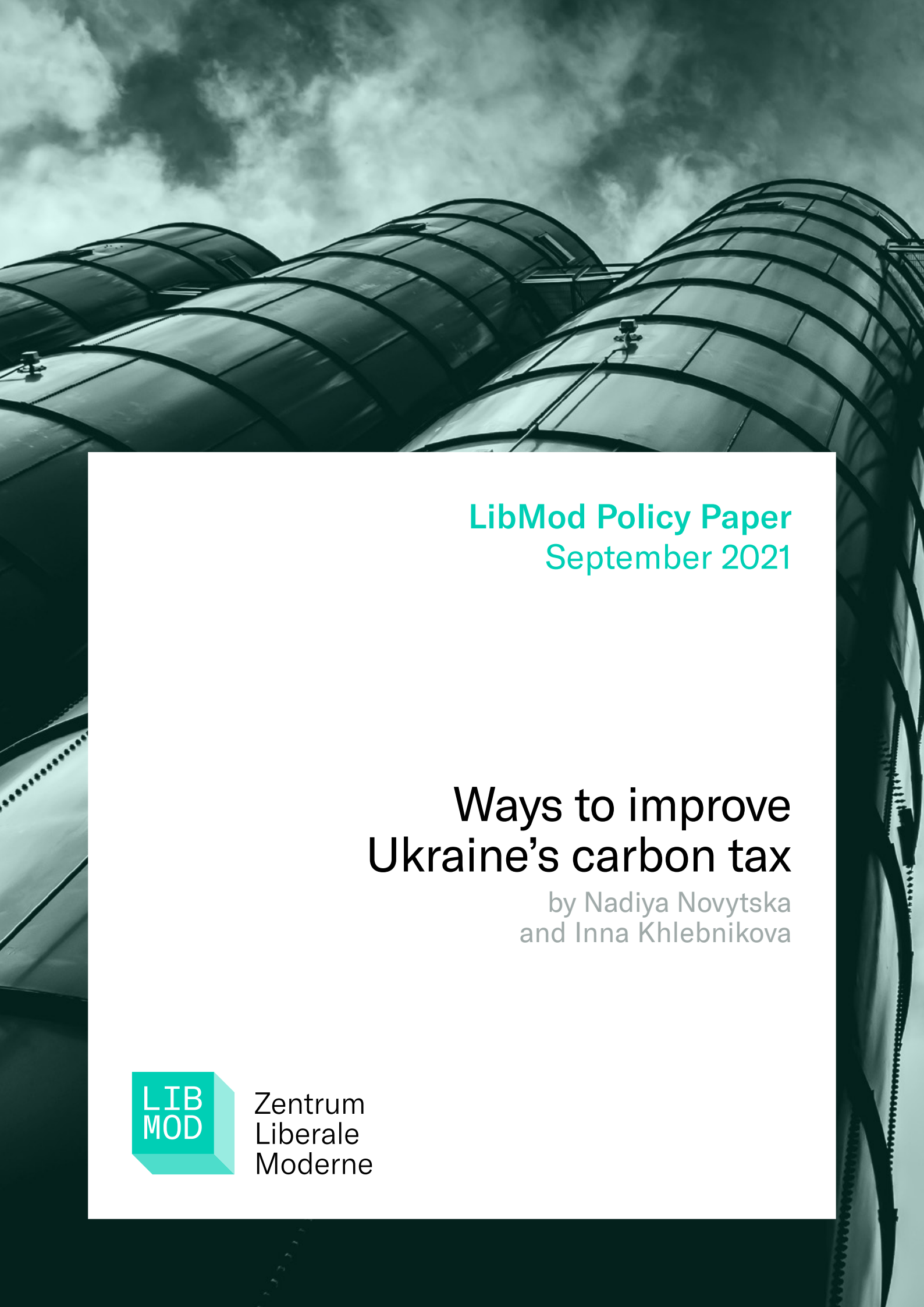

LibMod Policy Paper
September 2021

# Ways to improve Ukraine's carbon tax

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# Contents



**List of abbreviations:** CBAM – Carbon Border Adjustment Mechanism, $CO_2$ – Carbon dioxide, CPF – Carbon Price Floor, ET – Environmental tax, environmental taxes, ETS – Emissions Trading System, EU – European Union, GHG – Greenhouse gas, IEA –International Energy Agency, LPG – Liquefied petroleum gas, NE – Natural environment, OECD –Organization for Economic Cooperation and Development, STS – State Tax Service, TCU – Tax Code of Ukraine, TOE – Tonne of oil equivalent, UAH – Ukrainian hryvnia (currency)

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The authors' team express gratitude for the idea for the research to Mr. Oleksandr Shumskyi, Head of the Department of Administration of Resource Payments, Rent and Local Taxes and Fees on Legal Entities of the State Tax Service of Ukraine; advisory assistance and support to Mr. Oleksii Riabchyn, Low Carbon Business Development Advisor to CEO of Naftogaz of Ukraine Yurii Vitrenko.

**Ukraine in Europe: the parliamentary dimension**

is a project of the Center for Liberal Modernity that focuses on enhancing the capacity of the Ukrainian Parliament to implement the Green Deal agenda in Ukraine. It is carried out in cooperation with the East Europe Foundation and funded by the German Foreign Office from 2021 to 2022.

The program includes expert briefings for MPs and their staffers, closed-door discussions, public round tables and the preparation of analytical reports and information sheets. By transferring knowledge and building expert networks around the Ukrainian Parliament, the project promotes political support for the implementation of comprehensive reforms that enable a green transformation.

Titel image: Philippe Dubois / Pexels

# Introduction

The need for countries to transition to a climate-neutral economy is conditioned by the aggravated global environmental problems that have significantly undermined the sustainability of national economic systems.[1]Climate change is increasingly affecting all spheres of public life and has made it necessary to include goals to reduce greenhouse gas emissions in economic development strategies. Ukraine is no exception. Fulfilling its obligations under the Paris Climate Agreement, Ukraine, within the framework of the project of the Second Nationally Determined Contribution, has undertaken to achieve ambitious goals to reduce greenhouse gas emissions by 65% in 2030 compared to those in 1990. In addition, Ukraine has committed to achieve climate neutrality by 2060, as set out in the National Economic Strategy 2030 and approved by the Resolution No. 179 of the Cabinet of Ministers of Ukraine dated March 3, 2021. Also, Ukraine should synchronize its climate policy with the European Green Deal for the European Union, which provides for actions to transform Europe into the world's first climate-neutral continent by 2050. Such initiatives are aimed at stimulating economic development, improving people's health and quality of life and transforming climate and environmental challenges into opportunities in all areas and throughout all EU policies, ensuring a fair and inclusive green transition. In particular, within the framework of the Green Deal, the European Commission plans to revise Directive 2003/96/EU on Restructuring the Community Framework for the Taxation of Energy Products and Electricity, justifying this by the fact that the current energy taxation mechanism has reduced the efficiency of the energy tax and led to an increase in GHG emissions. In particular, it does not provide sufficient incentives to reduce fuel consumption. National energy tax rates on natural gas and electricity are only fragmenting the EU's internal energy market. In the EU Emissions Trading System (the ETS), this mechanism is set to achieve a variety of overlapping objectives, resulting in inconsistency. In addition, this mechanism sends false price signals to consumers in the framework of climate policy, because the tax rates are based on fuel volume or energy content and not on the carbon content.

> The hardest policies to implement are those with diffuse benefits and concentrated costs[1].
>
> Mancur Olson
> "The Logic of Collective Action:
> Public Goods and the Theory of Groups"

Currently, this is gaining special relevance in the view of significant energy and carbon intensity of the Ukrainian economy, outdated technological processes, and the lack of financial support to eco-modernize the industrial production, along with insufficiently favourable conditions for the development of energy production from alternative sources, along with large energy subsidies.

In light of the above, there is a pressing need to review Ukraine's climate policy and $CO_2$ pricing instruments. Among them, it is worth mentioning the fuel excise tax, along with the gradual introduction of the national Emissions Trading System, in addition to improving the methodology of taxing carbon dioxide emissions.

The transformation of the environmental tax (ET) on $CO_2$ emissions is the focus of our study, which presents proposals to simplify the procedure for calculating the tax base and increase the fiscal efficiency of the ET by changing approaches to its administration. This will make it possible to effectively influence the consumer behaviour of the taxpayers, without disrupting the activity of economic agents, and, ultimately, to achieve climate goals to reduce $CO_2$ emissions.

# 1 Stakeholders supporting the implementation of measures to restrict carbon dioxide emissions in Ukraine

Currently, in Ukraine, the environmental tax on carbon dioxide emissions is viewed solely as a fiscal measure. However, given the need to take measures to reduce GHG emissions to achieve the goals for the Second Nationally Determined Contribution of Ukraine with the Paris Agreement, as well as the European integration intentions and the need to harmonize domestic legislation with the EU Directives, it can be concluded that the system of taxing carbon dioxide emissions needs to be improved, in particular, considering that the main purpose of the environmental tax is to incentivize the reduction of environmental pollution and combat climate change.

In view of the above, the key stakeholders in Ukraine, in particular government agencies, are considering various approaches to reforming the $CO_2$ emissions tax, in order to pursue the following goals:

– Ensure the balance of budget revenues by ensuring more efficient use of the country's economic resources, as well as bringing the tax rates for carbon dioxide emissions closer to the European level (*Ministry of Finance of Ukraine*);

– Incentivize enterprises to reduce environmental pollution, creating conditions for the re-investment of $CO_2$ emission tax to finance energy efficiency measures and decarbonization programmes in order to combat climate change *(Ministry of Environmental Protection and Natural Resources);*

– Simplify the administration of the environmental tax on GHG emissions *(State Tax Service of Ukraine)*;

– Increase from the contribution of biofuels in Ukraine and the subsequent transition of enterprises from fossil fuels (coal, gas, peat) to fuel produced from biologically renewable sources of organic origin. Thus, *the Ministry of Energy of Ukraine* published draft legislation on the establishment of a zero tax rate for carbon dioxide emissions for installations burning biofuels. It is worth noting that this institution declares goals for the development of all types of renewables. In particular, the Cabinet of Ministers of Ukraine approved the National Action Plan for the Development of Renewable Energy till 2020, according to which the share of "green" energy produced by wind or solar plants, or small or large hydroelectric power plants, bioenergy, in the total energy production in 2020 was supposed to reach the level of 11%. However, according to DAEE, the share of renewables in 2019 was 8.1%, which is 2% less than planned.

It has to be noted that should Ukraine fail to establish the market price of GHG emissions, domestic enterprises exporting carbon-intensive products to the EU, may from 2023 become subject to the Carbon Border Adjustment Mechanism, *CBAM* developed by the European Commission. The mechanism is aimed at levelling prices of $CO_2$ emissions with trading partners, as well as stimulating them to accelerate the transition to a climate-neutral economy. Ultimately, the EU's struggle for clean energy, without due advocacy from the Ukrainian side, can simply 'bury' the prospects of the domestic manufacturing sector, which exports carbon-intensive products to the EU.

The government of Ukraine is taking efforts to regulate this situation. In particular, a working group has been created, consisting of representatives of the Cabinet of Ministers of Ukraine and the Ministries (the Ministry of Finance of Ukraine, the Ministry of Environmental Protection and Natural Resources, the Ministry of Energy and the Ministry of Economy). The main goal of the Working Group is to agree on the approach for the application of the Carbon Border Adjustment Mechanism in Ukraine in consultation with the EC.

Despite the difficult economic and political situation in Ukraine, the issue of continuously bringing the ET rates for GHG emissions to the level of the EU market price is being actively discussed. Hence, the tax per tonne has been raised by a factor of more than 24, from UAH 0.41 in 2019 to UAH 10.00 in 2020, or approximately EUR 0.31. However, the average price of quotas for $CO_2$ emissions in the EU in 2020 was more than EUR 26.00 per tonne.

Work is underway to further regulate this field, and a number of draft bills have been developed, including the key government proposed legislation:

– Draft Bill No. 4101, which, in order to prevent excessive tax pressure on industrial companies, introduced a schedule for an annual increase of the ET rate for carbon dioxide emissions by UAH 5 per tonne up to UAH 30 per tonne in 2024. However, such proposals were not supported by the Parliamentary Committee on Finance, Taxation and Customs Policy. The State Tax Service drew attention to the need to revise the provisions, recommending instead a one-off increase of the ET for $CO_2$ emissions to UAH 30 per tonne. According to the STS, using coal as an example, such an increase would not result in a sharp increase in electricity prices;

– Draft Bill No. 5600 on amendments to the tax code was developed by the Ministry of Finance and adopted in the first reading by the Ukraine parliament (*Verkhovna Rada*) on July 1, 2021. Among the proposals is an increase in the ET for carbon dioxide emissions from UAH 10 to UAH 30 per tonne.

It has to be noted that relevant initiatives to raise $CO_2$ tax rates have been successfully developed, adopted and implemented. That is, in order to be effective in terms of achieving climate goals, they must be considered and accepted by the public.

In addition to raising tax rates, there is an ongoing debate in Ukraine on the need to introduce targeted use of the tax on $CO_2$ emissions from stationary sources in order to develop innovations, introduce energy efficiency measures, reduce emissions and adapt to climate change. Among the main proposals submitted to the Rada Committee on Environmental Policy and Nature Management (as supported by the line Ministry) is the creation of the State Fund for Environmental Protection as part of the Special Fund of the State Budget of Ukraine. It has been planned that 30% of the ET (except tax on radioactive waste) and 100% of the ET levied on carbon dioxide emissions will be channelled to the fund. Currently under review is the idea to establish the fund as a separate legal entity to which part of the ET proceeds will be directed to ensure the implementation of programmes in the field of climate change and environmental protection. It should be noted that the Ministry of Environmental Protection and Natural Resources maintains the position that the resources from the fund shall be allocated in accordance with a clear procedure and criteria established by the Cabinet of Ministers of Ukraine.

The same position is widely shared by the public, in particular, by the Public Council under the Ministry of Environment of Ukraine. This Public Council advocates for the efficient allocation of resources from the ET to finance programmes in the field of environmental protection and calls for the introduction of an effective system to control the use of resources from this Fund, as well as insisting on the state support for the implementation of green modernization.

Earlier proposals were made for the targeted use of funds received from taxation of $CO_2$ emissions. In particular, in 2020, at the initiative of the ***Energy and Environment*** Inter-Factional Association, consisting mainly of representatives of the parliamentary faction of the *Servant of the People* political party, draft bills were submitted to parliament with the proposals to establish the State Decarbonization Fund (as per Amendments to the Budget Code, No. 4347) and to increase the rate of the ET for $CO_2$ emissions to 30 hryvnia per tonne (Amendments to the TCU regarding the revision of the rates of certain taxes, No. 4346). However, the line parliamentary committees found the draft bills lacked sufficient financial and economic justification.

