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The Expenditure-Based Energy Pricing as an Example of Sustainable Carbon Tax in Turkey

Türkiye'de Sürdürülebilir Karbon Vergisi Örneği Olarak Harcama Bazlı Enerji Fiyatlandırması

Yunus Önal^{a,*}

^a Investigator in Enforcement Department at Capital Markets Board of Türkiye, 06530, Ankara / Türkiye
ORCID: 0009-0005-8482-799X

ANAHTAR KELİMELELER

Karbon Vergisi
Emisyon Ticaret Sistemi
Gökyüzü Güven Programı
Enerji Adaleti

ÖZ

Türkiye gelişmekte olan bir ülkedir ve dünyanın önde gelen ekonomilerinden birine sahiptir. Karbon emisyonlarının ortadan kaldırılması açısından Emisyon Ticaret Sistemi için hazırlıklar yapılmaktadır. Bu çalışmada, karbon emisyonlarını azaltma yöntemlerinden biri olan karbon vergisi hane harcamalarına bağlı olarak uygulanmaktadır. Yöntemin prensibi, karbon vergisinden elde edilen gelirin hane harcamalarına orantılı ve eşit olarak dağıtılmasıdır. En düşük gelir grubundaki hanelerin karbon vergisi gelirleri %7,79 iken, en yüksek gelir grubundaki haneler %2,4 daha fazla ödeme yapmaktadır. Sonuç olarak yakıt ve elektrik enerjisi bazında gelir eşitliği sağlanmaktadır.

KEY WORDS

Carbon Tax
Emission Trading System
Sky-Trust Program
Energy Justice

ABSTRACT

Turkey is a developing country and has one of the world's leading economies. Preparations are currently being made for the Emissions Trading System in terms of elimination of carbon emissions. In this study, carbon tax, one of the methods of reducing carbon emissions, is applied to households depending on expenditure. The principle of the method is as follow the income obtained from carbon tax is distributed equally to households in proportion to their expenses. While the carbon tax revenues of households in the lowest income group are 7.79%, households in the highest income group pay 2.4% more. Therefore, income equality is achieved on the basis of fuel and electricity energy.

1. Introduction

Turkey's contribution to global carbon emissions is less than 1%, but due to its geographical location, it is among the countries most affected by climate change. Turkey became a party to the United Nations Framework Convention on Climate Change in 2004 and to the Kyoto Protocol in 2009. The Paris Agreement, which was prepared to accelerate efforts to combat climate change and set more ambitious targets, was accepted by 196 Parties at the UN Climate Change Conference of the Parties (COP21) held in Paris,

2015. The agreement entered into force on in 2016. The Paris Agreement, whose general goal is to keep the global average temperature increase below 2°C compared to the pre-industrial period and, if possible, to 1.5 degrees, is a legally binding international agreement on climate change. Turkey is pursuing a green growth policy and contributing to global efforts to combat climate change (T.C Çevre, Şehircilik ve İklim Değişikliği Bakanlığı, 2025). Believing that the Paris Agreement offers a unique opportunity to implement a green and just transition, Turkey supports the implementation of the mitigation and adaptation policies

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* Sorumlu yazar/Corresponding author.
e-posta: yunus.onal@spk.gov.tr

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included in this Agreement. In addition, as a candidate country for the European Union (EU), Turkey closely monitors EU policies and develops legislation on climate change and the environment in order to comply with the relevant acquis. There is Turkey's 12th National Development Plan prepared for the 2024-2028 period and long-term economic development plans and climate reform studies for 2053 (T.C Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2025).

The Government of the Republic of Turkey is presenting its updated First Nationally Determined Contribution (NDC) in the context of the Glasgow Climate Consensus, which was adopted by the Parties at the 26th Conference of the Parties as a supplement to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. With this statement, Turkey confirms that it will reduce its greenhouse gas emissions by 41% (695 Mt CO₂ equivalent in 2030) by 2030, compared to the reference scenario specified in the First Nationally Determined Contribution (and the Intended Nationally Determined Contribution), where 2012 is accepted as the base year. Turkey's updated First Nationally Determined Contribution covers the entire economy and includes comprehensive mitigation and adaptation actions as well as assessments of means of implementation. Turkey intends to reach its peak emissions by 2038 at the latest. The new reduction target represents a significantly more ambitious approach based on science and equity, and is one of the steps forward towards achieving net zero by 2053 (UNFCCC, 2023).

