cars, for example to reach their workplace. Diesel fuels are particularly widespread among commuters who cover long distances. From 2014 to 2021, diesel was actually significantly cheaper than in 2008. However, after the Russian invasion of Ukraine, prices really skyrocketed, as can be seen in Figure 2.

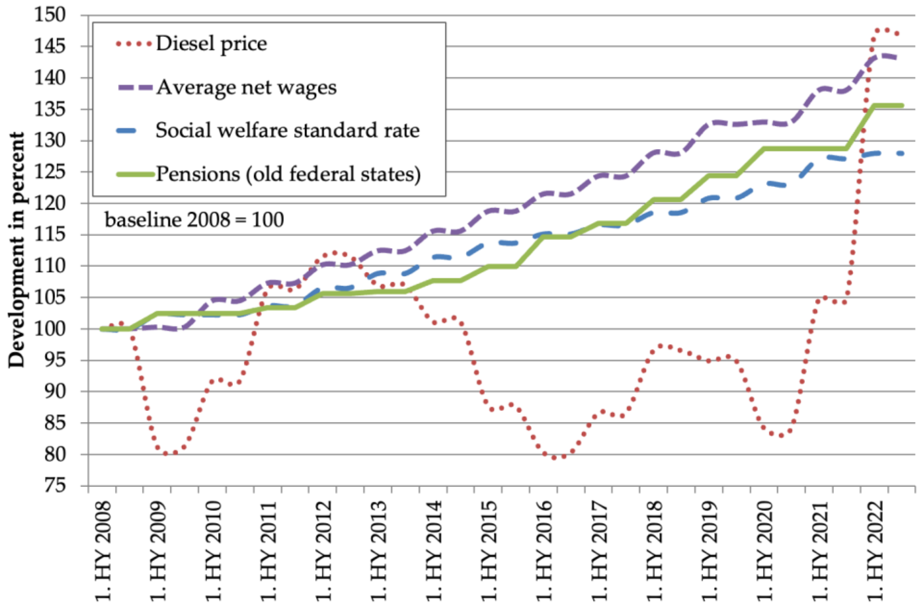

Figure 2. Development of diesel price compared with various incomes since 2008 [12–15].

Furthermore, it has been proven that an above-average household income is generally also associated with above-average energy consumption. Larger apartments with luxurious furnishings mean that households with high incomes also consume more energy on average. Put simply, an above-average income also leads to a more energy-intensive lifestyle [17] (esp. pp. 63f. and 91f.). To illustrate this, we can refer to analyses by the German Federal Statistical Office [18].

3.1.2. Division of Net Equivalent Incomes into Deciles

In the statistical analyses we use, net equivalent incomes are divided into deciles, i.e., into ten equally sized groups. Whereas net income is all income less taxes and compulsory social security contributions, net equivalent income also takes into account the number of people living in a household. It is the amount of money available per capita and month. The 10% of individuals with the lowest net equivalent incomes are grouped into the 1st decile, the next 10% form the 2nd decile and so forth. Accordingly, the ten deciles shown in Table 1 are as follows.

Table 1. Average net equivalent income in EUR per person and year in 2018 [19].

Decile	Net Equivalent Income (Average; EUR)
I	9458
II	13,444
III	16,520
IV	19,319
V	21,991
VI	24,772
VII	28,030
VIII	32,104
IX	38,351
X	58,509

To understand the significance of the correlations presented in our study, it is important to look at the share of employees in the low-wage sector, which affects almost 20% of all full-time jobs with clear structural backgrounds [20,21]. Occupations with below-average earnings include hairdressers, cooks, bakers, motor vehicle mechatronics technicians, geriatric nurses, office workers and firefighters. Depending on their family status, they almost automatically find themselves in the bottom two deciles and, even with full-time employment, achieve only a low income that is synonymous with a (very) low economic status. The at-risk-of-poverty threshold in Germany was at approximately EUR 14,300 in 2022 [22]. According to [23], the limit of EUR 16,300 represents a critical threshold below which special expenses, such as those due to rapidly increased energy costs, can easily pose a risk of poverty. In order to earn a net equivalent income of EUR 16,300 per person per year, for a family with two children, two adults together need to work 60 h per week (75%) if they are paid a low wage, as illustrated in Figure 3. Child benefits of EUR 250 per child per month (as currently paid in Germany) are taken into account here but not additional state transfer payments.