At the same time, the parliamentary committees considered a mechanism to re-finance taxpayers at the expense of the collected ET on $CO_2$ emissions. However, the Ministry of Environment and Natural Resources and the State Tax Service do not support the introduction of such a mechanism, arguing that it is necessary to revise the classification of environmental protection measures and introduce the necessary oversight tools. In addition, the return of funds from the collected ET to the emitter contradicts the “polluter pays” principle, according to which an enterprise that pollutes the environment must compensate for the damage caused.

# 2. European practice of combining tax instruments with the Emissions Trading System

With the climate change situation getting worse, the search for effective tools to curb GHG emissions is becoming extremely relevant. Options include pricing mechanisms such as the Emissions Trading System, and taxes. In international practice, effective tax instruments include excise taxes on energy and taxes on carbon dioxide emissions, which are directly related to emissions or the carbon content in fuel (Fig. 2.1). By introducing such taxes, governments set the price for each tonne of $CO_2$ emissions. This is how their static and dynamic efficiency is used. The first is the ability to reduce $CO_2$ emissions in the least costly way. The second creates incentives for the development and implementation of innovative technologies to reduce emissions.

Although excise duty on energy and carbon taxes are usually similar, excise duty rates are usually independent of the carbon content of the fuel. Instead, they are differentiated to compensate for unintentional distortions in the labour market due to environmental taxation (applying a lower rate to diesel compared to Petrol), creating competitive advantages for more environmentally friendly fuels (lower rate for diesel with lower sulphur content); protection of national energy-intensive enterprises, prevention of energy poverty.

This type of ET consists of Pigou and Ramsey components , which are determined by the need to realize the fiscal potential. Fuel excise taxes generally take away a considerable share of the budget revenues, as they are earmarked to become a source of financing the costs of transport infrastructure. In addition, they create price signals as regards the cost of negative external factors caused by the emission of GHGs and air pollutants as a result of fuel combustion, road congestion, accidents and noise. Therefore, the main function of this type of tax is regulatory. It is exercised by handling the size of the tax burden and the rate differentiation. The desired outcome of the environmental taxes is the substitution effect aimed to improve the behaviour of economic agents in the market, as well as boosting the turnover in the higher quality fuel market. In the short-term, the desired effects of fuel taxes include a reduction in energy consumption, whereas in the long run the anticipated result is the impact on the behaviour of private car users: shortening the distance between work and home, replacing cars with less energy-intensive means of transport, as well as rational choice in terms of duration and length of trips by private transport, and substitution of private vehicles by mass transit. This type of tax, applied along with the ETS, is the most effective when supplemented by the environmental standards for fuel quality, tax reliefs aimed to incentivize the energy efficiency course and to increase the share of alternative fuels in the country's energy balance, in addition to rationalizing energy subsidies. Excise duties on energy are harmonized at the level of EU countries, so the approaches to taxation at the level of Member States are similar.

Taxes of the second type provide for direct taxation of $CO_2$, and their rate consists only of the Pigou component. Countries choose the form of tax: the tax on the measured or estimated emission of a given greenhouse gas (emission-based carbon tax), or the tax on energy consumption (fuel-based carbon tax), the rates of which are differentiated depending on the carbon content of the fuel. The objects of taxation include both energy for the transport sector (petrol, diesel fuel) and energy used by households, industry and utilities (liquid fuels, natural gas, coal and electricity).

Since the tax on $CO_2$ emissions is not harmonized in the EU, member states have chosen different approaches to implementing this tax. In Annex A, a brief summary of key features of the different types of carbon tax is presented. Countries that have prioritized the minimization of transactional costs in the tax collection have established a fuel tax rate based on the carbon content in all types of energy resources. This type of tax makes it possible to ensure the second-best-solution with regard to social impact of pollution, thus, it may influence the taxpayers' behaviour only in the direction of reducing the share of fuel which produces the highest $CO_2$ emissions. It should be noted that this approach may result in the same object being taxed twice; in addition, both finished goods and production factors may become subject to taxation , however, breach of the criteria for the tax system optimality may be justified by the need to achieve the climate policy goals. Of the nineteen European countries that introduced carbon tax, most of them have chosen this type of tax. In particular, the fuel-based carbon tax as $CO_2$ structural component in the rate of fuel excise tax was introduced in Denmark, Ireland, Luxembourg, Norway, Portugal, Finland, France and Sweden. In Iceland, Liechtenstein, the Netherlands, Slovenia, Switzerland, a similar approach is used, but the tax is set separately from the excise tax.

Countries that have not introduced a direct $CO_2$ tax participate in the European ETS, so carbon dioxide emissions are transformed into the monetary form. However, unlike the ETS, which sets the emission ceilings without determining the price of $CO_2$ emissions, and at the same time sets a certain environmental target, the $CO_2$ tax takes both factors into account. On the one hand, according to the European Commission, the ETS proves to be efficient, owing to the fact that it has managed to reduce GHG emissions by 35 % over the past fifteen years.

On the other hand, taxes on carbon dioxide emissions are intended to improve environmental and climate performance, improve the efficiency of the tax system, and contribute to a country's fairness, prosperity and competitiveness.

The International Monetary Fund supported the idea of introducing a global tax on carbon dioxide emissions into the atmosphere. It maintains that taxation is one of the most effective tools for limiting the use of fossil fuels and the related carbon dioxide emissions. In addition, the tax can provide a tool to accumulate financial resources to facilitate the transition to renewable energy sources.

In order to achieve the Paris Climate Agreement goals to reduce the level of GHG emissions into the atmosphere by one third, the International Monetary Fund recommended to the member states, in the period till 2030, to introduce a levy per tonne of carbon dioxide gas emissions at a level of US $75.

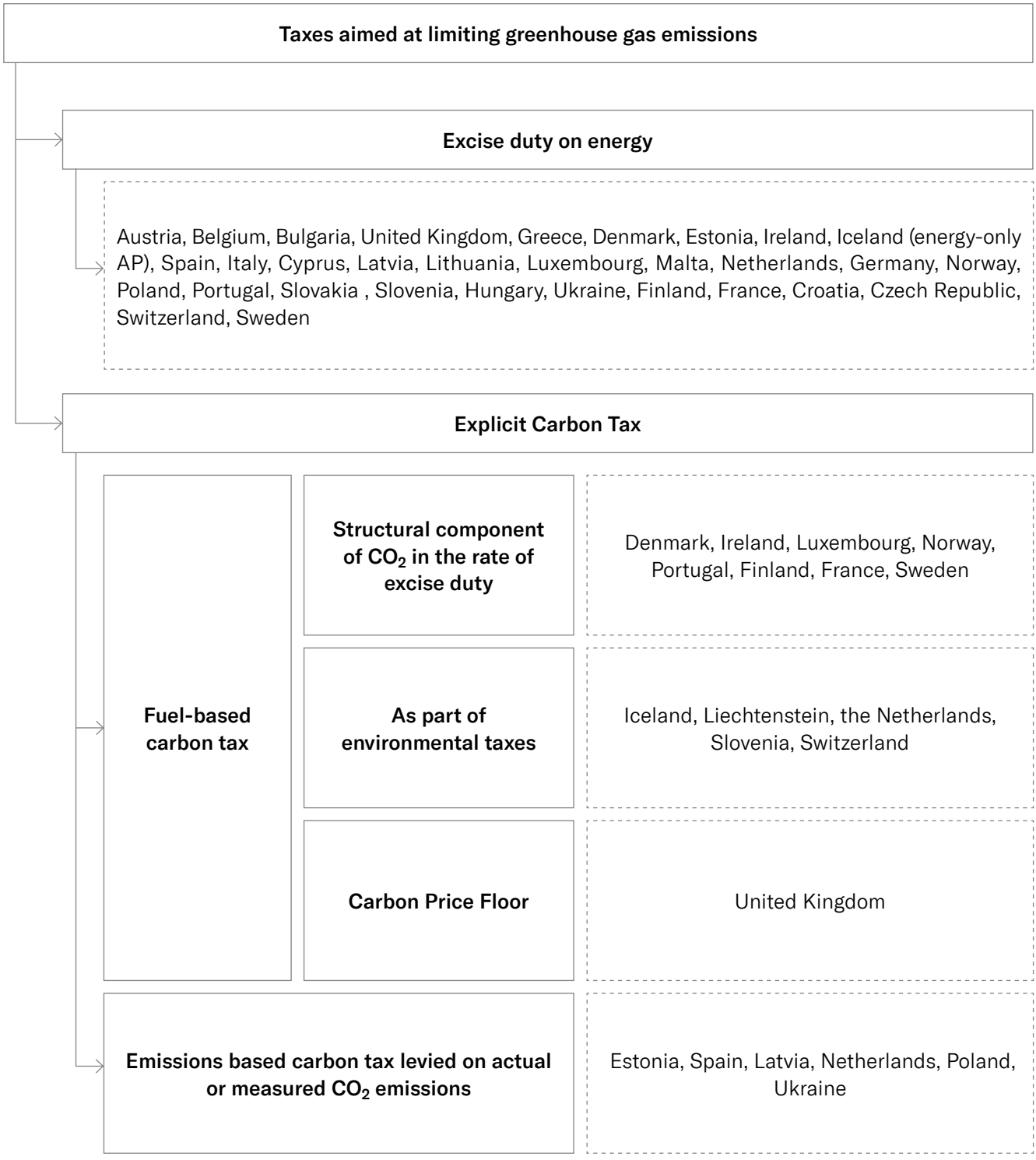


**Fig. 2.1.** Taxes Aimed at Limiting Greenhouse Gas Emissions in European countries

**Source:** compiled by the authors

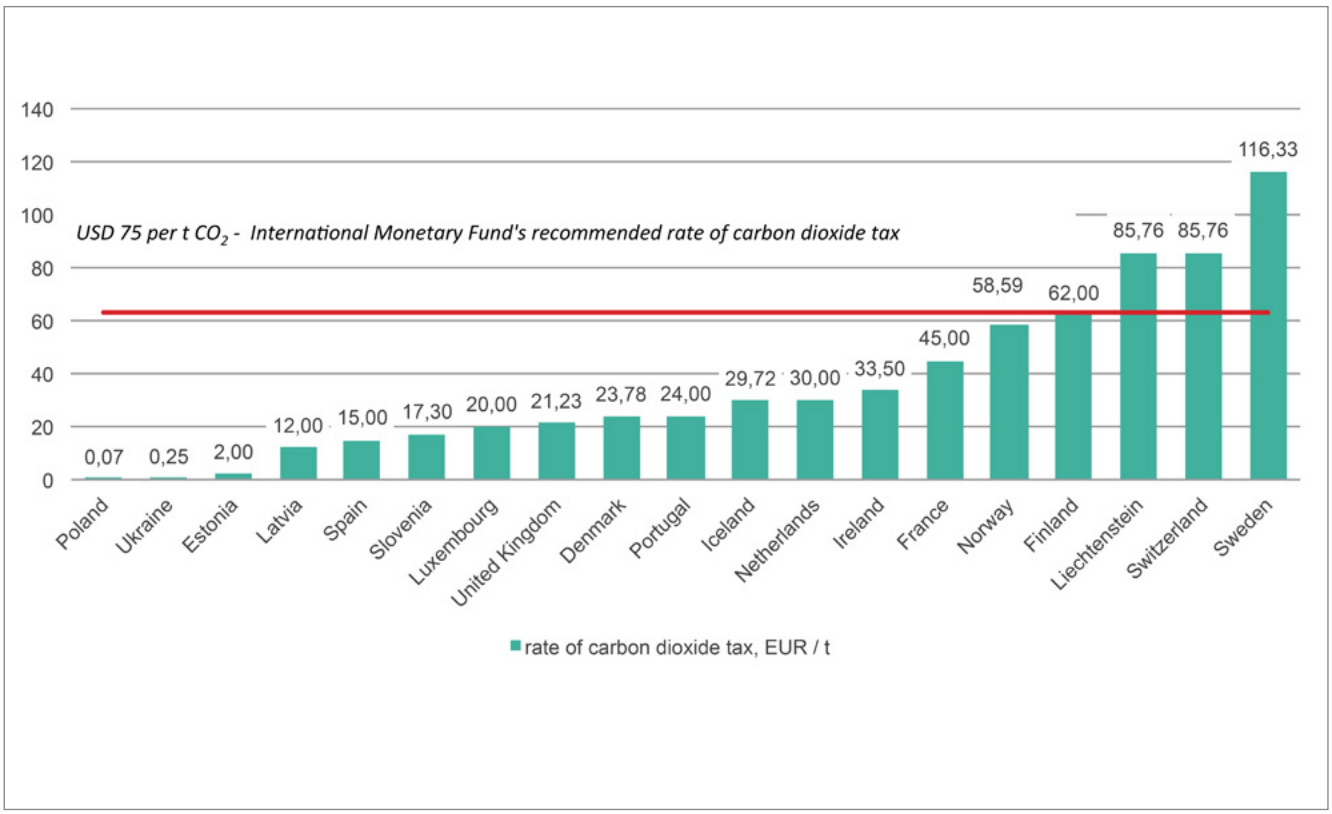


**Fig. 2.2.** Rates of Carbon Dioxide Tax in Some European Countries as of 2021[28]

**Source:** compiled based on the data of the International Monetary Fund and [29].

Denmark, Finland, Sweden and Norway were the first countries to adopt a carbon dioxide tax in addition to other fuel excise taxes. Researchers have repeatedly published their findings as regards the effectiveness this type of tax. Tax rates in those countries as of 2021 are shown in Fig. 2.2. The highest tax rates per tonne of $CO_2$ emissions, established in line with the recommendations, are observed in Sweden – EUR 116.33, Switzerland and Liechtenstein – EUR 85.8, and Finland – EUR 62.0, whereas the lowest tax rates are found in Poland – EUR 0.07, Ukraine – EUR 0.25, and Estonia – EUR 2.00.

When developing public policy measures for a climate-neutral economy, it is recommended to consider a coordinated approach to use both taxes on $CO_2$ emissions and the ETS to make sure the optimal pricing model for carbon dioxide emissions can be established.

The examination of the European practices of implementing measures to combat climate change reveals several effective combinations of the said pricing instruments, namely as follows:

- Model 1 – countries use ETS to curb $CO_2$ emissions, as well as excise duties for energy products, which are indirect price instruments to reduce GHG emissions. There are no explicit carbon taxes (Austria, Belgium, Greece, Italy, Lithuania, Germany, Slovakia, Hungary, Czech Republic);
- Model 2 – countries combine ETS with the carbon tax. In this case, the tax on $CO_2$ emissions can be of two types: a) fuel-based carbon tax (Denmark, Ireland, Iceland, Liechtenstein, Luxembourg, Norway, the Netherlands, Slovenia, Portugal, Finland, France, Switzerland, Sweden); b) emission-based carbon tax (Estonia, Spain, Latvia, the Netherlands, Poland, Ukraine);
- Model 3 – countries combine the ETS with a carbon price floor (CPF), a price –support mechanism that is used to balance the ETS pricing (UK). If the price of quotas in the ETS is below the minimum price level for carbon dioxide emissions in the country, producers pay the difference in the form of a levy. This ensures a stable level of prices for $CO_2$ emissions, while incentivizing investments in climate-neutral technologies, without distorting market conditions for different sectors of the economy.