As in all developing countries, Turkey's carbon emissions have been increasing over the years. The most important factors in this are the increase in industrialization and the increase in the welfare of people. As shown in Fig. 1 carbon emissions have increased approximately 2.5 times from 1990 to 2022 (TÜİK Gas Emission, 1990-2022).

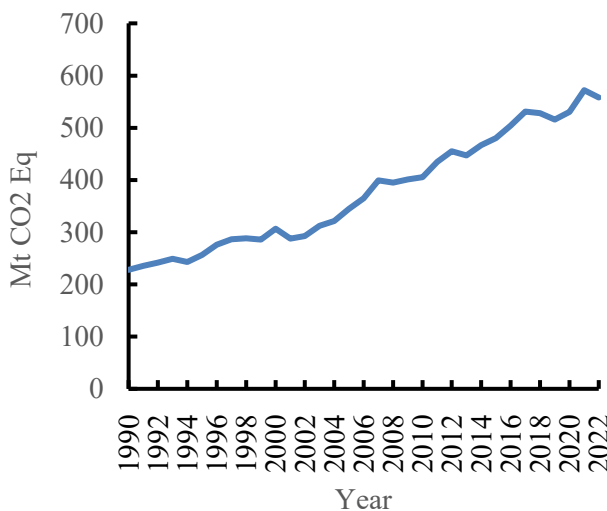


Figure 1. The total amount of greenhouse gases emitted by Turkey between 1990-2022

The way to reduce carbon emissions is to set up a carbon fee system by increasing the price of fossil fuels. The first carbon price was implemented in Finland in 1990 and later spread to many European countries (Beck et al. 2015). Studies show that carbon taxes can be an effective policy option and that their major negative impacts can be offset through the design of the tax and the use of the resulting fiscal revenues. Although governments at the national level have several policy tools to choose from, locally implemented carbon taxes are also important for decarbonization. There will be winners and losers in these local regulations. Since carbon taxes are based on the carbon energy balance, they are harder to apply to a system than other environmental taxes. The distribution of carbon tax is very important for both welfare impact and policy payoff for a country. There are two problems at here one of them how high taxes will affect the public and other is how the revenue collected will be used.

The reason for the innovation in this study is that environmental taxes tend to be regressive, meaning that poor people pay a disproportionate share of their income in these taxes compared to rich people, which is a disadvantage. The methodologies used in these studies vary from simple calculations to general equilibrium models based on the shares of energy products in household expenditures (Baranzini et al. 2000).

The distributional impact of a carbon fee depends not only on its impacts on households but also on the use of the revenue generated. The carbon money collected can be used to reduce public spending or other taxes. Here, the income is distributed back to households. This is also called “energy right” or “sky trust”.

The right to energy was first made known with the establishment of the United Nations in 1950 (Shyu C.W., 2021).

This right was established to ensure and support to have access to energy at affordable prices in particular citizens in EU countries. Although the right to energy is widely discussed in politics, theoretical and academic studies are few (Hesselman et al. 2019).

In this study, the transition to renewable energy will be encouraged by taking the right to energy as a basis and ensuring that everyone has access to energy. The carbon tax collected here is distributed to low-income households, thus preventing from using high-carbon fossil fuels of these households.

The first similar study was Pollin and Chakraborty's study on India in 2015. Here, emissions were significantly reduced while low-carbon energy investment increased by 1.5% of GDP. The paper finds that by undertaking clean energy investments, India will achieve significant CO₂ emission reductions and make significant gains in employment opportunities. (Pollin, R., Chakraborty, S. 2015)

In Azad et al.'s 2020 study on energy policy in India, there

is a free fuel and electricity allowance of 2268 kWh per household per year and a travel pass of \$17.9 per person per year for public transport (Azad, R., Chakraborty, S., 2020).

In a study conducted by Dinan and his colleagues in the United States in 2002, there were two ways to evaluate the carbon revenues collected. The first of these was to distribute the collected revenue to facilities that consume high amounts of fossil fuels, and the second was to distribute it equally to households. Since the first was difficult to calculate, the second application was implemented. According to this application, the incomes of the lowest income groups increased by 3.5%, while the incomes of the highest income groups decreased by 1.6% (Dinan, T. M., Rogers, D. L., 2002).