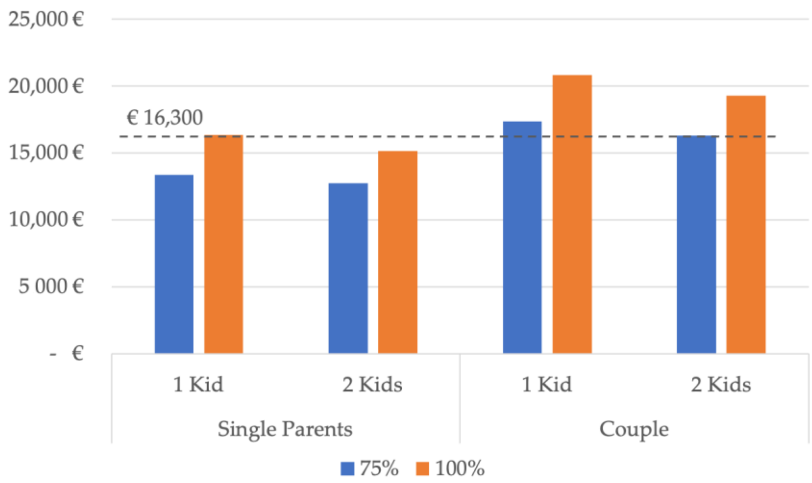

Figure 3. Net equivalent income per person and year by family status and employment type. Own calculation.

Depending on the age of the children and against the background of a deteriorating childcare crisis in Germany, the implementation poses major challenges for parents. Single parents with one child can only achieve the aforementioned net equivalent income on a low wage with a full-time job, whereas with a second child, a single parent on a low wage can basically no longer reach the threshold. This rough calculation provides a first explanation to why single parents in Germany in 2021 still had an at-risk-of-poverty rate of 42.3%, even after social benefits, compared with 11.3% for couples with two children and 16.9% for the population average [24].

3.1.3. Energy Consumption and Share of Energy Cost by Income

An analysis of the income-specific energy consumption of private households confirms the fact presented above (see Figure 4), that energy consumption also increases as income rises.

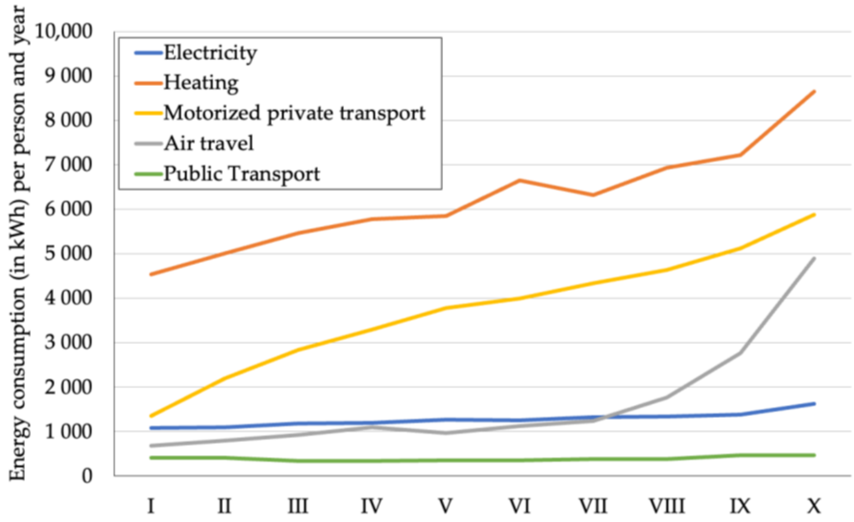

Figure 4. Area-specific energy consumption per person for different income classes. Own presentation, based on [18].