All models work in conjunction with the existing harmonized excise duties for energy products in the EU. The EU member states, as well as the UK , Iceland, Liechtenstein, Norway and Switzerland , which apply a carbon tax, are also part of the ETS. In some countries, enterprises in certain sectors covered by the ETS are provided with carbon tax relief in the form of a refund of the tax paid. But there are also countries where both instruments are applied simultaneously to the same entities (for example, UK, Ireland, the Netherlands, Finland ).

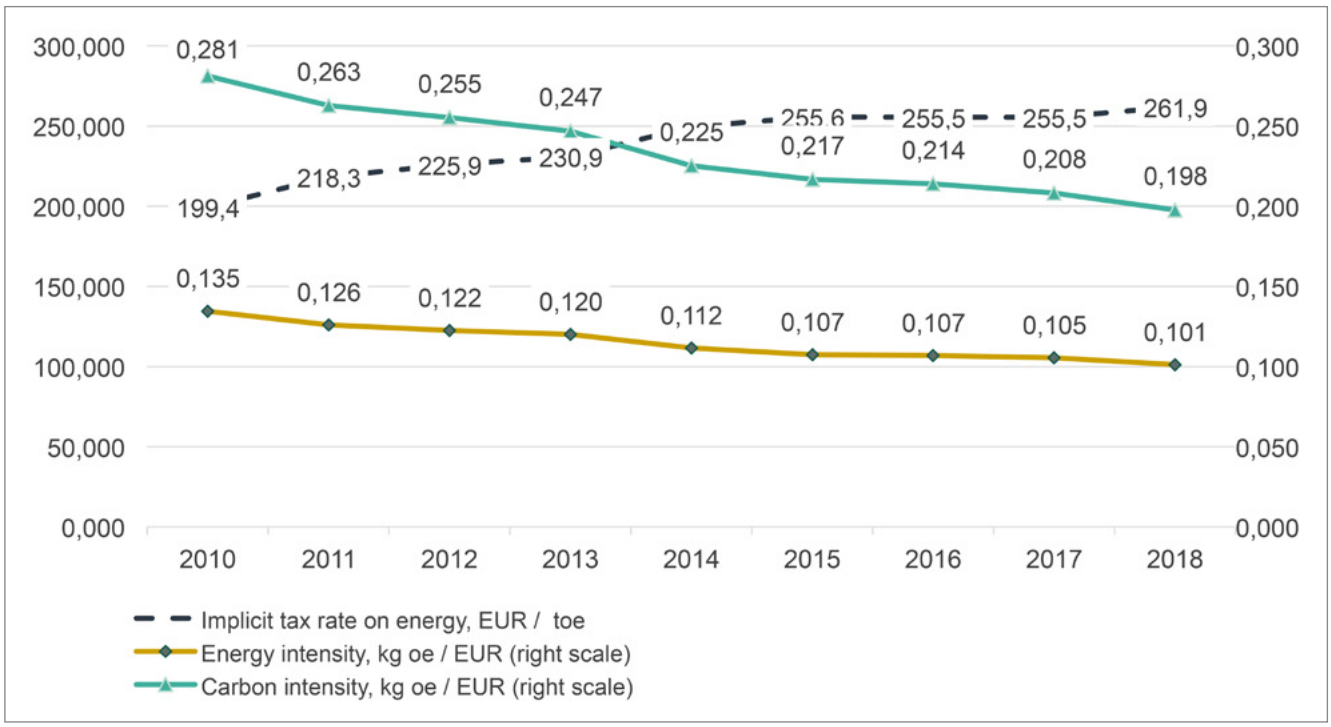


**Fig. 2.3.** Comparing the GDP energy and carbon intensity and the ITR in the EU countries, 2010-2018

**Note:** The ITR is defined as the ratio between total energy tax revenues and final energy consumption. The indicator is measured in EUR per TOE.

**Source:** Taxation trends in the European Union: Data for the EU Member States, Iceland and Norway (2020 Edition) Luxembourg: Publications Office of the European Union, 2020. 308 p. URL: https://op.europa.eu/en/publication-detail/-/publication/c0b00da7-c4b1-11ea-b3a4-01aa75ed71a1; data from Eurostat and the International Energy Agency

In order to study how effective the combination of harmonized excise duties for energy products and $CO_2$ taxes is, let us analyze the dynamics of the GDP energy and carbon intensity and the *implicit tax rate on energy, ITR*, which covers excise duty and taxes on $CO_2$ emissions, in the EU countries in the period of 2010-2018 (Fig. 2.3, 2.4). It has to be noted that typically, when calculating energy intensity and carbon intensity, the total primary energy supply and carbon dioxide emissions from fuel combustion shall be divided by GDP at purchasing power parity. However, because the ITR is determined without adjusting tax proceeds from energy taxes to calculate relevant indicators (unfortunately no specific deflator for energy prices is available), in this research we calculate GDP in market prices.

Although fuel excise taxes are not directly related to $CO_2$ emissions, one can visually trace the effect of the ITR over the GDP energy and carbon intensity. The corresponding values of the correlation coefficients in the EU countries are -0.994 and -0.988, whereas those indicators in Ukraine constitute -0.665 and –0.723, respectively. This makes it possible to conclude that as the ITR is going up, the GDP energy intensity is going down, both in Ukraine and in economically developed countries, which is suggesting a significant regulatory effect of this type of taxes.

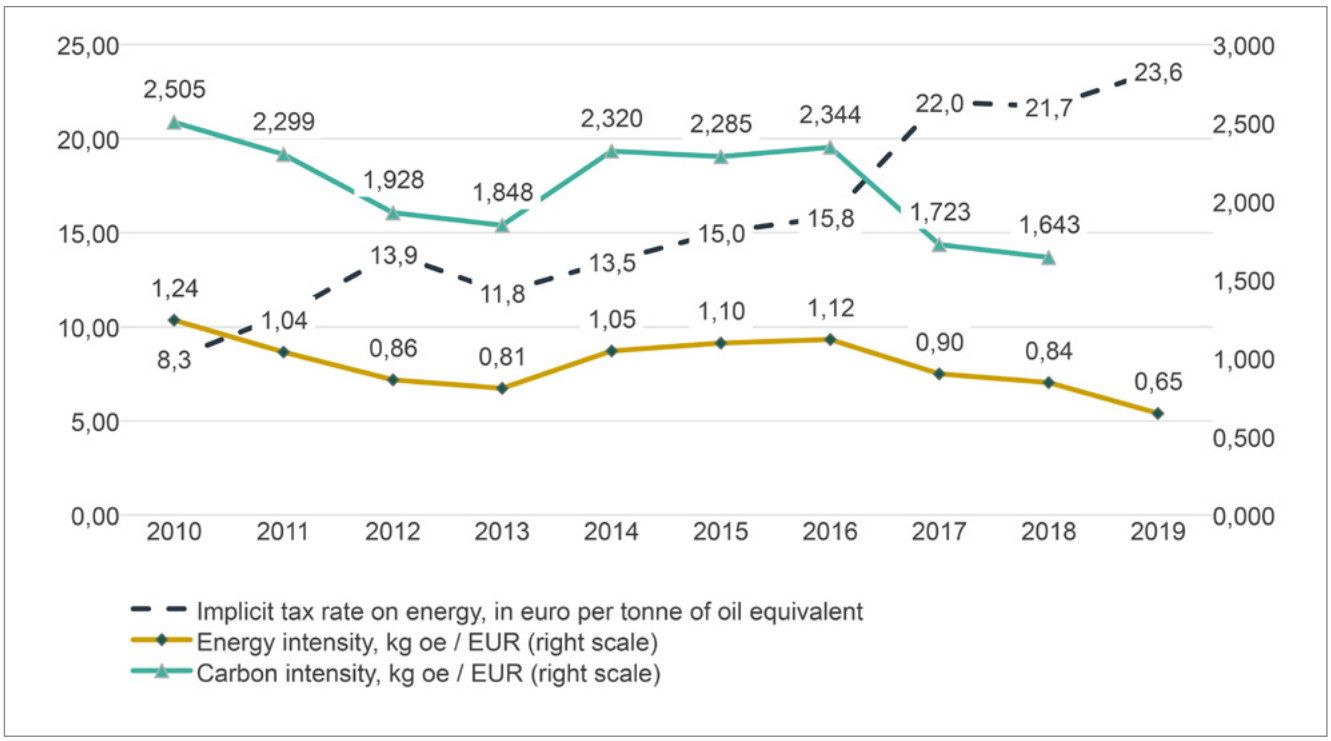


**Fig. 2.4.** Comparing the dynamics of GDP energy and carbon intensity and the ITR in Ukraine, 2010-2018

**Note:** To convert energy tax proceeds into EUR, we used the average annual official exchange rate of the NBU

**Source:** Taxation trends in the European Union: Data for the EU Member States, Iceland and Norway (2020 Edition) Luxembourg: Publications Office of the European Union, 2020. 308 p. URL: https://op.europa.eu/en/publication-detail/-/publication/c0b00da7-c4b1-11ea-b3a4-01aa75ed71a1; data from Eurostat and the International Energy Agency.

However, compared to the EU countries, Ukraine has shown much higher GDP energy and carbon intensity values, in particular, in 2018, Ukraine's indicators exceeded those of the EU by factors of 8.4 and 8.3, respectively. This suggests the need to take actions to improve energy efficiency, including through tax instruments. Currently, the ITR in Ukraine is a twelfth of that in the EU countries. It can therefore be concluded that the fiscal potential of this type of tax has not been realized. This stresses the need to search for a way to increase tax rates on $CO_2$ emissions when making managerial decisions, considering the low paying capacity of economic agents.

As the implicit tax rate is going up, the GDP energy intensity is going down, both in Ukraine and in economically developed countries, which is suggesting a significant regulatory effect of this type of taxes.

# 3 Proposals to reform tax on carbon dioxide emissions in Ukraine

In Ukraine, tax instruments to cut $CO_2$ emissions include excise duty on energy and the carbon tax, which is part of the ET. In this framework, the carbon tax deserves special attention to ensure its fiscal efficiency and to reduce its transactional costs to improve the tax administration.

The taxpayers eligible to pay the ET on carbon dioxide emissions are entities whose total annual carbon dioxide emissions exceed 500 tonnes. The taxation base of the carbon tax is the amount of $CO_2$ emissions by stationary sources, reduced by 500 tonnes based on the results of the fiscal year. It is worth mentioning that $CO_2$ emissions in the transport sector, which make up about 15 – 19 % of the total emissions, are not taxed at all.

As of 2020, 20 000 legal entities were liable to pay this tax. Annual tax revenues per taxpayer are extremely low and amount to UAH 47.5 thousand on average. For comparison, this constitutes 0.01 % of a similar indicator calculated for the fuel excise duty. At the same time, in some sectors, not all $CO_2$ emissions are fully covered by the tax. In particular, in iron, steel and ferro-alloy sector, which is one of the heaviest air pollution sectors, in addition to being one of the largest taxpayers for carbon tax, only 79 % of $CO_2$ emissions get taxed .

It stems from the fact that according to the TCU , the tax calculation shall be based on actual indicators of $CO_2$ emissions, however, in reality it is calculated using a special method, which is rather complicated. In the best case, the calculation is based on the energy consumed and the specificity of the production process. Sometimes business companies determine their tax liabilities “by eye” based on the emission permit data issued to them even before they start their operations. Otherwise, the administration of this tax is characterized by labour-intensive tax audits and the need to involve experts from environmental authorities to verify the tax base calculation. Ultimately, this results in reduced efficiency of this tax and poor tax compliance of taxpayers, as they become aware of possibilities to avoid taxation. All the above does not allow observing the principle of economy of taxation and actually stresses the need to look for ways to simplify the process of tax administration based on international best practices.

As far as Ukraine in concerned, the best solution would be to impose a fuel-based carbon tax. This would make it possible to simplify the administration process, thus incentivizing economic agents to change their energy consumption patterns and production behaviour. Ultimately, all the above should result in improved energy intensity indicators, thus contributing to counteracting climate change.

Based on the review of international best practices, it can be concluded that in order to convert the emission-based carbon tax into the fuel-based carbon tax, the following coefficients should be used: carbon content factor of the fuel, the net calorific value, and the carbon oxidation factor. Such factors also provide the basis for compiling an inventory of GHG emissions for each of the countries participating in the Kyoto Protocol. In particular, the Intergovernmental Panel on Climate Change has developed default carbon content factors for different types of fuel. Taking into account the national fuel performance properties of each country, the carbon factors shall be adjusted to the corresponding fuel indicators determined by the institutions responsible for compiling GHG inventories. For instance, in Ireland, the tax rate is based on the factors calculated annually by the Environmental Protection Agency.

It is highly recommended to use the same practice in Ukraine. The relevant indicators, congruous with the national fuel performance properties, are determined by the National Centre for GHG Emission Inventory, and their values become the basis for compiling the National Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of all GHG for a certain year. If this approach is taken as the basis for the transformational processes of environmental taxation of carbon dioxide emissions, it is necessary to take into account the need for annual approval of such indicators by the Ministry of Environmental Protection of Ukraine.

The applicable coefficients used in the Draft National Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of all GHGs in 1990-2018 , are provided in Annex B.

The formula to convert the tax rate from a carbon dioxide-based tax rate to the one based on physical units of fuel mass / volume of fuel is as follows:

$$Rate_{FB_n} = Rate_{EB} \cdot CC_n \cdot NCV_n \cdot COF_n \cdot D_n \cdot 44/12 \cdot 10^{-3}, \quad (3.1)$$

where $Rate_{FB_n}$ – rate of fuel-based carbon tax per unit of mass (volume) of the n-th type of fuel, UAH / t ($m^3$)

$Rate_{EB}$ – emissions-based carbon tax rate, UAH / t $CO_2$;

$CC_n$ – Carbon Content Factor (tC / TJ or kg C / GJ);

$NCV_n$ – Net Calorific Value (GJ / t);

$COF_n$ – Carbon Oxidation Factor (for complete oxidation the value is 1. Lower values allow for carbon retained in ash or soot);

$D_n$ is the density of the n-th type of fuel, if it is necessary to convert the taxation base from units of mass to units of volume, t / thousand $m^3$;

44/12 – conversion factor from C to $CO_2$.