Climate change and economic inequality are closely linked. This inequality is especially evident as low-income households spend a large portion of their income on carbon-intensive products. In a study conducted by Fremstad et al. in 2019, the carbon footprints of households in the United States where a \$50 tax was applied were calculated. Accordingly, dividing the carbon tax into dividends reduced inequalities between groups. It benefited 84% of people in the lower income group and 56% of all people. As a result, it was accepted that the distribution of the carbon tax was insufficient for the purchasing power of Americans (Fremstad, A., Paul, M., 2019).

The world is moving towards increasingly small households. The number of people living alone is increasing. In this case, it would be more appropriate to conduct these studies on an individual basis rather than on a household basis.

2. Household expenditures and energy use in Turkey

As of the end of November 2024, Turkey's installed capacity has reached 115.144 MW. The distribution of our installed capacity by resources is 28% hydroelectric energy, 21.4% natural gas, 19% coal, 10.9% wind, 16.8% solar, 1.5% geothermal and 2.3% other resources (TC. Enerji ve Tabii Kaynaklar Bakanlığı, 2025).

Share of environmental protection expenditure in GDP was 0.85% in 2023 and 63.3% of environmental protection expenditures realized for waste management services (TÜİK Expenditure, 2025).

Turkey has the 17th largest economy in the world according to IMF reports. Turkey's GDP value in 2023 is 1.024 trillion dollars. Turkey, which is a member of the OECD and G20, needs to solve poverty and economic problems in order to continue its development and progress. For this reason, the combating fossil fuels should be among the priorities. Turkey has a lot of trade with the EU and it is the 3rd largest country exporting to the EU. Turkey has to prioritize carbon studies due to the Border Carbon Adjustment Mechanism that the EU will implement. The society will get used to this system with the carbon tax application starting from

households and it will be a fair solution to income distribution inequality (CBAM, 2025).

The most important condition for environmental protection revenues are fair and sustainable. Studies are developing various applications and researches to ensure that these revenues also have financial and socio-economic returns, one of which is the study in this article. According to previous research, environmental taxes can have unequal effects on income distribution, but progressive environmental taxes can reduce inequalities. Environmental tax reform can meet both distributional and environmental goals when properly designed to address distributional concerns. Environmental taxes and green tax reforms are powerful tools to promote the transition to sustainable economies and they can increase welfare by internalizing externalities, a fundamental principle of environmental economics (Domguia, E. N. 2023; Bercholz, M., Roantree, B. 2019; Labeaga, J. M., Xavier, L., 2020).

One method used in environmental taxes is the "Sky Trust" program. Entrepreneur Peter Barnes redefines the debate about climate change in his article. He argues that by treating the sky as a common asset, we can protect the atmosphere while paying every American cash. Barnes proposes a nongovernmental Sky Trust that would charge rent on carbon emissions and pay each of us equal annual dividends. The Sky Trust would also ease the burden on workers, firms, and households who are hardest hit by the transition to a lower-carbon economy. This study redefines the debate about the costs of addressing climate change and proposes a market-based institution called the Sky Trust that would set limits on carbon emissions and pay dividends to all of us who collectively own the atmosphere (Barnes, P., 2003). Some of the work done on this subject will be adapted to Turkey. Some of the studies conducted on this subject will be adapted to Turkey. In short, the aim here is the process of decarbonizing the sky that we all own.

In the methodology used in this study, carbon tax is calculated based on the amount of energy consumed by the household. Carbon tax is determined in proportion to the carbon content of the goods and services used. Household expenditures in developing and developed countries will differ from each other. For example, there is no house heating and fossil fuels such as wood are used more intensively for cooking in hot climate countries.