However, these facts only tell half the story. In absolute terms, low-income households are less affected by rising energy prices than the highest earners. Relative to their income, however, rising energy prices have a greater impact on them [25]. This is because low-income households have to spend proportionately more on energy costs than rich households; for electricity consumption the difference is more than a factor of 4 and for heating consumption it is more than a factor of 3 (see Figure 5).

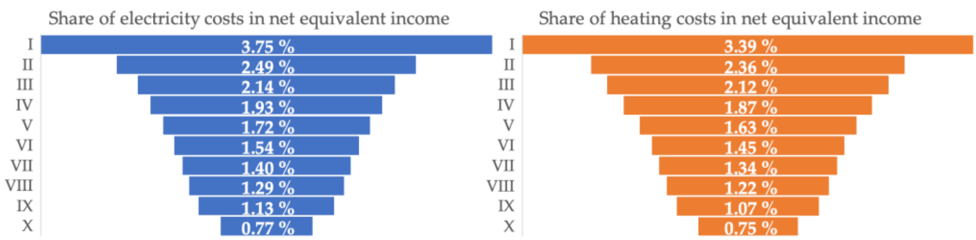

Figure 5. Relative energy price burden for electricity (**left**) and heat (**right**) for different income classes. Own calculation, based on [19,26].

In addition, very wealthy households find it much easier to respond to rising prices without this having a significant impact on their lifestyle. This is because, when it comes to sacrificing comfort, it is naturally easier to occasionally do without a sauna or sell the third car than to reduce the temperature in the living area. In addition, high-income households have more opportunities to save energy costs by purchasing more economical appliances or better thermal insulation than poor households, which have very little influence on the energy standard of their rented housing. While the respective shares of energy costs in household income have changed rather moderately compared with 2013 cf. [27], there have been relatively large savings in electricity and heating consumption. The upper deciles obviously have significantly greater flexibility to adjust to disproportionately higher prices, especially for heating energy, as illustrated by Figure 6.

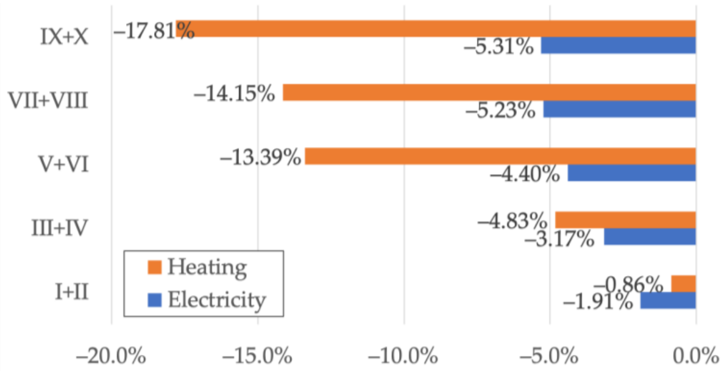

Figure 6. Change in consumption per person and year by income class, compared from 2018 to 2013. Own presentation, based on [18,26].

The comparison of energy consumption by decile in 2018 with that in 2013, or summarized here as quintiles based on the data from [18,26], shows that it has generally decreased, with highly varying degrees depending on income. Here, the lower two deciles were able to realize small savings of less than 1% for heating and just under 2% for electricity. Particularly in the case of heating, savings increase sharply with income compared with 2013; the top two deciles reduced their heating demand by almost 18%, over twenty times more than the bottom two deciles. A similar (though less pronounced) trend is observed for electricity. Here, the savings of the top two deciles are almost three times as high, at over 5%.