Calculation of the rate of fuel-based carbon tax is based on Equation 3.1 and Carbon Content Factor itemized in Annex B, as well as based on the Draft Law of Ukraine No. 5600 adopted in the first reading on July 1, 2021 to raise the carbon tax rate to UAH 30 / t (about EUR 1) (see Appendix B).

It has to be noted that the above tax rates are differentiated depending on the fuel carbon content in each of the types of fuel used by the national economy. In addition, when implementing changes to the established fuel-based carbon tax, it is necessary to provide for an exemption from the tax for the use of biomass, since carbon dioxide emissions from combustion of organic matter are offset by the $CO_2$ absorbed during the growth phase.

When modelling the revenue from the carbon dioxide tax based on physical units of fuel measurement, a number of econometric models were created that made it possible to establish the inelasticity of demand with respect to the price of fuel for both the transport sector (petrol –0.47; diesel fuel 0.25; LPG –0.28) as well as other sectors (natural gas –0.002), thus taking into account the effect of a slight decrease in demand when projecting potential revenues (Table 3.1).

| Fuel Type | Model Type |
|---|---|
| **Transport Sector** | |
| Petrol | $\widehat{Cons_{petrol_t}} = \underset{t}{69\,590\,000} - \underset{4.105}{1\,411\,000} \cdot Price_{petrol_t} + \underset{6.478}{0.6202} \cdot Cons_{petrol_{t-1}}$ |
| | $R^2$ = 0.6874, Elasticity coefficient = -0.47 |
| Diesel Fuel | $\widehat{Cons_{diesel_t}} = \underset{t}{59\,810\,000} - \underset{3.265}{1\,036\,000} \cdot Price_{diesel_t} + \underset{7.352}{0.6992} \cdot Cons_{diesel_{t-1}}$ |
| | $R^2$ = 0,6149, Elasticity coefficient = -0.25 |
| Liquefied Petroleum Gas (LPG) | $\widehat{Ln(Cons_{LPG_t})} = \underset{t}{3.27} - \underset{3.1}{0,28} \cdot Ln(Price_{LPG_t}) + \underset{16.1}{0,86} \cdot Ln(Cons_{LPG_{t-1}})$ |
| | $R^2$ = 0.8570, Elasticity coefficient = -0.28 |
| **Stationary Sources of Pollution** | |
| Natural Gas | $\widehat{Cons_{NG_t}} = \underset{t}{57.8} - \underset{1.36}{0.001} \cdot Price_{NG_t} + \underset{13.66}{1.7} \cdot Cons_{NG_{t-1}} - \underset{-5.45}{0,7} \cdot Cons_{NG_{t-2}}$ |
| | |
| **Designations:** $Cons_{petrol_t}$, $Cons_{diesel_t}$, $Cons_{LPG_t}$, $Cons_{NG_t}$ – consumption volumes of petrol, diesel fuel, liquefied gas and natural gas in the current time period; $Price_{petrol_t}$, $Price_{diesel_t}$, $Price_{LPG_t}$, $Price_{NG_t}$ – prices for petrol, diesel fuel, liquefied petroleum gas and natural gas in the current time period; $Cons_{petrol_{t-1}}$, $Cons_{diesel_{t-1}}$, $Cons_{LPG_{t-1}}$, $Cons_{NG_{t-1}}$, $Cons_{NG_{t-2}}$ – consumption volumes of petrol, diesel fuel, liquefied and natural gas in the previous time periods. | |

**Table 3.1** econometric models of price elasticity depending on fuel demand (according to the SSSU 2016-2019)

Considering that the oil products market is oligopolistic, the tax burden will ultimately be placed on fuel consumers. However, according to our calculations, the impact of such changes in the ET system on consumer welfare will be negligible. Hence, the price of petrol, diesel fuel and liquefied gas will increase by 3 to 8 kopecks per litre compared to the respective prices as of January 2021, that is, by 0.2 – 0.4 %. The price of natural gas and fuel oil will increase on average by 0.3 %, whereas the price for coal is expected to rise by 0.9 % (Table 3.2).

According to the Tax Code of Ukraine, the tax calculation shall be based on actual indicators of $CO_2$ emissions. However, in reality it is calculated using a special method, which is rather complicated.

| Fuel Type | Unit | Prices as of January 2021, UAH | Proposed Rate of $CO_2$ Emissions Tax, UAH | New Price, UAH | Price Increase, % |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| **Transport Sector** | | | | | |
| **Price of UAH 10 per tonne of $CO_2$** | | | | | |
| Petrol A-92 | l. | 24.52 | 0.02 | 24.54 | 0.09 |
| Petrol A-95 | l. | 25.66 | 0.02 | 25.68 | 0.09 |
| Diesel Fuel | l. | 24.84 | 0.03 | 24.87 | 0.11 |
| Liquefied Gas for Cars | l. | 12.67 | 0.02 | 12.69 | 0.12 |
| **Price of UAH 30 Per tonne of $CO_2$** | | | | | |
| Petrol A-92 | l. | 24.52 | 0.07 | 24.59 | 0.28 |
| Petrol A-95 | l. | 25.66 | 0.07 | 25.73 | 0.27 |
| Diesel Fuel | l. | 24.84 | 0.08 | 24.92 | 0.32 |
| Liquefied Gas for Cars | l. | 12.67 | 0.05 | 12.72 | 0.36 |
| **Stationary Sources of Pollution** | | | | | |
| **Price of UAH 10 Per tonne of $CO_2$** | | | | | |
| Natural Gas | UAH per thousand m3 | 7056.00 | 19.27 | 7075.27 | 0.27 |
| Fuel Oil | t. | 11850.00* | 31.09 | 11881.09 | 0.26 |
| Energy Coal | t. | 2220.00** | 20.07 | 2240.07 | 0.90 |
| **Price of UAH 30 Per tonne of $CO_2$** | | | | | |
| Natural Gas | UAH per thousand m3 | 7056.00 | 57.81 | 7113.81 | 0.82 |
| Fuel Oil | t. | 11850.00* | 93.26 | 11943.26 | 0.79 |
| Energy Coal | t. | 2220.00** | 60.20 | 2280.20 | 2.71 |
| * as of February 2020, ** as of January 2020 | | | | | |

**Table 3.2** Impact of the proposed $CO_2$ tax on the fuel price in transport sector and stationary pollution sources

**Source:** compiled according to the data of the State Statistics Service of Ukraine; Stock quotes. Ukrainian Energy Exchange LLC. URL: https://www.ueex.com.ua/exchange-quotations/coal-products/#data-filter; Analytical panel (dashboards). Naftogaz of Ukraine NJSC. URL: https://bit.ly/3E1A8MD (www.naftogaz.com/...).

By improving the institutional framework for administering the carbon tax, through conversion of a tax on estimated carbon dioxide emissions into a fuel tax, it is possible to significantly increase tax revenues, even without raising the price of CO2. Thus, according to the results of modelling performed using the data on certain types of fuel consumption by stationary sources of pollution in 2019 to Q1 2021, it can be concluded that potential tax revenues would be increased by 70 % on average if the current price of UAH 10 per tonne of CO2 emissions is maintained (Figure 3.1). However, should the price for CO2 emissions be increased to UAH 30 per tonne, as proposed in a recent Draft Law submitted by the government (Draft Law No. 5600), then considering the drop in fuel consumption in relation to the coefficient of elasticity, potential proceeds from this tax could skyrocket 5.1 times on average. Calculations made on the basis of data from the State Statistics Service of Ukraine for 2019 on the use of all fuels for conversion into other fuels and energy, for consumption by the energy sector, final consumption, including losses in distribution, transport and storage showed that revenues from stationary sources can be doubled at the emission price of UAH 10 / t $CO_2$ and increased by a factor of 6.3 at the emission price of UAH 30 / t.

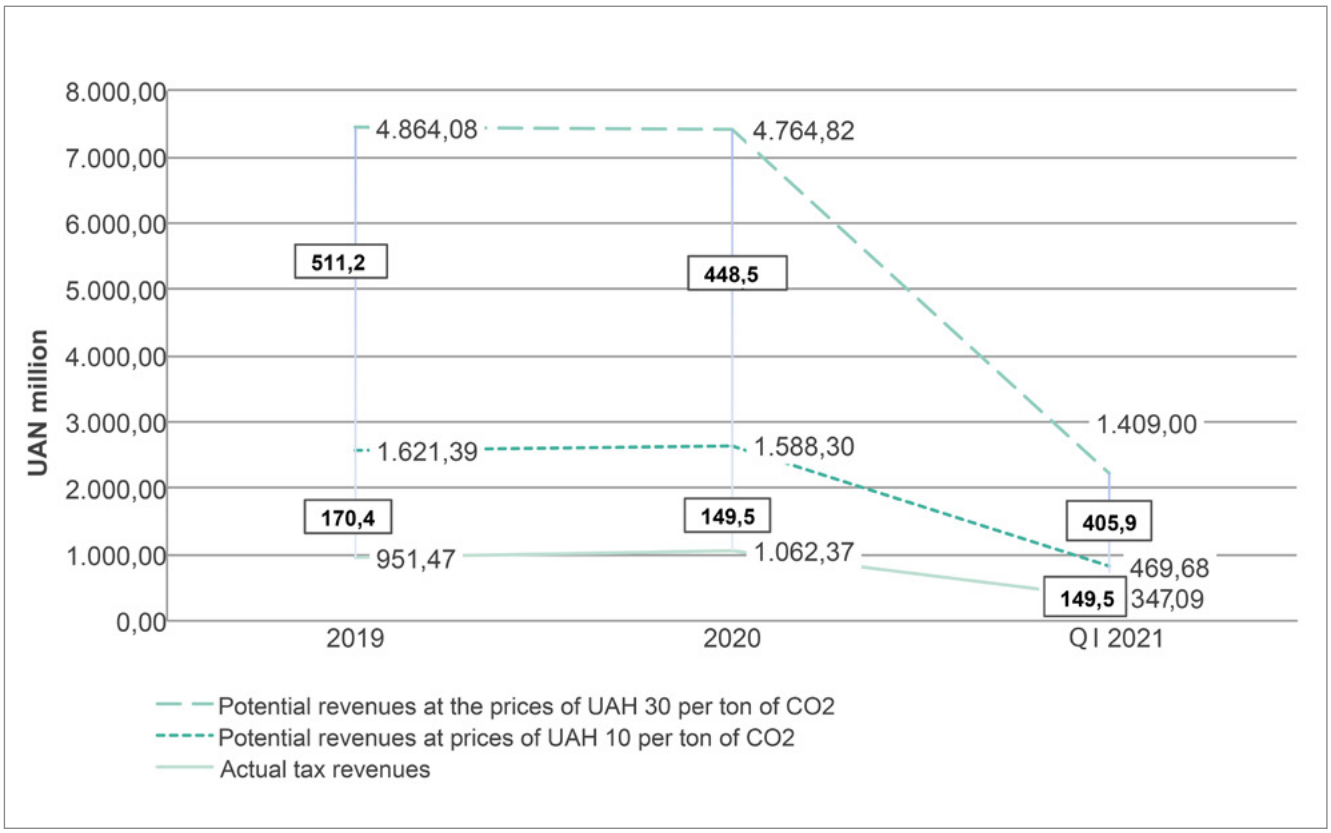


**Fig. 3.1.** Comparing actual and potential tax revenues from the ET on carbon emissions as per results of modelling based on data on certain types of fuel consumption by stationary sources of pollution

**Source:** compiled according to the data of the State Statistics Service of Ukraine and the State Treasury Service of Ukraine.

In addition, budget revenues are expected to grow as a result of taxation of fuel in the transport sector. At the price of UAH 10 per tonne of $CO_2$ emissions, revenues will amount to UAH 1,151.7 million, or 0.06% of the GDP. Should the price be increased to UAH 30 per tonne of $CO_2$, revenues are expected to be UAH 5,357.7 million, or 0.17% of GDP.

It should be pointed out that in metallurgy, cement and other industries, $CO_2$ emissions are generated not only in the course of fuel combustion, but also as a result of various industrial processes and the use of different products. Such emissions are not currently taxed and shall not be included in the proposed solution. In particular, in the production of clinker / cement, such emissions can amount to about 50%, even under condition of a full transition to renewable energy sources. In this regard, it will be necessary to further study the issue of expanding the tax base to cover the relevant types of emissions.

In addition, it will be necessary to provide a tax rebate mechanism to refund the tax paid on fuel used as raw materials in industrial technological processes, for example, in the chemical industry. In order to do so, a mechanism similar to the excise duty on light and heavy distillates used to produce ethylene can be applied. In particular, such energy resources may be taxed at a zero rate and the regulatory authorities shall monitor their intended use. Producers issue a tax bill for the amount of excise duty charged on the volume of oil products received on the basis of a rate that is defined as the difference between the base and zero rate of excise duty. A tax bill must be regarded as settled in case of documentary confirmation of the fact of the intended use of light and heavy distillates exclusively as raw materials in the production of ethylene.

Should the developed solutions be taken into account, it will create conditions for a true display of taxable objects in the tax returns submitted by taxpayers, contributing to simplifying the audit process performed by tax authorities. In addition, it shall boost fiscal efficiency of the ET on $CO_2$ emissions.

Should the tax rate be raised without taking efforts to introduce the relevant structural changes to eco-modernize the economy, it will create an additional tax burden, thus, failing to produce the desired reductions in energy consumption and $CO_2$ emissions. In other words, it will not be possible to achieve environmental goals only by raising the tax rate. Hence, should the Draft Law No. 5600 be adopted, it will be crucially important to make sure that the budgetary revenues received as a result of this reform are channelled to finance climate and environmental measures and resource-conservation.

Government policies should focus on the efficient use of tax revenues. In some countries, in addition to the implementation of a carbon tax, the law clearly defines the ways of using the corresponding tax proceeds, which are collected at an established rate into the budget and Special Funds. This is aimed at improving the state of the natural environment, as well as encouraging environmental initiatives of economic agents. However, the general trend in developed countries is the substitution of the targeted use of the ET with a universal fiscal approach.

To mitigate the social consequences of fiscal regulation of environmental development, special trust funds can be established, the resources from which shall be provided to respective economic agents (through state subsidies programmes) in order to reduce energy consumption and related costs. In France, the National Housing Agency" (ANAH) supports energy efficiency investments and provides assistance to households with moderate incomes using the resources from the Special Trust Fund. In Switzerland, the percentage of the $CO_2$ tax is shared equally among all citizens through the health insurance system. In the Baltic States, some of the tax revenues are directed to certain special environmental programmes.