The household expenditures are grouped into 12 categories for Turkey as can be seen from the TÜİK data in Figure 2. These are food and non-alcoholic beverages, alcoholic beverages, cigarette and tobacco, clothing and footwear, housing and rent, furniture and houses appliances, health, transportation, communication, entertainment and culture, educational services, restaurant and hotels and various good and services. According to the results of the household budget survey for 2022, housing and rent expenditures have the highest share in consumption expenditures of households. Housing and rent expenditures have consumption expenditures with 22.4% of all consumptions,

followed by transportation expenditures with 21.3% and food and non-alcoholic beverage expenditures with 22.8%. The types of expenditures that had the lowest share in total consumption expenditures were education services with 1.4%, health with 2.2%, and entertainment and culture expenditures with 2.5% (TÜİK Household, 2022). As seen in Figure 2, household expenditures are divided into 20% segments from low to high. Accordingly, it is seen that low-income households allocate more than twice as much share to food as high-income households. When we look at the distribution of consumption expenditures in 2022 according

to 20% groups ranked by income, households in the first 20% group, which is the lowest income group, allocated 35.8% to food and non-alcoholic beverage expenditures, 29.3% to housing and rent expenditures, 8.3% to transportation expenditures and 5.5% to furniture and household goods expenditures. Households in the fifth 20% group, which is the highest income group, allocated 28.5% to transportation expenditures, 19.3% to housing and rent expenditures, 16.6% to food and non-alcoholic beverage expenditures and 6.8% to restaurant and hotel expenditures.

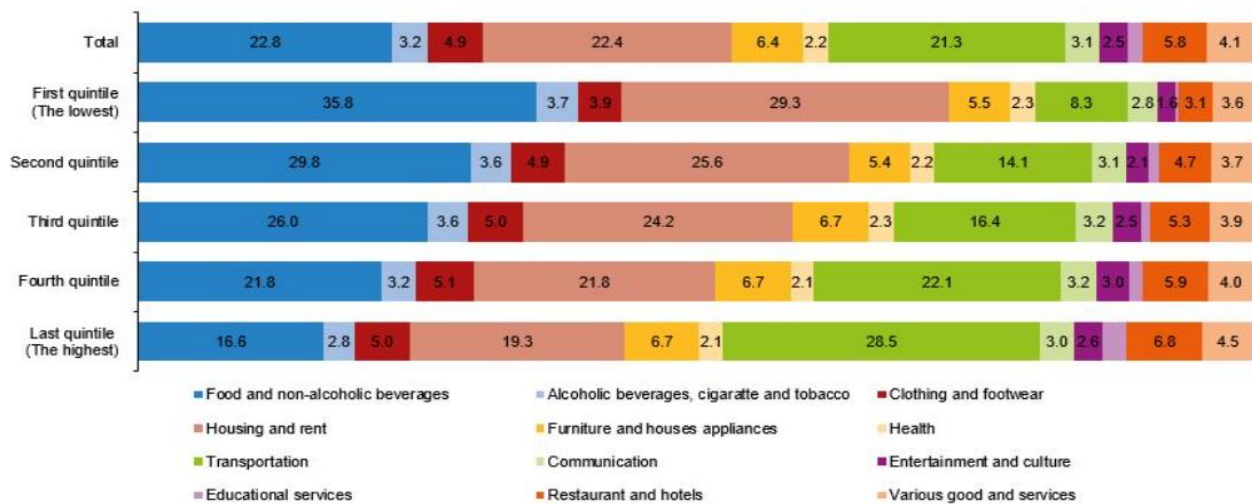


Figure 2. Distribution of consumption expenditure by quintiles ordered by income (%), 2022

3. Implementation of the Sky Trust Method

According to the results of the household budget survey in 2022, housing and rent expenditures ranked first in terms of the share allocated to total household expenditure. It was seen that two-thirds of housing expenditures consist of rent (Alomaliye, 2019). Since rents constitute a significant share of income in Turkey, rent and home maintenance expenses are excluded from the study, anyway, rent and home maintenance expenses are not very effective in carbon consumption. This study divides the above expenses, excluding rent and home maintenance, into 5 groups. Health, entertainment and culture, educational services, restaurant and hotels and various good and services are combined under the “other” group. Alcoholic beverages, cigarette and tobacco, clothing and footwear, furniture and houses appliances are combined under the “Industrial goods”. The values in the housing are named as fuel and electricity. The expenditures considered in this study are food and non-alcoholic beverages, industrial goods, fuel and electricity, transportation and communication and other expenditures. The proportion of food and fuel decreases in relation to total expenditure, while the proportion of transportation increases from the lowest income group to the highest income group.