3.2. CO_2 Pricing on Fossil Fuels

3.2.1. Status in Germany (May 2023) and the Impact on Various Income Groups

In recent years, the introduction of a national CO_2 tax has been highly debated and numerous, often very different, proposals have been put forward [28–31]. In January 2021, a CO_2 price on gasoline, diesel, heating oil and gas was introduced throughout Germany. The price for a ton of CO_2 was initially EUR 25—and thus far lower than most scientists were calling for—but was set to rise gradually to up to EUR 55 per ton in 2025 [7]. As a price increase, based on the emission factors, this currently results in the following add-ons (at a present CO_2 price of EUR 30 per ton) [32]:

- Gasoline: 0.071 EUR/L;
- Diesel: 0.079 EUR/L;
- Heating oil: 0.079 EUR/L;
- Gas: 0.006 EUR/kWh.

Building on the observations of the last section, the question then arises as to how strongly different income classes will be affected by these price increases and how social hardships can be alleviated.

3.2.2. Instruments for the Relief of Particularly Affected Citizens

The introduction of CO_2 pricing is not aimed at increasing government revenues but at contributing to the achievement of the set climate protection targets in the most economical way possible. Therefore, the revenues are to be used in a revenue-neutral manner to further support the activities of the climate protection program and as relief for particularly affected citizens. The introduction of a CO_2 price hits low-income households in particular, as they proportionally spend a larger share of their income on energy consumption.

In 2021, some first measures were implemented in order to compensate the additional burden of the CO_2 tax and to provide incentives for more climate friendly ways of heating and mobility. In addition to low-income households, (long-distance) commuters and tenants are also to be relieved. These measures included, among other things:

- An increase in the housing allowance of 10%;

- An increase in the commuting allowance for commuters from the 21st kilometer from 30 to 38 cents/km. A mobility bonus was also introduced so that low-income earners could equally benefit from the increased commuting allowance. Both are limited to the years 2021–2026;
- A reduction in VAT on long-distance rail tickets from 19% to 7%. In return, the air traffic tax for intra-European flights was raised.

The increase in the distance allowance must be viewed rather critically, as it serves to offset the cost of kilometers driven and therefore at least partially offsets the CO_2 price on fuels. The incentive to reduce fuel use is thus undermined without stimulating the already low elasticity in transport mode choice/mobility [33]. The inelastic demand here means that a change in the price of gasoline and diesel results in only a small direct change in demand. This is because purchasing decisions and the choice of residence are long-term and therefore require a clear signal as well as a bundle of different instruments, as has been achieved for tobacco, for example, increasing tax, advertising bans, warning notices, increase in smoking bans, etc.

A whole bundle of actions is also required for the mobility transformation; all of which (as in the case of tobacco) should work in the same direction. The distance allowance highlights a whole series of inequities that must also be taken into account. This is because the urban–rural divide in purchasing power poverty is very much related to population structure, according to which urban areas are much more likely to be home to population groups at risk of poverty (such as those from jobless households and single parents) than rural or semi-urban areas [34]. The distance allowance provides an incentive for people with particularly high incomes to move their residence from the city to the countryside and to commute, which also deprives the municipalities of the municipal share of income taxes, which nevertheless have to finance large parts of the social and cultural infrastructure. The mobility premium introduced is intended to "replace the tax savings to which low-income earners are actually entitled as a result of the increased commuting allowance" [35]. However, the calculation of the mobility premium is quite complex and has to be applied for by filing a tax return.

How a relief for tenants can be realized is controversial. Since tenants have an influence on their own heating behavior but usually not on the heating system used or the degree of refurbishment in the apartment building, a new law became effective in January 2023 that regulates the sharing of costs for heating-related carbon dioxide emissions between tenants and landlords depending on the building's efficiency in a ten-stage model [36]. This means that tenants are not solely burdened and that landlords are given an incentive to upgrade the energy efficiency of their properties. To accelerate building renovation further, it is also conceivable that, following the UK model, a refurbishment obligation could be introduced for unrefurbished buildings, after which a ban on letting unrefurbished buildings (worse than efficiency class D) would provide a strong incentive [37]. In Germany, this would also relieve the burden on municipal budgets, as the municipalities bear the costs of housing for the recipients of assistance.