In line with the best European practices to finance environmental protection measures, it is advisable to consider the proposals of the Ministry of Environment and Natural Resources to create a Special Fund as a separate legal entity of public law. It is suggested that 100% of the ET on $CO_2$ emissions shall be directed to this fund, the purpose of which shall be to implement tools to incentivize and support the execution of environmental protection measures, including those in the field of climate change. However, to ensure the effective use of this mechanism, it is critically important

It will not be possible to achieve environmental goals only by raising the tax rate.

to introduce a competition-based selection procedure for decarbonization projects, in addition to developing an oversight and reporting system to safeguard the targeted use of resources.

The proposed solutions to increase the institutional capacity of tax administration, subject to the introduction of effective mechanisms to finance environmental measures in the field of decarbonization, are expected to lead to the reduction of GHG emissions without having a detrimental effect on the economic competitiveness of domestic enterprises. In addition, due to changes in the tax base, in particular in relation to the carbon dioxide tax, it shall be possible to reduce the number of taxpayers from twenty thousand to one thousand legal entities, while boosting the average annual tax payment from UAH 47.57 to UAH 2103.12. It is suggested to impose the duty to pay these tax-on-tax agents, in particular energy generators and importers. In addition, tax base accounting will be made easy and transparent. This will significantly simplify the job of tax authorities in verifying the tax liability, thus making the punishment for any attempt of taxpayers to lower the tax base inevitable. In this way, the regulatory potential of this tax will be significantly increased.

At the same time, if the tax rate on $CO_2$ emissions goes up appreciably, due to the low coefficient of elasticity of demand for fuel, it is not expected to either change the behaviour of taxpayers or reduce the $CO_2$ emissions. In addition, globally, Ukraine ranks 112$^{th}$ by GDP per capita, hence, the country belongs to the group of countries with an emerging lower-middle income economy. According to A. Pantyukhov, economic expert in Ukraine Economic Outlook, in nine cases out of ten, rising tax pressure would generally produce a negative effect on economic activity. Hence, once the tax rate is raised, it is expected to have a negative effect on the country's GDP and, accordingly, on the level of income of the population.

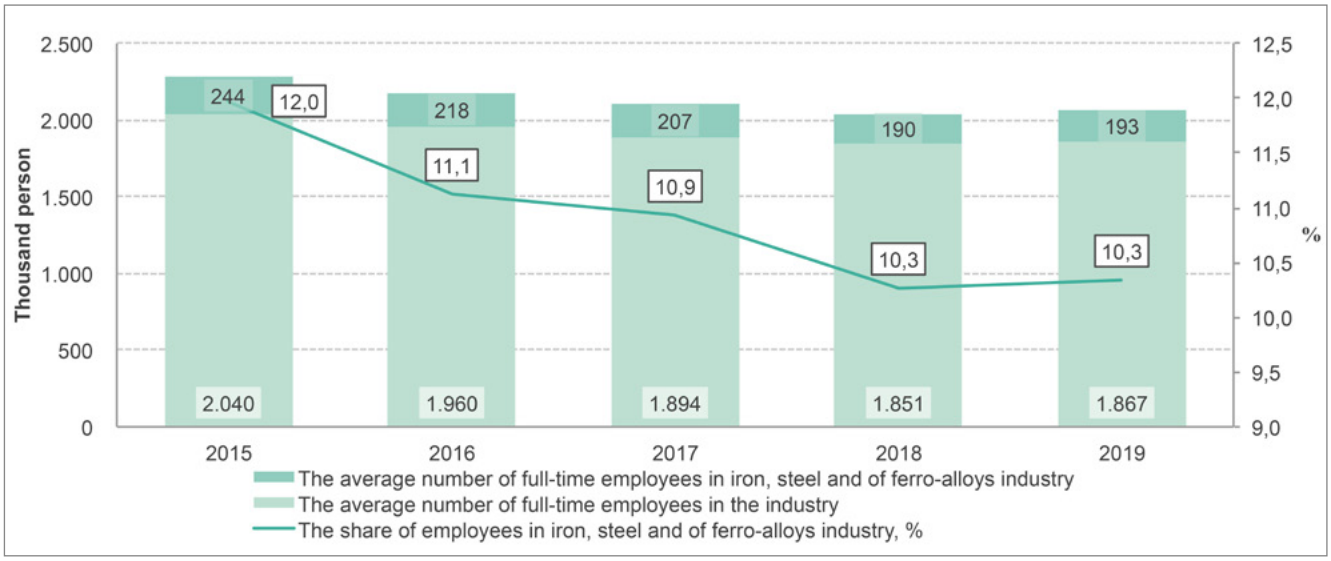


**Fig. 3.2.** Share of workers employed in the iron, steel and ferro-alloy industry, 2015 – 2019

**Source:** calculated according to the data of the State Statistics Service of Ukraine.

It is anticipated that such measures will have the greatest effect on the electricity and metallurgical industries, which generate the largest GHG emissions. Thus, an increase in the tax rate on $CO_2$ emissions to UAH 30 per tonne will lead to the electricity price increase by 1.5–2.6 % (or 3-6 kopecks). As a result, the costs for both industrial consumers and the general public will increase, since the tax is included in the cost of the finished goods. In addition, the industry requires significant investments in eco-modernization, since the fixed assets in the power industry are worn out and by no means energy efficient. An increase in the tax burden can catalyze the process of withdrawing inefficient coal-fired power stations and, in general, the downsizing of the coal industry, while the new technologies are expected to grow, in particular, flexible and highly efficient gas-fired power generators, in addition to renewable technologies. Further increases in the cost of carbon dioxide emissions should occur simultaneously with the introduction of financial tools to boost energy efficiency. This will make it possible to achieve greater environmental benefits.

As already noted, the second strategically important sector of the Ukrainian economy in terms of $CO_2$ emissions is the iron, steel and ferro-alloy sector, the share of which in the total volume of goods and services sold by companies in 2015–2019 totalled to 6% on average. In 2015–2019, the iron, steel and ferro-alloy sector employed 11% of the industrial workforce (Fig. 3.2). About 13% of the personal income tax transferred by the processing industry to the state budget was paid by employees in the iron, steel and ferro-alloy sector.

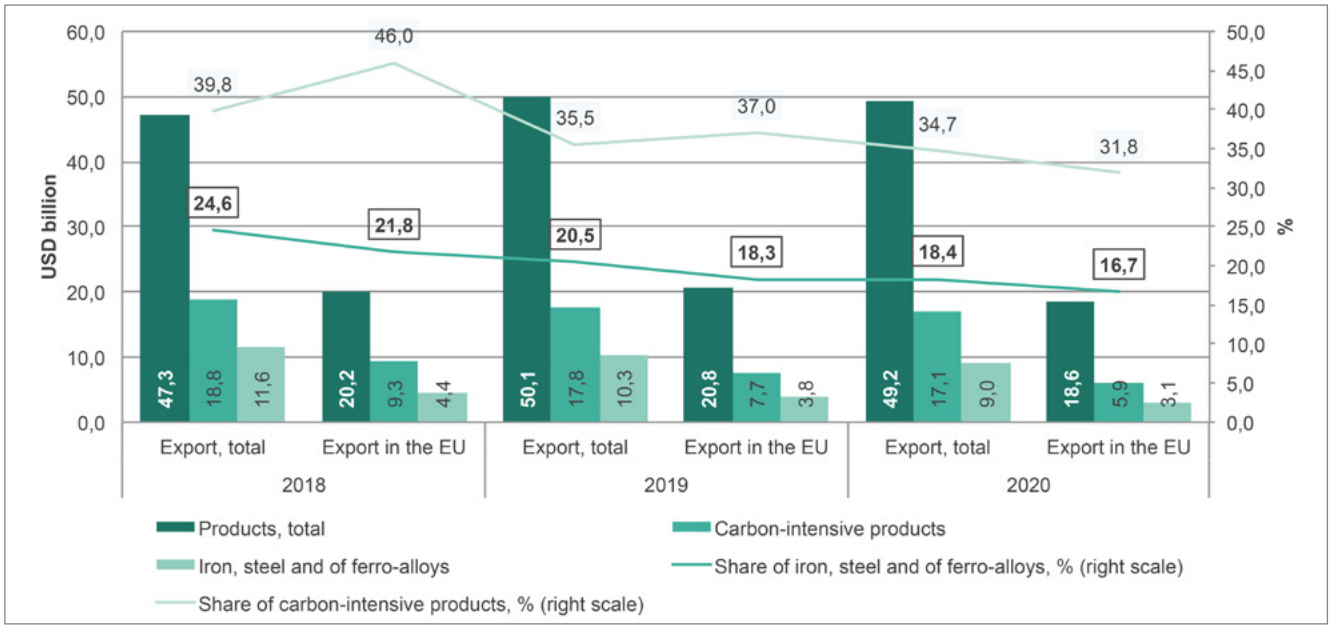


**Fig. 3.3.** Share of exports of carbon-intensive products, including iron, steel and ferro-alloys, in the total volume of exports and exports to the EU in 2018–2020.

**Source:** calculated according to data of the State Statistics Service of Ukraine.

Because the industry is export-oriented, the key factor which determines the demand for the products of the Ukrainian metallurgy is the global economic situation. In recent years this has been unfavourable, partially due to the impact on the world market of the COVID-19 pandemic. As a result, the profitability of enterprises in the industry went negative. However, during the analyzed period, the share of metallurgical products in the total exports remained at a level of 22%, hence the iron, steel and ferro-alloy industry would typically bring US$ 9 billion annually to the Ukrainian economy in the form of currency earnings (Fig. 3.3).

In recent years, Ukrainian exports have re-oriented to the European countries, following the military aggression by the Russian Federation. In particular, metallurgical products accounted for 19% of the total exports to EU member states in 2018-2020, or almost 50% of all carbon-intensive products.

In view of the above, if the cost of carbon dioxide emissions is sharply increased above the level of UAH 30, this may create a difficult situation for the iron, steel and ferro-alloy industry, with risks of undermining domestic product competitiveness, lowering employment and cutting the GDP. From this perspective, it is important to make sure that iron, steel and ferro-alloy enterprises in Ukraine have time and resources to carry out the eco-modernization and decarbonization in order to reduce $CO_2$ emissions. Afterwards, it will be appropriate to further increase the tax rate on $CO_2$ emissions in order to gradually bring it in line with European tax rates. Indeed, with the introduction of the EU Carbon Border Adjustment Mechanism, the difference in the price of carbon dioxide emissions is likely to be remitted to the budget of the EU countries. The higher the tax rate in Ukraine, the more tax revenues are going to stay in the domestic budget, so that less will be transmitted to the EU.

The iron, steel and ferro-alloy industry is the most energy-intensive type of industrial economic activity in Ukraine. It accounts for more than 18% of the total final consumption of energy, the sources of which are coal and peat (48%), natural gas (17%), electricity (18%), heat (16%), and renewable energy sources (less than 1%). At the same time, to produce steel, Ukraine still relies heavily on the outdated and energy inefficient open-hearth method, the share of which is the largest in the world (in 2020, it constituted 19% versus the global indicator of 0.3%). On the other hand, the global iron, steel and ferro-alloy industry is evolving in the direction of improving the energy performance of the existing equipment. In particular, in developed countries, ferrous metallurgy is characterized by intense structural changes, namely, the predominant use of oxygen-converters (73.2% of all steel produced in the world), or electric-arc furnaces (26.3%), as well as the introduction of new concepts to operate electric arc furnaces, along with modern casting technologies. Improvements in operating efficiency, including enhanced process control and predictive maintenance strategies and implementation of best available technologies contribute to approximately 20% of total emissions savings. Furthermore, experts of the World Steel Association have developed the necessary transformational technologies and approaches to ensure decarbonization, in particular:

1) *carbon capture, utilization and storage* (CCUS) and/or sustainable biomass, which can play a critical role in this sustainable transformation. In some industrial and fuel transformation processes, CCUS is considered to be one of the most cost-effective solutions with the potential to yield large-scale $CO_2$ emission reductions;

2) *green hydrogen* can be a clean alternative to coal in iron ore reduction and can replace natural gas as a source of heat in the iron, steel and ferro-alloy industry. This is because when hydrogen reacts with iron oxide the only by-product is water vapour. When the hydrogen used in this process comes from renewable or decarbonized sources, the steelmaking process can become carbon neutral, producing “green steel”;

3) the use of electrical energy in an electrolysis-based process.

Hence, the world best practices suggest there are a number of effective technologies to reduce $CO_2$ emissions. Thanks to these it may be possible to reduce the use of energy in the production of a tonne of cast iron from 13-14 GJ to 2-2.7 GJ, with the investment cost of new technologies amounting to US$ 540-600 per tonne of steel. The energy intensity of state-of-the-art blast furnaces is already approaching a minimum level. In the conditions of eco-modernization of steel manufacturing, the tax hike shall not potentially lead to increasing a tax burden, considering the implied minimization of the tax base.

# 4 Impact of current energy subsidy regime on the efficiency of $CO_2$ emission tax

Among the factors that neutralize the expected positive impact of environmental taxation, one can mention energy subsidies in the form of government support for any kind for energy production, which may lead to reducing the costs of energy production, raising the price for producers, or cutting the price paid by consumers. State subsidies generally have significant negative effects both for the environment and the economy, and their consequences typically include the following: fostering wasteful energy consumption; rapid decline in exports; disparity in the distribution of income in favour of the wealthier segments of the population; increased burden on the state budget; creating threats to energy security by increasing imports; market distortions and barriers to investment in resource-conserving technologies (or marginalization of such technologies); subsidy fraud and corruption. Subsidies to producers or consumers lower the energy price for end-users, and consequently raise energy consumption, hence increasing pollutant emissions. To rationalize the energy subsidy system, it would be necessary to implement measures to inventorise, analyze and evaluate all types of state assistance in order to find optimal solutions in this field. It may be assumed that the transition from the system to provide incentives for energy consumption to targeted support of low-income segments of the population shall help to reduce the burden of energy subsidies on the state budget, leading to more efficient distribution of financial resources, as well as diminishing the excessive burden on the natural environment.

Therefore, the rationalization of energy subsidies and, in the long-run, their complete elimination, seems to be a very important step within the framework of structural reforms necessary to incentivize the employment and post-crisis recovery of the global economy, thus helping the environment, both in the economically developed countries and in Ukraine.

Reforms to rationalize subsidies are expected to condition the economic effect (more efficient distribution and rational use of energy resources), fiscal effects (cutting budget spending and tax incentives, thus, reducing the budget deficit and the external debt) and, more importantly, the environmental effect, such as reduction of GHG emissions and other pollutants released to the air.

The decisive impact of measures to rationalize energy subsidies on the NE will be registered if traditional energy resources are replaced by alternative sources, while the energy conserving measures are widely implemented.

It is beyond doubt that the task to reduce the volume of energy subsidies for Ukraine is extremely important, since Ukraine is one of the 25 countries of the world with the largest volume of energy subsidies (Fig. 4.1), e.g. in 2019 the energy subsidies amounted to 1.5 % of GDP.