In order to make household consumption expenditures

comparable, the equivalent consumption expenditure per person obtained by taking into account household size and composition is used. The average monthly consumption expenditure per household in 2022 was estimated 12157 (including rent) and 9950 (excluding rent) Turkish Lira (TL).

In this study, the principles of the egalitarian energy policy studies conducted for China and India are taken as basis and applied to Turkey.

According to this method, Turkey's monthly spending amounts by household are obtained from 2022 Turkish Statistical Institute (TÜİK) household expenditure data (TÜİK 2022). As seen from Table 1, rent is deducted and only fuel and electricity are given as housing.

For the analysis of the energy policy proposed here, the carbon burden of households and the carbon footprint of each of these deciles are found. The amount of carbon used by households using carbon loading factors are shown in Table 2. Table 2 shows the corresponding TOE values and the GDP equivalents of these energy expenditures. TOE/10000 TL and ton carbon/10000 TL values are used for the sake of simplicity.

Table 1. Monthly household expenditure breakdowns for Turkey in 2022

From lowest income to highest group	Total monthly expenditure (TL)	Percentage of total expenditures (%)	Food (%)	Industrial goods (%)	Fuel and electricity (%)	Transport and communication (%)	Other (%)
1	3830.58	8.1	36	7.6	7.04	11.3	15.76
2	6542.4	13.5	29.9	8.5	5.6	17.6	18.5
3	8527.48	17.4	26	8.6	4.8	20.1	21.1
4	11838.44	24	21.8	8.3	4	25.7	22.4
5	18990.57	37	16.6	7.8	2.9	31.9	24.4

Turkey's population was 85 million 279 thousand 553 people and gross domestic product per capita was 176 thousand 651 TRY in 2022. According to the Turkish Statistical Institute (TÜİK) data, there were 26 million 75 thousand households in Turkey in 2022. The average household size was 3.17 people (TÜİK GSYİH, 2022).

Turkey's total GDP was 15 trillion 11 billion 776 million TL and the total final energy consumption of households was 1 million 287 thousand 738 tera joules for 2022 (TÜİK Energy Consumption, 2022).

Table 2. Carbon Loading Factors, 2022

Expenditure	Energy (Bin TOE)	GDP (Billion)	TOE/10000 TL	Ton carbon/10000 TL
Food	5129	480.352	0.106	0.338
Industrial goods	41614	855.627	0.486	1.541
Fuel and electricity	38121	330.242	0.115	0.365
Transport and communication	10456	450.033	0.232	0.736
Other	7717	225.165	0.342	1.084

1 Ton Oil Equivalent (TOE) releases 10 million kcal of energy. The carbon consumed for each expenditure is calculated assuming that 1 TOE emits 3.17 tons of CO₂ (Turkish Greenhouse Gas Inventory, 2022)

Carbon consumption per household is calculated with the following formula:

$$C = 0.034 * (EXP)_F + 0.154 * (EXP)_I + 0.036 * (EXP)_E + 0.0736 * (EXP)_T + 0.11 * (EXP)_O \quad (1)$$

For example, the monthly carbon consumption for the lowest income group is found as follows.

$$C = 0,34(3830*36/100) + 1,54(3830*7,6/100) + 0,36(3830*7,04/100) + 0,74(3830*11,3/100) + 1,1(3830*15,76/100) = 1998 = 0,2 \text{ ton}$$

C indicates carbon consumption in kg. (EXP)_F, (EXP)_I, (EXP)_E, (EXP)_T and (EXP)_O indicate food, industrial goods, fuel electricity, transport communication and other expenditures, respectively.

Equation 1 is obtained from the last column of Table 2 and gives the carbon used by households in ton.

According to Table 3, low-income groups pay 3.55 percent

of their total expenditures as carbon money, while high-income groups pay 4.7 percent. This confirms that higher income groups use more carbon intensively.

Table 3. Carbon distribution by households, 2022

Total monthly expenditure (TL)	Consumed CO ₂ (ton)	Charge for CO ₂ (TL)	Charge for CO ₂ /total expenditure (%)
3830.58	0.2	136	3.55
6542.4	0.38	258.4	3.95
8527.48	0.53	359	4.2
11838.44	0.77	525.6	4.4
18990.57	1.31	892.8	4.7

The carbon price determined for Turkey is approximately 40 euros per ton. In the previous studies, a ton of carbon was taken as 40 euros. In Zhang's study in China in 1998, carbon reductions were examined over 20 years by determining the carbon ton as 205 yuan and 400 yuan, and a 20% and 30% reduction was observed, respectively (Zhang, Z., 1998).