Before concrete mechanisms for a more direct return of revenues from the CO_2 tax to citizens could be agreed upon and implemented, the Russian invasion of Ukraine began, and with it, a massive increase in energy prices. In order to minimize the impact on the population and companies, the German government adopted a total of three relief packages. Among other things, the following measures were introduced to ease the burden of energy costs on low-income households [38–40]:

- Abolition of the Renewable Energies Act levy, effectively from July 2022;
- Target group-specific one-time payments;
- Reduction of the energy tax on fuels and the introduction of a monthly EUR 9 ticket for public transport from 1 June 2022 to 31 August 2022. Since May 2023 this has been replaced by a monthly EUR 49 ticket;
- Doubling the housing allowance from 2023 and adjustment of the assessment threshold so that more households become eligible;

- Takeover of the December 2022 instalment payment for private households and small- to medium-sized enterprises in buildings with gas heating;
- Introduction of a price brake on electricity, gas and district heating for 80% of the respective demand, from March 2023, retroactively from January 2023.

The energy prices for households are currently (summer 2023) falling again, and many of the German government's measures will expire in the foreseeable future [41,42]. It is therefore time to again take a closer look at the CO_2 tax and to discuss appropriate compensation mechanisms. The possibilities for returning the revenues of a CO_2 tax include, above all, the per capita flat rate (also climate dividend, climate bonus, energy transition bonus, etc.) [28,30,31,43]. This is paid out (in the same amount) as a lump sum to all citizens. Due to the fact that poorer households generate lower CO_2 emissions in absolute terms, such a reimbursement would cause a financial redistribution from richer to poorer households. If the per capita flat rate is also paid to children, families would also be relieved. Such a refund would be extremely well targeted, as it would also reach people who currently fall through the cracks of social transfers because, for example, they are just above an assessment threshold. The per capita flat rate would also increase the acceptance of CO_2 pricing among the entire population, since everyone would receive cash. There is, of course, one prerequisite for the success of the per capita flat rate: it would have to be paid in addition to existing transfer payments and not be allowed to be offset against them, as is usually the case in the current social system.

According to a report by the Macroeconomic Policy Institute [44], if the entire revenue—taking into account possible price pass-through by companies—is refunded in the form of a per capita climate premium, there will be no additional burden on average. Low-income households, families with children and households without a car are counted among the winners in this scenario. One-person households with high incomes and households that drive a lot, on the other hand, will be burdened more. Correspondingly, there is no general increase in the burden on the rural population compared with the urban population. The economic efficiency of redistribution can be further improved if part of the revenue is used in parallel to promote climate protection actions, especially energy efficiency and innovation [45].

3.2.3. Effect of Carbon Pricing on Different Households

In order to represent German society as accurately as possible, sample households are used for many calculations and to describe the effects for different groups. The most relevant factors here are income (high, low, pensioner, student) and household size (single, number of children, single parent). In the following, we exemplarily briefly discuss three different types of households specified in Table 2 and show the effects of the current CO_2 tax of 30 EUR/tCO_2 plus a per capita climate premium.

Table 2. Basic information on the sample households [46].

	DINKS	Family with Three Kids	Single Parent with One or Two Kids
Living space (sqm)	122	163	76
Energy consumption			
Electricity (kWh/year)	3648	5222	3336
Heating fuels (kWh/year)	10,233	17,975	8462
Fuels (L/year)	1722	2296	469
Travel to work (km/year)	12,118	17,582	2700

- The first sample household is often used in microsimulation studies. It is called DINKS—double income, no kids. This household type is among the richer households with two incomes, no children, home ownership and two cars;

- The second sample household is a family with three kids; they live in the country, have one main earner with a commuting route above 15 km, own a house and have two cars;
- The third sample household is a single parent with one/two kids.