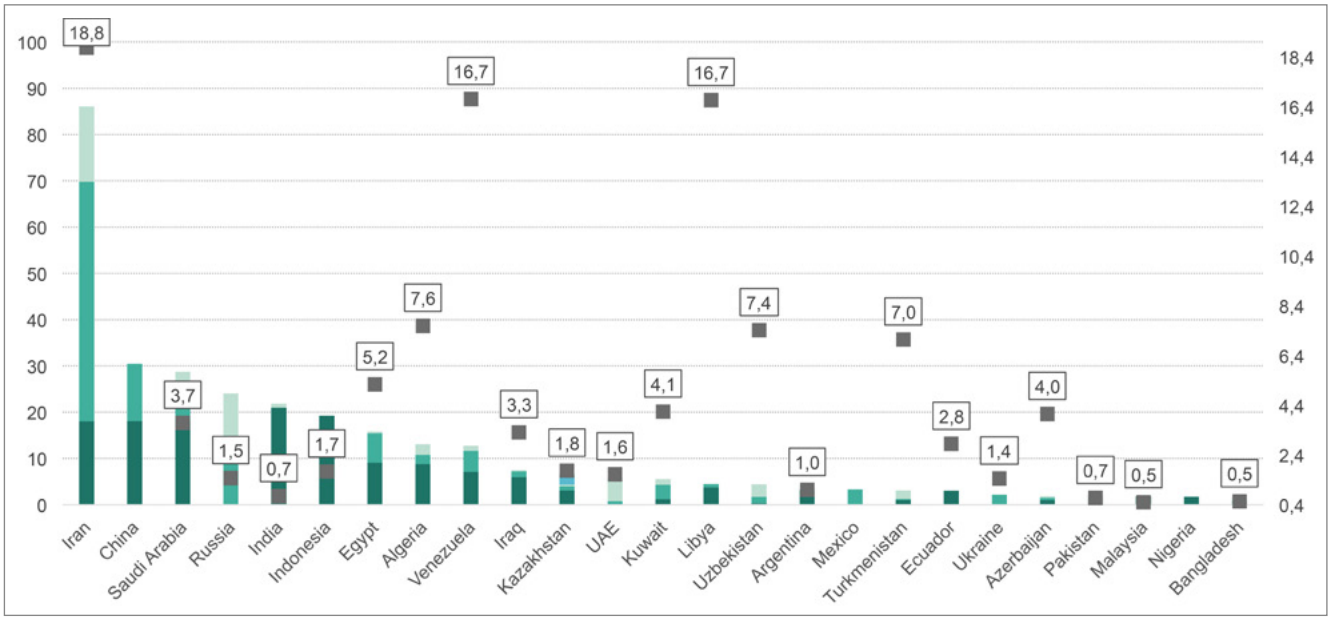


**Fig. 4.1.** Energy subsidies in top 25 countries in 2019, US$ Billion and % of GDP

**Source:** Energy subsidies. Tracking the impact of fossil-fuel subsidies. International Energy Agency. URL: https://www.iea.org/topics/energy-subsidies

In the realm of energy subsidies, Ukraine has demonstrated its commitment to vigorously enforce reforms. To a large extent, it has been galvanized by the occupation of Crimea by the Russian Federation in 2014 and the military conflict in Donbas, resulting in disruption of Ukraine's energy supply chain, since a significant part of coal mines are located in this region. Extremely difficult economic and political situation made the burden of energy subsidies unbearable for Ukraine's budget, impelling the government to launch a rather radical reform of energy subsidies. In view of Ukraine's international commitments, in particular, the EU-Ukraine Association Agreement, and consistent with the IMF conditionality, Ukraine has begun to implement measures to improve energy efficiency.

In particular, the government has reduced cross-subsidization in the electricity sector and taken steps towards market liberalization. Moreover, the government is gradually phasing out subsidies to the coal sector, while de-commissioning unprofitable state-run coal mines. Since 2014, the World Bank's Energy Sector Management Assistance Program (ESMAP), through its Energy Subsidy Reform Mechanism, has provided advice and support to the government of Ukraine in implementing reforms to tariffs and energy subsidies, and related social security measures to prevent energy poverty. As a result, in 2014-2016, the Government managed to raise tariffs for households as follows: by 470% for natural gas, up to the market level, and by 193% for district heating. This has produced a positive effect on the reduction of the budget deficit and the national debt. In particular, it helped to improve the financial viability of the gas sector, which in 2016 recorded the first ever financial surplus.

At the same time, the government supported low-income groups faced with the rising utility prices, expanding the number of subsidy recipients under the housing and utility subsidies programme from one million to 6.9 million households in 2018. Despite the fact that the targeted subsidies is a necessary measure to support vulnerable groups of the population, they may also become a deterrent to energy conservation at the household level, considering that about a third of households currently receive partial compensation for utility bills in accordance with the social consumption standards. This, in turn, could impede the long-awaited modernization of the housing sector. Having imposed more stringent requirements for utility subsidies, the government has managed to reduce the number of subsidy recipients to 3.6 million households in 2019 and to 3 million households in 2021. Simultaneously, the awareness raising campaign has been launched to communicate the reasoning for political decisions and to highlight the government commitment to enhance social assistance tools.

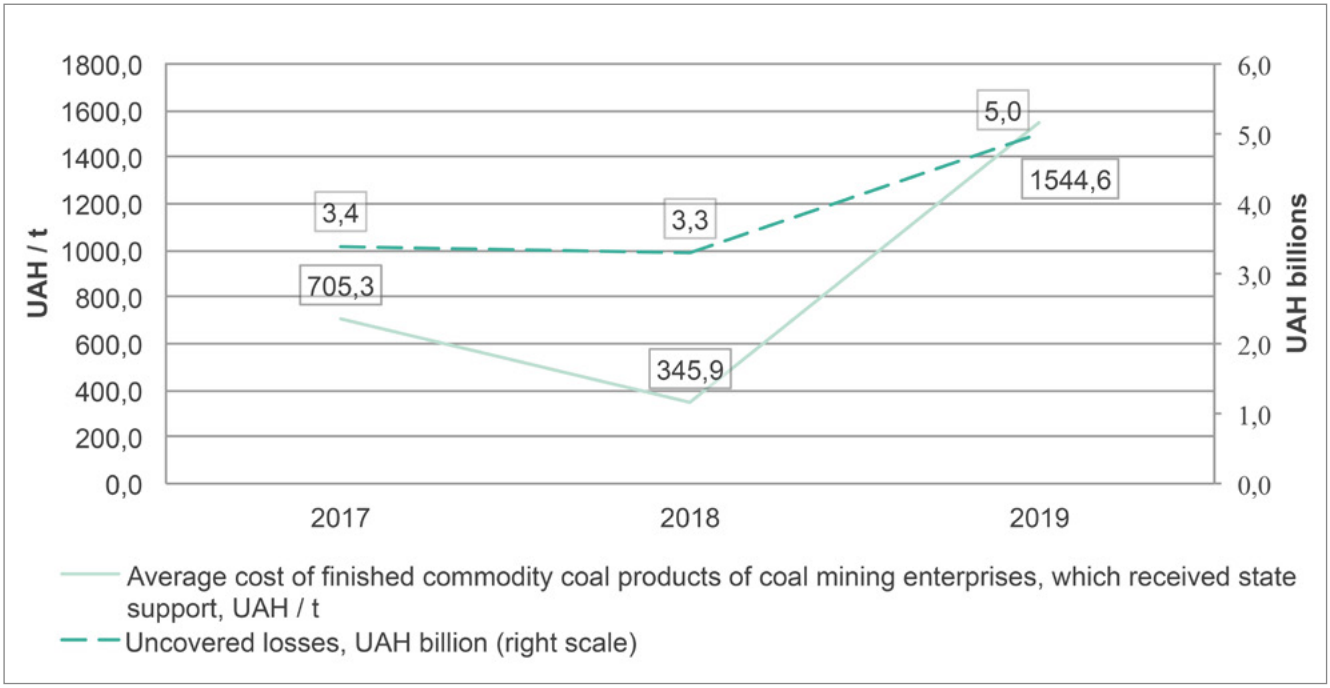


**Fig. 4.2.** Uncovered losses of coal mines and average cost of finished goods, 2017 – 2019 dynamics

**Source:** Source: compiled by the authors according to the Report on the results of the efficiency audit of the state budget funds, which was provided for the Ministry of Energy and Coal Industry of Ukraine for state support of coal mining enterprises to partially cover the costs of finished coal products. Approved by the decision of the Accounting Chamber dated 12.11.2019 №32-2.
URL: https://rp.gov.ua/upload-files/Activity/Collegium/2019/32-2_2019/Zvit_32-2_2019.pdf

Considering that the prices for oil and oil products in Ukraine are market-based, the IEA inventory of energy subsidies established that no subsidies were granted in the oil sector. The government assistance to coal industry enterprises should not be considered as an energy subsidy, as the price difference methodology covers only those government interventions that affect end-user prices. However, in Ukraine, production subsidies are being offered for state-owned mines. As a result, state-owned enterprises sold finished commodity coal products below their cost. Consequently, the state-run enterprises in the coal sector experienced a continuous cashflow shortage (created by the difference between the selling price and the cost, resulting in losses not covered by the sale). Overall, in 2017-2019, the state-owned enterprises in the coal sector incurred losses amounting to UAH 3.9 billion on average, originating from the sale of commercial goods below their costs, despite receiving state subsidies to partially compensate for the costs of production of finished goods. In the meantime, the average cost of finished marketable coal products was constantly increasing (Fig. 4.2). In comparison, the cost of coal mining per tonne at the state-owned enterprise "Krasnolimanskaya Coal Company" amounted to UAH 260 000 per tonne in January 2021, whereas in February of the same year it was equal to UAH 1.11 million per tonne, in March UAH 1.17 million per tonne, and in April UAH 928 200 per tonne.

So, the question of the formation of prices for coal products remains unresolved. Since the beginning of the COVID-19 pandemic in Ukraine, the government support for decarbonization, energy efficiency and environmental measures has generally decreased, while support for fossil fuels has increased, which contradicts global practice (Figure 4.3).

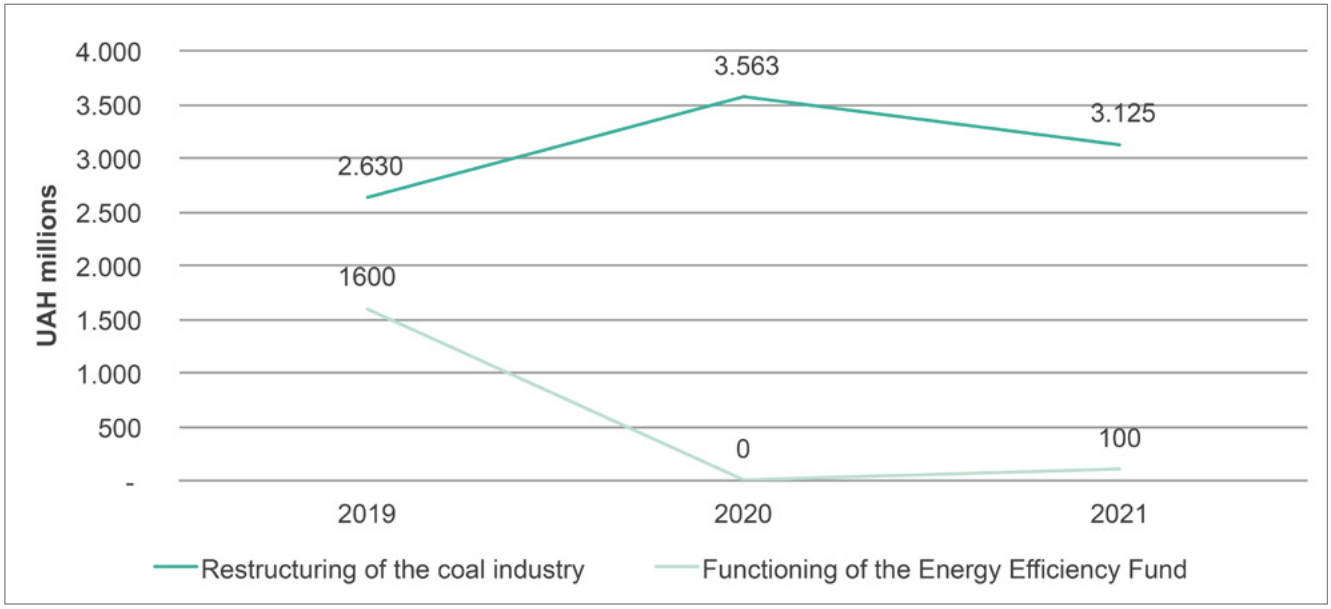


**Fig. 4.3**. Expenditures from the consolidated budget of Ukraine for restructuring of the coal industry and eco-modernization, 2019 – Q1 2021 dynamics

**Source:** compiled on the basis of the Law of Ukraine No. 2629-VIII "On the State Budget of Ukraine 2019" dated November 23, 2018. URL: https://zakon.rada.gov.ua/laws/show/2629-19#Text; Law of Ukraine No. 294-IX "On the State Budget of Ukraine 2020" dated November 14, 2019. URL: https://zakon.rada.gov.ua/laws/show/294-20#Text; Law of Ukraine No. 1082-IX "On the State Budget of Ukraine 2021" dated December 15, 2020. URL: https://zakon.rada.gov.ua/laws/show/1082-20#Text

A good practice would be to plan for phasing out subsidies to cover the costs of state-run coal enterprises; the released funds can be allocated to programmes fostering employment and social benefits for workers.

It should be mentioned that in the State Budget 2020, UAH 1.6 billion was allocated to finance the Energy Efficiency Fund, however, pursuant to the amendments adopted on April 13, 2020, this amount was redirected to the Anti-COVID-19 Fund.

Currently, in Ukraine the issue is being considered to run two pilot projects in coal mining cities of Chervonograd and Mirnograd to steer the coal industry transformation. In particular, the pilot projects provide for the establishment of new manufacturing sites, along with new opportunities for coal mining communities. At the same time, it has been suggested to divide the state-owned coal mines into three groups, namely: 1) the resource base of the "Centerenergo" Energy Company, which will be further re-organized to create a vertically integrated corporation consisting of the most efficient coal mining enterprises; 2) "dual-use" mines, in particular, mines that produce energy coal and coking coal (the latter for use in metallurgy); 3) mines that will be privatised industrial complexes (not just coal mines). Such industrial complexes can afterwards be easily converted into facilities for other types of economic activities.

It should be noted that the coal regions transformation in Ukraine should continue until 2028-2030. In Ukraine, 60 settlements with 30 000 workers employed in the coal industry require the implementation of such changes[2].