The tax required to implement this program is €40 per ton of carbon. Calculations were made by taking 680 TL, which is the equivalent of 40 euros in Turkey for 2022. The carbon fee in the EU was around 60-70 euro in 2022 (Statista, 2025).

Table 4 shows the effect of the Sky Trust scheme, in which the money from the carbon fee is redistributed equally to households. The size of the dividend payment, 434.4 TL per house, is calculated by dividing total income by the number of house in Turkey. The net benefit of the method is obtained by deducting the carbon fee per house from the dividend. The last three columns of Table 4 show the dividend, net profit as a percentage of household expenditure and Turkish Lira respectively. 1% of total revenue should be deducted for administrative costs, but this deduction is ignored in this study.

As seen in Table 3, even without an egalitarian redistribution of income, the carbon burden will continue to increase. Households in the lowest 20% income group pay 3.55% of their total expenditures as carbon fees, while those in the highest income group pay 4.7% of their total expenditures. This shows that rich households use carbon more intensively than poor households. This study contradicts studies that state that the carbon burden has a neutral or regressive effect. As seen in Table 3, even if there is no equal redistribution of income, the carbon burden will continue to increase. The households in the lowest 20% income group pay 3.55% of

their total expenditures as carbon fees, while those in the highest income group pay 4.7% of their total expenditures. This shows that rich households use carbon more intensively than poor households. The effect will be stronger at lower carbon intensity in the consumption of poor households.

Table 4. Carbon dividend values by households, 2022

Income groups in 20% slices	Total monthly expenditure (TL)	Dividend (%)	Net profit (%)	Net profit (TL)
1 The lowest %20	3830.58	11.34	7.79	298.4
2	6542.4	6.64	2.69	176
3	8527.48	5.1	0.9	76.75
4	11838.44	3.67	-0.73	-86.42
5 The highest %20	18990.57	2.3	-2.4	-455.8

The most households receive more in refunds than they paid as a result of higher fuel prices as shown in Table 4. The flow diagram of the method is shown in Figure 2.

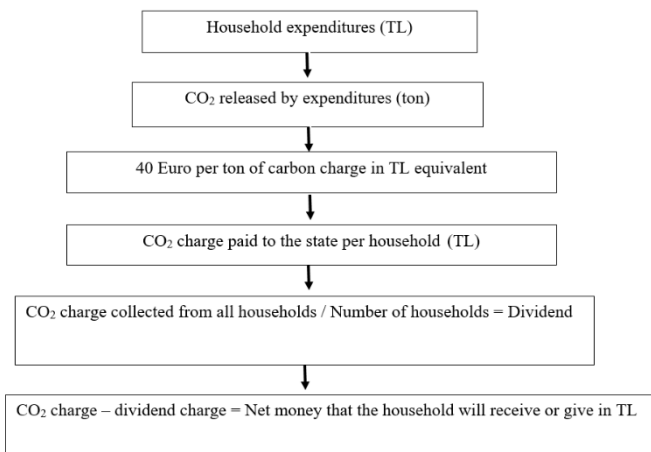


Figure 2. Flow chart of the method

This study contradicts studies that state that the carbon burden has a neutral or regressive effect. On the other hand, there are also studies that support this study, that is, that argue that the distribution of carbon taxes has a progressive effect (Ayu, P, 2018., Okonkwo, J. U,” 2021).

Using the model, we find that the carbon tax is highly progressive, such that the negative impact of the carbon tax on households with below-average incomes is smaller than the negative impact on households with above-average incomes. We show that the welfare effects of a carbon tax are a result of a household's spending being determined primarily by the source of its income rather than its destination. Finally, we show that the current income recycling is progressive. Overall, the tax appears to be highly progressive. Whether carbon taxes are progressive, regressive or neutral depends on whether the application is fair and sustainable, where there is fair application without economic loss.

Especially in developing countries like Turkey, where the Gini Coefficient is not very low, such fair practices support green transformation (TÜİK, Income Distribution, 2022).