In addition to this information, Table 3 shows income and energy expenses for the three sample households, in EUR per year and in percent of net household income.

Table 3. Income and energy expenses of the sample households [46].

	DINKS		Family with Three Kids		Single Parent with One or Two Kids	
To be classified into decile		9		5–6		2
	EUR/year	Share of NHI	EUR/year	Share of NHI	EUR/year	Share of NHI
Gross household income (GHI)	101,961	151.3%	94,355	139.9%	30,075	116.50%
Net household income (NHI)	67,373	100%	67,451	100%	25,823	100%
Energy expenses						
Electricity	976	1.4%	1377	2.0%	898	3.5%
Heating	780	1.2%	1374	2.0%	648	2.5%
Fuels	2294	3.4%	2858	4.2%	636	2.5%

Table 4 shows the effects of the burden of the Fuel Emissions Trading Act in 2022 and potential relief effects, calculated by a recent study on behalf of the German Federal Environmental Agency as basis for the first progress report of the German Federal Government [46].

Table 4. Burden of the Fuel Emissions Trading Act (FETA) 2022 for sample households, plus potential relief by a per capita flat rate [46].

	DINKS		Family with Three Kids		Single Parent with One or Two Kids	
Net household income (NHI)	67,373	100%	67,451	100%	25,823	100%
FETA burden 2023 (EUR 30/tCO_2)	EUR/year	Share of NHI	EUR/year	Share of NHI	EUR/year	Share of NHI
Fuels	157	0.2%	208	0.3%	40	0.2%
Heating fuels	82	0.1%	152	0.2%	73	0.3%
Potential relief by a per capita flat rate of EUR 100	−200	−0.3%	−500	−0.7%	−250	−1.0%
Net effect	+39	0.1%	−140	−0.2%	−137	−0.5%
Potential relief by a per capita flat rate of EUR 70	−140	−0.2%	−350	−0.5%	−175	−0.7%
Net effect	+99	0.1%	−10	0.0%	−62	−0.2%

In 2022, the CO_2 tax on fuels and heating fuels was quite moderate, with EUR 30 per ton CO_2. Accordingly, Table 4 shows that the burden for the sample households lies between 0.1% and 0.3% of their net household income. However, the burden for the families is higher than for the DINKS household. As the CO_2 tax will rise constantly, the burden for households will rise as well. At least in 2022 and probably also in 2023, a relief in the form of a per capita flat rate was not paid to the households. A climate premium is envisaged in the coalition agreement of the current federal government as a social compensation mechanism for private households. The administrative and technical implementation of such a direct payment from the state to households is currently being prepared [47].

The scenario of a per capita flat rate of EUR 100 implies that the total income of the CO_2 tax will be paid back to the population. The net effect shows that high-income households will be moderately burdened, whereas mid- and low-income households will have a positive net effect. If not distributing the total income of the CO_2 tax, the net effects for the households are lower. For DINKS, the change is minimal; for the family with three kids, the net effect is zero; for the single parent, the net effect is still mildly positive (0.2%) but close to zero. To keep this distribution with negative/zero net effects for high-income households and with positive/zero net effects, it would be necessary to adjust the per capita flat rate each year and to distribute higher reliefs when the CO_2 tax rises. The results shown are based on simulation calculations as of 2022. Since energy prices have risen very sharply since the start of the Ukraine war, energy consumption is also likely to have declined. Therefore, the impact on the burden is overestimated [46].