Energy subsidies provided to enterprises have not created a significant positive impetus for beneficiaries and entities in related industries. Further work has to be done to revise the mechanism of granting state subsidies, as well as the scope of budgetary and tax support for the energy sector in Ukraine, which is expected to release additional financial resources in the public domain. Instead, such resources can be successfully directed in those sectors that can actually produce a positive impetus to the development of related industries, in particular, agriculture, mechanical engineering, and infrastructure development. A fairly effective tool to cut the state subsidies is the privatization process, which shall enable businesses to independently perform their economic activities on the market in a self-reliant manner. Based on this, we consider it as a good practice to plan for phasing out subsidies to cover the costs of state-run coal enterprises; the released funds can be allocated to programmes fostering employment and social benefits for workers. Furthermore, it is recommended to provide funds for the restructuring of coal mining enterprises based on the concentration of production potential, keeping in mind rational use of financial resources; to continue the transfer of high-potential enterprises to private property through the privatization process and to shut-down unprofitable enterprises in the coal industry.

Despite significant reforms, the volume of energy subsidies remains significant, bringing down the energy costs. This essentially undermines the regulatory effectiveness of the carbon tax, since it does not lead to establishing a fair price for carbon dioxide emissions.

# Conclusions

This research paper offers a solution to an important theoretical and practical issue: how to improve the methodology to determine the principles for environmental taxation of carbon dioxide emissions and how to develop research-based proposals to enhance the effectiveness of the ET administration in Ukraine.

This study has revealed a high degree of national awareness, along with the political will of the executive authorities to implement measures to reduce carbon dioxide emissions in Ukraine, both by raising the environmental taxes on $CO_2$ emissions, and by creating the Special Trust Fund, which shall accumulate tax revenues to finance further programmes to counteract climate change.

The research paper summarizes the key features of environmental taxes of different kinds. In the course of the study, the synergy effect of a direct carbon tax coupled with the GHG ETS is demonstrated, working towards generating price signals reflecting the cost of carbon dioxide emissions which incentivize $CO_2$ emitters to consider the scope of environmental impacts, at market prices. It was identified that particular types of taxes can help to reduce carbon dioxide emissions, namely: 1) direct taxes on $CO_2$ emissions, the rate of which consists only of the environmental component; and 2) excise duty on energy, in which a fiscal component is added to the environmental component. It has been highlighted that the types of direct taxes are the following: emission-based carbon tax and a fuel-based carbon tax, the rate of which is differentiated depending on the fuel carbon content.

Based on a review of the best European practices of taxing $CO_2$ emissions, the following methods of combining different price instruments to counter climate change have been identified:

1) the main instrument to curb $CO_2$ emissions is the GHG ETS (Austria, Belgium, Greece, Italy, Lithuania, Germany, Slovakia, Hungary, Czech Republic);

2) the ETS is coupled with a carbon tax; this method is divided into subtypes:

   2.a) the ETS is combined with Fuel-based Carbon Tax ($CO_2$ structural component in the excise duty rate / as part of environmental taxes);

   2.b) the ETS is used jointly with carbon taxes in the form of the Emission-based Carbon Tax;

3) combination of the ETS with a Carbon Price Floor (CPF). We conclude that the taxation of $CO_2$ emissions by levying a tax on the fuel carbon content is established in countries which prioritize the ease of tax administration and its overall efficiency.

Should the proposed measures be implemented, the environmental tax on CO2 emissions is expected to incentivize economic agents to change their consumption patterns and production behaviour, leading to the GDP energy and carbon intensity reduction and assisting with addressing climate change.

Considering the ways to improve the institutional framework for the administration of the ET in Ukraine, it is advisable to introduce a fuel-based carbon tax, depending on the carbon content in fuel. In parallel with setting the price for each tonne of $CO_2$ emissions, this will boost the static and dynamic efficiency that lie in the tax's potential to reduce $CO_2$ emissions in the least costly way and to influence the process of technological change by creating incentives to develop and implement the innovative technologies to reduce emissions. In this way, the overall tax administration can be also improved, with the following results:

1) cutting the number of taxpayers, while increasing the amount of tax paid by one taxpayer, by way of bringing in tax agents;
2) simplifying the procedure to calculate the tax base for both taxpayers and tax officials;
3) increasing the fiscal efficiency of the ET on carbon dioxide emissions from stationary sources by 70% if the price for $CO_2$ emissions is set at a level of UAH 10 per tonne (or increasing it by a factor of five if the price for $CO_2$ emissions is set at UAH 30 per tonne, as suggested in the Draft Law No. 5600), in addition to bringing potential revenues from the transport sector, which will lead to a total increase in revenues to 0.06-0.17% of GDP;
4) promoting compliance with the principle of economic efficiency and inevitable punishment for breach of tax legislation.

Should the proposed measures be implemented, the ET on $CO_2$ emissions is expected to incentivize economic agents to change their consumption patterns and production behaviour, leading to the GDP energy and carbon intensity reduction and assisting with addressing climate change. At the same time, such institutional transformations are unlikely to have an adverse effect on the well-being of end-users.

As a result of the study, it has been concluded that raising the cost of carbon dioxide emissions to UAH 30 UAH per tonne, together with the proposed measures, will be effective only if the following can be ensured:

1) Targeted use of budget revenues using the Special Fund to finance eco-modernization and decarbonization programmes, in order to ensure the compensatory function of the ET. Furthermore, the public policy focus should be placed on the pragmatic use of tax revenues. Ultimately, a tax increase not complemented by corresponding structural transformations in terms of eco-modernization will create an extra tax burden, at the same time failing to produce the desired effect of reduced energy consumption and carbon dioxide emissions. In other words, it shall not be possible to achieve environmental goals only by amending the tax rate.
2) Following the increase in the cost of $CO_2$ emissions, as declared in the Draft Law No. 5600, it will be crucially important to allow time for modernization of carbon-intensive industries. This will allow the industry to adapt to the new tax rate.

It has been established that the main factors undermining the regulatory potential of the ET on $CO_2$ emissions are energy subsidies which cut energy prices and weaken price signals to carbon emitters. However, the government of Ukraine has made significant efforts to reform subsidies in the fossil fuel industry, which have helped to reduce the budget deficit. At the same time, the funds were partly channelled into targeted subsidies for low-income groups of the population and the energy efficiency programme in the residential sector.

# Bibliography


1 Mancur O. Jr. The Logic of Collective Action: The Logic of Collective Action: Public Goods and the Theory of Groups. Cambridge: Harvard University Press 1971. 208 p.

2 On Approval of the Second Nationally Determined Contribution of Ukraine to Paris Agreement: Draft Resolution of the Cabinet of Ministers of Ukraine. URL: https://bit.ly/3h7VDkW (mepr.gov.ua/files/images).

3 On Approval of the National Economic Strategy 2030: The Resolution of the Cabinet of Ministers of Ukraine No. 179 dated March 3, 2021. URL: https://www.kmu.gov.ua/npas/pro-zatverdzhennya-nacionalnoyi-eko-a179.

4 European Green Deal: Opportunities and Threats for Ukraine. Analytical Document. NGO "Resource Think Tank "Society and Environment", NGO "Institute for Economic Studies and Political Consultations" and NGO "DIXI Group". 2020. URL: http://www.ier.com.ua/files/publications/Policy_papers/IER/2020/european-green-dealwebfinal_UKR_IER_com_ua.pdf.

5 The Ministry of Finance to Present Draft Amendments to Tax Legislation. Ministry of Finance of Ukraine. 2021. URL: https://www.kmu.gov.ua/news/ministerstvo-finansiv-prezentuye-proekt-zmin-do-podatkovogo-zakonodavstva.

6 Government and Business Work Together to Develop Proposals to Reduce Carbon Emissions in Line with the EU Plans. 2020. URL: https://mepr.gov.ua/news/35368.html.

7 Application No. 17/2020 dated September 12, 2019 submitted by the Tax Administration Department of the STS of Ukraine with the Research Institute of Fiscal Policy of the University of the State Fiscal Service of Ukraine to conduct a Research (Theoretical and Technical Work) on the Topic: "Optimization of Environmental Taxation of Activities That Create Excessive Burden on the Environment".

8 On May 13, 2021, the Committee held hearings on the topic: "Distribution and Use of Environmental Tax in Ukraine: Current State of Affairs and Reform Priorities". The Verkhovna Rada of Ukraine Committee on Environmental Policy and Nature Management 2021. URL:http://komekolog.rada.gov.ua/news/main_news/75532.html.

9 The Ministry of Energy suggests a zero rate of environmental tax as a result of burning biofuels – the draft bill is being discussed. Ministry of Energy of Ukraine. 2021. URL: https://www.kmu.gov.ua/news/minenergo-proponuye-vstanoviti-nulovu-stavku-ekologichnogo-podatku-v-rezultati-spalyuvannya-biopaliva-trivaye-obgovorennya-zakonoproektu.

10 On the National Action Plan for Renewable Energy for the Period up to 2020: Ordinance of the Cabinet of Ministers of Ukraine; Action Plan; Measures; No. 902-p as of October 1, 2014. URL: https://zakon.rada.gov.ua/laws/show/902-2014-%D1%80#Text.

11 More than 8% was a share of "green" energy (with large hydropower plants) in the final energy consumption in Ukraine at the end of 2019 / The State Agency on Energy Efficiency. URL: https://saee.gov.ua/uk/news/3620.

12 It has to be noted that the price instruments to restrict $CO_2$ emissions, in line with the European Grean Deal and, respectively, the EU's commitment to achieve carbon neutrality by 2050, should be expanded through the introduction of a tool that complements both taxes and the ETS. This is the Carbon Border Adjustment Mechanism, or CBAM, which will be discussed in more detail below. In the EU, this mechanism implementation is currently being discussed. This tool aims to incentivize other countries to accelerate transition to climate neutrality and prevent the relocation of industrial production outside the EU, or to replace the EU production with imports of products with higher (compared to the EU) $CO_2$ emissions (carbon leakage). However, such an approach may be found disadvantageous for the target countries and contrary to the WTO rules.

13 On the Establishment of the Working Group to Agree on the Approach to the Application of the Carbon Border Adjustment Mechanism at the Border of Ukraine for Consultations with the European Commission: Ordinance of the Cabinet of Ministers; Composition of the Collegial Body; Regulations No. 265 dated March 24, 2021. URL: https://zakon.rada.gov.ua/laws/show/265-2021-%D0%BF#Text.

14 On Amendments to the TCU and Some Legislative Acts of Ukraine to Improve Administration and Revise the Rates of Certain Taxes and Fees: Law of Ukraine No. 2628-VIII dated 23.11.2018. URL: https://zakon.rada.gov.ua/laws/show/2628-19#Text.

15 On Amendments to the TCU and Other Laws of Ukraine Regarding Ensuring the Balance of Budgetary Revenues: Draft Law No. 4101 Dated 15.09.2020. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=69946.

16 On Amendments to the TCU and Some Legislative Acts of Ukraine Regarding Ensuring the Balance of Budgetary Revenues: Draft Law No. 5600 Dated 02.06.2021. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=72106.

17 What Should Be the Environmental Tax and the System for Financing Environmental Activities: the Position of the Ministry of Environment. Ministry of Environmental Protection and Natural Resources of Ukraine. 2020. URL: https://www.kmu.gov.ua/news/yakim-maye-buti-ekologichnij-podatok-ta-sistema-finansuvannya-prirodoohoronnih-zahodiv-poziciya-mindovkillya.

18 Report on Instruments to Incentivize Green Modernization of Industrial Enterprises in the EU Countries and Ukraine. 2021. Public Council under the Ministry of Environment and Natural Resources of Ukraine. All-Ukrainian Non-Governmental Organization "Living Planet". URL: https://mepr.gov.ua/files/%D0%B7%D0%B2%D1%96%D1%82.pdf.

19 Sandmo A., investigating optimal rates of the environmental tax, came to the conclusion that in order to tax goods, the production or consumption of which places an excessive burden on the environment, the tax rate should be set not only in accordance with the social costs of pollution, but also taking into account the elasticity of demand for the taxed goods. The researcher proved that the rate of indirect ET should consist of the Pigou and Ramsey components, the share of which shall be determined by the need to realize the fiscal potential. If the specific weight of the Ramsey component is a, and the specific weight of the Pigou component is (1-a), the ET rate shall be: T = a TR + (1–a) MSPC; 0 < a < 1, in which T is the ET rate. TR is a fiscal component and (1–a) MSPC is the environmental component; TR is the inverse price elasticity of demand for goods that are the base of taxation; MSPC is the marginal social cost of pollution. (Sandmo A. Optimal Taxation in the Presence of Externalities. The Swedish Journal of Economics. 1975. Vol. 77. № 1. pp. 86–98).

20 Expenses related to the calculation of tax liabilities, tax collection and security; and all other expenses incurred by any party that allow, facilitate and ensure the relationship between taxpayers and tax authorities.

21 If, for some reason, the fulfilment of as many Pareto optimality conditions as possible is not the most reliable way to achieve maximum efficiency, and at the same time certain conditions are still violated and the "best solution" is unattainable, it is necessary to search for the "second-best-solution", which is suboptimal and involves deliberate deviation from options that appear most effective in the context of partial equilibrium (Andrushchenko V. L., XX century. Theoretical conceptualization and science problems state finances: [monograph]. Lviv: Kamenyar, 2000. 305 p.) 2000. 305 c.).

22 According to the production efficiency theorem of P.Diamond and J.Mirlis, the condition for the optimality of the tax system is the collection of taxes on finished, not intermediate goods (Crawford I. Value Added Taxes and Excises / I. Crawford, M. Keen, S. Smith // The Mirrlees Review [by eds. J. Poterba]. Oxford : Oxford University Press for Institute for Fiscal Studies, 2010).

23 EU Emissions Trading System (EU ETS). European Commission. URL: https://ec.europa.eu/clima/policies/ets_en.

24 Fiscal Monitor: How to Mitigate Climate Change. International Monetary Fund. 2019. URL: https://www.imf.org/en/Publications/FM/Issues/2019/09/12/fiscal-monitor-october-2019#Mitigating%20Climate%20Change.

25 Paris Agreement: International Document. United Nations. 12.12.2-15. URL: https://zakon.rada.gov.ua/laws/card/995_l61.

26 Fiscal Monitor: How to Mitigate Climate Change. International Monetary Fund. 2019. URL: https://www.imf.org/en/Publications/FM/Issues/2019/09/12/fiscal-monitor-october-2019#Mitigating%20Climate%20Change.

27 Lin, B.; Li, X. The effect of carbon tax on per capita $CO_2$ emissions. Energy Policy 2011, 39, 5137–5146.

28 The IMF's recommended level of tax on carbon dioxide emissions is 63 euros per ton of CO2 (exchange rate as of July 2021).