This also contributes to the progressivity of the carbon tax, as lower-income households receive a larger share of their income from transfers.

The aim of this study is to direct expenditures from intensive carbon sources to low carbon sources. In a study conducted in the United States in 2002, low-income groups reduced their spending more than high-income groups due to a tax on gasoline prices (West, S. E., Williams, R. C. 2002). The focus point here is to ensure that carbon use is reduced for the high-income segment.

4. Conclusion

Total carbon emissions in Turkey in 2022 is 558.3 million tons. With this study, approximately 200 million ton of CO₂ per year was priced at 40 euro per ton. Thus, 1/3 of the total emissions were priced through households with this practice.

The aim of this method is to reduce the amount of carbon used by pricing carbon. The previous studies have shown that while the removal of subsidies has a negative effect, the distribution of carbon money has a positive effect (Brennera, M. et al. 2007). This study also supports this effect.

In this method, activities are carried out through a foundation established with state support, but without the use of the state budget. The foundation distributes the income from carbon fees back to households after making a small financial cut. One of the advantages of this system is that it is independent of public spending and fiscal policy issues. As a result, it is a fair system that rewards those who use less carbon and penalizes those who use more. This study only addresses household expenditures. There is no data on per capita expenditures. Also there is also no expenditure data for rural and urban households. The study can be expanded by assuming that there is an average of 3.17 people in each household in Turkey in 2022.

This study only addresses household expenditures. There is no data on per capita expenditures. Also there is also no expenditure data for rural and urban households. The study can be expanded by assuming that there is an average of 3.17 people in each household in Turkey in 2022.

As can be understood from the results, the “sky trust” project yields positive results on a household basis in Turkey.

This project may negatively affect people whose livelihoods depend on fossil fuels. This negative case can be eliminated if a fund from this income is allocated to these people. The carbon tax collected can also be used in other ways. A portion of the collected carbon tax can be used to invest in low-carbon technologies, while the rest can be distributed to households as fuel and electricity. Additionally, the carbon price can be increased to generate more revenue.

As a carbon tax, 666 million euros or 11.3 billion TL could be collected from households with the values in this study in 1 month in 2022.

According to the results of the household budget survey in 2022, housing and rent expenditures ranked first in terms of the share allocated to total household expenditures. It was observed that two-thirds of housing expenditures consisted of rent. In this study, rent is excluded from carbon calculations.

This article argues that an environmental policy that provides equitable and sustainable growth without compromising the growth rate can be designed. This study provides information on green growth, carbon tax and dividend policy, which have been extensively debated and politically evaluated in developed countries but less discussed in the context of the developing world. Here, the carbon tax not only controls the demand for fossil fuels but also makes the process of distributing tax revenue in the form of universal access to energy equitable.

Nationwide, there are gains for households in the bottom 3 income quintiles and losses for households in the top 2 income quintiles. For the year 2022, the carbon tax is calculated at around 40 euros, and the methodology for calculating the carbon tax for the year 2022 is around 26 euro (TL 434.4), which is calculated based on the value of the dividend, shows that this method is highly progressive.

The poorest 20 percent would see a net income gain equivalent to 7.79 percent of total spending, while the richest 20 percent would see a 2.4 percent decline with this carbon tax. Nationwide, roughly 60 percent of Turkey's population would gain from this policy, helping to eliminate economic inequality.

This study is also in line with the new regulation decision of the Energy Market Regulatory Authority regarding electricity consumption in Türkiye dated January 1, 2025. With the regulation that will be valid as of January 1, 2025, the limits are determined as 5 thousand kilowatt-hours (kWh) per year for residential subscribers. Places such as mosques, places of worship, associations, AFAD temporary shelter centers are excluded from the regulation. The Minister of Energy reports that only 1.2 million households will have a change in the cost of electricity in the new electricity regulation. In other words, 3% of subscribers will be affected by this situation. The bills of subscribers who will not benefit from state support will increase by a maximum of 93% according to the current Market Clearing Price. There will be a maximum increase of 11% in industrial and commercial electricity. Other subscribers will continue to receive state support. The aim here is to ensure a more equitable distribution of the support currently provided to all electricity subscribers and to encourage the efficient use of energy resources (Euronews, 2025).

In this study, a smoother transition is suggested by determining a more gradual level.

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