4. Discussion

Before we dive into the discussion on different existing or envisaged measures of taxation and reimbursement, it shall be noted that we implicitly assume carbon taxation to have an effect in terms of decreasing emissions, as several publications conclude [9,48–50]. Following the objections to carbon taxation regarding the question of "fairness" in [51], any further discussion about a socially just distribution of a burden posed on a society would be obsolete if there was no benefit seen outweighing the cost. Obviously, there are findings in other publications, such as [52,53], challenging our assumption, but the discussion of the effectiveness of carbon taxation is not supposed to be the object of this paper. For the purpose of this work, we decided to assess a set of policy measures as socially just, as long as they altogether do not aggravate the existing situation by increasing the net share on energy-related expenditures relative to household income for the lower economic strata. By this choice, we intend to avoid double standards in the assessment of climate policy with regard to other political areas. Although the social dimension of sustainability must absolutely be taken into account in all climate policies, new measures introduced to the same system can hardly solve all existing (social) problems at once.

With regard to mobility, the pro-car-driving lobby in Germany currently seems to have great influence, as the steering effect of higher fuel prices is reduced or even completely compensated for by a higher distance allowance. However, even here, cuts in the form of much higher costs for gasoline- and diesel-based transport are necessary to achieve the climate targets that have been set. A strategy of relying entirely on the switch to e-mobility will not work, since the greenest possible electricity has to come from somewhere. Instead, we see bigger potential in laying the main focus on more attractive, more available and more balanced pricing of local and long-distance public transport as an alternative to cars that everyone can afford [54].

Another proposal to achieve the revenue neutrality of the CO_2 tax is to reduce direct taxes or social insurance contributions, similar to the Ecological Tax Reform. This way, resources would be taxed instead of labor, which is also discussed as an option in the sufficiency debate. However, the main problem with regard to social compatibility would be that some population groups are either not subject to income tax or do not pay social insurance contributions. Thus, these population groups would then not be excluded from the CO_2 levy but would be excluded from the rebate [55].

Regardless of how a CO_2 price is designed in detail, it entails higher costs and thus a financial burden for all citizens. This is even necessary to achieve the desired steering effect [33]. Nevertheless, it is of course essential to create broad acceptance among the population for the pricing of greenhouse gas emissions, which can be achieved through equitable burden sharing. Furthermore, fair burden sharing with targeted relief for low-income households is a must in order to achieve social justice in a CO_2 tax.

It should be noted that the present study is a meta-study that compiles various existing approaches in order to create an overview on different forms of the social design of CO_2 pricing in Germany and to contrast them against each other. Therefore, micro-analyses were not conducted. The trends identified do not represent generally valid statements for individual cases, especially not for cases of hardship due to multiple burdens. They do, however, provide starting points for more in-depth analyses. Accordingly, the conclusions drawn in the following are to be understood as initial pointers that need to be examined in greater detail. We aim to use our exploratory research approach to provide an entry point into more in-depth analyses. These are necessary to gain a comprehensive understanding of the effects analyzed here.

5. Conclusions

In order to effectively drive climate protection forward and achieve the climate targets set, an overall package of instruments is needed that are effectively coordinated and designed to be socially just. In principle, poorer households are more affected by rising energy prices than richer households because, although they consume less energy overall, they have to pay significantly more as a percentage of household income. Therefore, when designing the instruments, social justice must be a priority in addition to achieving the climate targets. Since the burdens of a rising CO_2 price primarily hit richer people with above-average energy consumption, the payment of a per capita flat rate is expected to lead to greater relief for poorer households. From this first observation, we derive the conclusion that the payment of a per capita flat rate is an adequate way to consider social justice in climate protection.

However, it should be noted that there are good reasons for addressing social problems with the political instruments of the welfare state and for countering the climate crisis with environmental and energy policy measures. It is simply not possible, nor does it make sense, to try to solve social problems through climate policy measures alone. Low incomes, which lead to precarious living conditions, make it necessary to find other redistribution mechanisms to provide social support for climate policy requirements. Yet, warnings that climate policy will lead to social division must be countered by the fact that no climate policy will lead to much greater social division. A good climate policy is therefore essentially characterized by a balanced mix of instruments and measures.

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