29 Asen E. Carbon Taxes in Europe. Tax Foundation. 2021. URL: https://taxfoundation.org/carbon-taxes-in-europe-2021/.

30 Carbon Pricing Dashboard. The World Bank. URL: https://carbonpricingdashboard.worldbank.org/map_data.

31 The UK ETS became operational on January 1, 2021, on the UK's exit from the EU and the EU ETS. The design features of the UK ETS are very similar to those of the EU ETS, however, the UK ETS has a stricter emission limit (5% lower than the EU ETS limit), which is going to be reduced every year by 4.2 million tonnes.

32 Swiss ETS came into operation in 2008 with a five-year voluntary phase as an alternative to a $CO_2$ tax on fossil fuel. The revised regulations came into force in January 2013. Later on, the ETS became mandatory for large energy-intensive enterprises, while the medium-sized companies could join it voluntarily. In January 2020, the Swiss ETS was linked to the EU ETS and expanded to include Swiss domestic aviation (including flights to the European Economic Area) and fossil thermal power plants. In addition to it, the ETS is applied to industrial enterprise in the cement, chemical, pharmaceutical and paper industry, as well as the refining and metallurgical industries. The ETS participants are exempt from $CO_2$ tax.

33 Linking the emission trading systems of Switzerland and the EU: Negotiation process. URL: https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/climate-policy/emissions-trading/linking-the-swiss-and-eu-emissions-trading-schemes/linking-of-the-emission-trading-systems-of-switzerland-and-the-e.html.

34 Proposals for the development of carbon pricing instruments in Ukraine. Partnership for market readiness in Ukraine (PMR). 2019. URL: https://bit.ly/3jN0vxy (mepr.gov.ua/files/...).

35 Based on the data of the STS of Ukraine, the indicator is calculated as the ratio of the taxation base to the carbon dioxide emissions into the atmosphere produced by stationary sources of pollution. If we use the data of the National Inventory of Anthropogenic Emissions from Sources and Removals by Sink of all GHGs in Ukraine, then the share of taxed emissions will constitute only 40%.

36 TCU: Law of Ukraine No. 2755-VI dated December 2, 2010. URL: https://zakon.rada.gov.ua/laws/show/2755-17#n5980.

37 Draft National Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of all GHG in 1990-2018. Ministry of Environmental Protection and Natural Resources of Ukraine. URL: https://mepr.gov.ua/news/34928.html.

38 Draft Law On Amendments to the Tax Code and Some Legislative Acts of Ukraine Regarding Ensuring the Balance of Budgetary Revenues: Draft Law No. 5600 Dated 02.06.2021. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=72106.

39 Coal, motor petrol, diesel fuel, natural gas, heavy fuel oils, liquefied propane and butane.

40 On Amendments to the TCU and Some Legislative Acts of Ukraine Regarding Ensuring the Balance of Budgetary Revenues: Draft Law No. 5600 Dated 02.06.2021. URL: http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=72106.

41 Report on Instruments to Incentivize Green Modernization of Industrial Enterprises in the EU Countries and Ukraine. 2021. Public Council under the Ministry of Environment and Natural Resources of Ukraine. All-Ukrainian Non-Governmental Organization "Living Planet". URL: https://bit.ly/3nbh4Fs (mepr.gov.ua...)

42 Raising taxes: are we on the right track? / Comments.ua. 2021 https://politics.comments.ua/ua/news/domestic-policy/pidvischennya-podatkiv-virnoyu-dorogoyu-ydemo-679412.html.

43 The open-hearth smelting process is based on oxidation processes, as a result of which liquid steel with a set composition is produced from metal charge. Unlike converters in open-hearth furnaces, melting occurs due to the heat of the flame formed during combustion of a mixture of blast furnace and coke oven gases in the furnace.

44 Iron and Steel Technology Roadmap. Technology report / IEA. October 2020 URL: https://www.iea.org/reports/iron-and-steel-technology-roadmap45.

45 Climate change and the production of iron and steel / World Steel Association. 2021. 8 p. URL: https://www.worldsteel.org/publications/position-papers/climate-change-policy-paper.html.

46 Report 3 / Modeling Report on the Second Nationally Determined Contribution to the Paris Agreement URL: https://bit.ly/3jNYRvv (mepr.gov.ua/files/images...), p. 47.

47 World Energy Outlook – 1999 insights. Looking at Energy Subsidies: Getting the Prices Right. – Paris: International Energy Agency [Electronic resource]. – Access: http://www.iea.org.

48 Novytska N.V. „Energetychni subsydii: svitovi tendencii ta ukrainska praktyka" / D. M. Serebrianskyj, N.V. Novytska // Naukovi zapysky. Serija «Ekonomika»: zbirnyk naukovych prac. – 2012. – Issue. 19. – P. 56–60.

49 In September 2009, G20 leaders agreed to rationalize and phase out inefficient energy subsidies in the medium term. A similar commitment was made by the leaders of the Asia – Pacific Economic Cooperation (APEC) in November 2009.

50 Snapshot of Ukraine's Energy Sector Institutions, Governance and Policy Framework. OECD. 2019. URL: https://www.oecd.org/eurasia/competitiveness-programme/eastern-partners/Snapshot-of-Ukraines-Energy-Sector-EN.pdf.

51 Inventory of energy subsidies in the EU Eastern Partnership Countries: Ukraine. URL: https://www.oecd.org/environment/outreach/Energy%20subsidies%20in%20Ukraine_final_UA_3.02.2019.pdf.

52 Energy Subsidy Reform Facility Country Brief: Ukraine. World Bank Group. 2019. URL: https://olc.worldbank.org/content/energy-subsidy-reform-facility-country-brief-ukraine.

53 Inventory of energy subsidies in the EU Eastern Partnership Countries: Ukraine. URL: https://www.oecd.org/environment/outreach/Energy%20subsidies%20in%20Ukraine_final_UA_3.02.2019.pdf.

54 Inventory of energy subsidies in the EU Eastern Partnership Countries: Ukraine. URL: https://www.oecd.org/environment/outreach/Energy%20subsidies%20in%20Ukraine_final_UA_3.02.2019.pdf.

55 Report on the results of auditing the public funds allocated to the Ministry of Energy and Coal Industry of Ukraine to provide state assistance to coal mining enterprises in the form of partial coverage of costs of finished coal commodity products. Approved by the Resolution of the Accounting Chamber No.32-2 dated November 12, 2019. URL: https://rp.gov.ua/upload-files/Activity/Collegium/2019/32-2_2019/Zvit_32-2_2019.pdf.

56 Information on coal commodity products. URL: https://data.gov.ua/dataset/19a376c7-90a3-40d2-a9da-2df2c354646e.

57 Global Best Practices for Green Recovery During the COVID-19 Pandemic: Opportunities for Ukraine. DiXi Group. 2021 Quarterly Report No. 1. URL: https://dixigroup.org/wp-content/uploads/2021/04/dixi_greenrecovery_qr1-1.pdf.

58 Bredikhina G. Shmyhal named the first coal miners' cities to participate in the experiment under the "Green Deal" with the EU. UNIAN. 2021. URL: https://www.unian.ua/economics/energetics/shmigal-nazvav-mista-v-yakih-teper-budut-rozvivati-vugilnu-galuz-novini-sogodni-11474932.html.

# Annexes

| Tax Components | Types of carbon taxes | | | |
|---|---|---|---|---|
| | $CO_2$ structural component in the rate of excise duty on (Fuel-based) | Components of Taxes on Environmental Pollution | | Mechanism for keeping coal dioxide prices as low as possible |
| | | Tax on Measured / Estimated Emissions (Emissions based) | Tax on Energy Consumption | |
| **Taxpayers** | producers and importers of fossil fuel and oil products (other than crude oil) | economic agents that use fossil fuel as a factor of production | | |
| **Object of tax** | operations for the sale of fossil fuel and oil products | actual or estimated volumes of $CO_2$ emissions | volumes of fossil fuel consumption | |
| **Tax Base** | physical volumes of fossil fuel and oil products | volumes of $CO_2$ emissions | physical volumes of fossil fuel | |
| **Criteria for Rate Differentiation** | depending on the type and origin of the fuel and fuel carbon content | n/a | depending on the type of fossil fuel and its carbon content | |
| **Exemptions** | exemption, refund | establishing the emitter's maximum capacity and/or maximal emission limits, subject to taxation | exemption | low-capacity electricity producers, standby generators, exemption based on geographic criterion; enterprise that use co-generation technologies |

**Annex A**: Summary of key features of different types of carbon taxes

**Source: compiled by the authors based on the data of Carbon Pricing Dashboard of the World Bank.**

**URL: https://carbonpricingdashboard.worldbank.org/map_data.**

| Fuel | Carbon content factor, tC/TJ | Net calorific value, NCV GJ/t | COF (carbon oxiditation factor) | Density, t / thousand $m^3$ | Molecular weight ratio of $CO_2$ to C |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| Coal | 25.99 | 21.51 | 0.98 | | 3.67 |
| Briquettes, pellets from coal | 26.60 | 15.23 | 1.00 | | 3.67 |
| Lignite | 27.60 | 8.63 | 1.00 | | 3.67 |
| Briquettes, pellets from lignite | 26.60 | 16.53 | 1.00 | | 3.67 |
| Non-agglomerated fuel peat | 28.90 | 10.28 | 1.00 | | 3.67 |
| Briquettes, pellets from peat | 28.90 | 14.66 | 1.00 | | 3.67 |
| Crude oil, including oil from bituminous materials | 20.00 | 41.55 | 1.00 | | 3.67 |
| Gas condensate | 17.50 | 37.97 | 1.00 | | 3.67 |
| Natural gas | 15.22 | 48.50 | 1.00 | 0.71 | 3.67 |
| Coke and semi– coke from coal, gaseous coke | 29.20 | 28.59 | 1.00 | | 3.67 |
| Coal, lignite, and peat resins | 22.00 | 28.00 | 1.00 | | 3.67 |
| Pitch and pitch coke | 29.20 | 28.20 | 1.00 | | 3.67 |
| Aviation gasoline | 19.10 | 44.30 | 1.00 | | 3.67 |
| Motor Petrol | 19.65 | 43.04 | 1.00 | | 3.67 |
| Mixed motor fuel containing bio-ethanol ... 5% -30% | 19.65 | 43.04 | 1.00 | | 3.67 |
| Fuel for jet engines of the gasoline type | 19.65 | 43.04 | 1.00 | | 3.67 |
| Oil distillates, other light fractions | 19.65 | 43.04 | 1.00 | | 3.67 |
| Light oil distillates for production of motor Petrol | 20.00 | 40.20 | 1.00 | | 3.67 |
| Fuel for jet engines of the kerosene type | 19.50 | 44.10 | 1.00 | | 3.67 |
| Kerosene | 19.60 | 43.80 | 1.00 | | 3.67 |
| Gas oil | 20.12 | 43.05 | 1.00 | | 3.67 |
| Medium oil distillates, other medium fractions | 20.12 | 43.05 | 1.00 | | 3.67 |
| Heavy fuel black oils | 21.10 | 40.18 | 1.00 | | 3.67 |
| Petroleum oils, heavy oil distillates | 20.00 | 39.81 | 1.00 | | 3.67 |
| Propane and butane, liquefied | 17.20 | 45.35 | 1.00 | | 3.67 |
| Ethylene, propylene, petroleum gases, other... | 15.70 | 43.67 | 1.00 | | 3.67 |
| Petroleum coke (including shale) | 26.60 | 31.65 | 1.00 | | 3.67 |
| Other types of oil products | 20.00 | 40.20 | 1.00 | | 3.67 |
| Other fuel processing products | 20.00 | 40.20 | 1.00 | | 3.67 |
| Coke oven gas produced as a by-product | 12.10 | 35.22 | 1.00 | | 3.67 |

**Annex B:** Indicator values to calculate the carbon dioxide tax rate based on physical energy units

**Source:** compiled based on the following: Guidelines for National GHG Inventories. Volume 2 (Energy). Intergovernmental Panel on Climate Change: IPCC 4 Geneva, Switzerland 2006 IPCC; Draft National Inventory of Anthropogenic Emissions from Sources and Removals by Sink of all GHG in Ukraine in 1990-2018. Ministry of Environmental Protection and Natural Resources of Ukraine. URL: https://mepr.gov.ua/news/34928.html.

| Fuel | Price of $CO_2$ emissions: UAH 10 / t | Price of $CO_2$ emissions: UAH 30 / t |
|---|---|---|
| | Tax rate, UAH / UAH / t (thousand $m^3$) | |
| Coal | 20.07 | 60.20 |
| Briquettes, pellets from Coal | 14.85 | 44.56 |
| Lignite | 8.73 | 26.20 |
| Briquettes, pellets from lignite | 16.12 | 48.37 |
| Non-agglomerated fuel peat | 10.89 | 32.68 |
| Briquettes, pellets from peat | 15.53 | 46.60 |
| Crude oil, including oil from bituminous materials | 30.47 | 91.41 |
| Gas condensate | 24.36 | 73.09 |
| Natural gas | 19.27 | 57.81 |
| Coke and semi– coke from coal, gaseous coke | 30.61 | 91.83 |
| Coal, lignite, and peat resins | 22.59 | 67.76 |
| Pitch and pitch coke | 30.19 | 90.58 |
| Aviation gasoline | 31.02 | 93.07 |
| Motor Petrol | 31.01 | 93.03 |
| Mixed motor fuel containing bio-ethanol ... 5% -30% | 31.01 | 93.03 |
| Fuel for jet engines of the gasoline type | 31.01 | 93.03 |
| Oil distillates, other light fractions | 31.01 | 93.03 |
| Light oil distillates for production of motor Petrol | 29.48 | 88.44 |
| Fuel for jet engines of the kerosene type | 31.53 | 94.59 |
| Kerosene | 31.48 | 94.43 |
| Gas oil | 31.76 | 95.28 |
| Medium oil distillates, other medium fractions | 31.76 | 95.28 |
| Heavy fuel black oils | 31.09 | 93.26 |
| Petroleum oils, heavy oil distillates | 29.19 | 87.58 |
| Propane and butane, liquefied | 28.60 | 85.80 |
| Ethylene, propylene, petroleum gases, other... | 25.14 | 75.42 |
| Petroleum coke (including shale) | 30.87 | 92.61 |
| Other types of oil prod. | 29.48 | 88.44 |
| Other fuel processing products | 29.48 | 88.44 |
| Coke oven gas produced as a by-product | 15.63 | 46.88 |

**Annex C:** carbon tax rates based on measured / estimated $CO_2$ emissions and physical energy units

**Source:** calculated by authors based on Formula 2.1.

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This research paper is an overview of theoretical aspects of carbon taxing. This publication aims to review and summarize the practice of combining the environmental taxation system with the $CO_2$ Emissions Trading System commonly used in European countries. In the course of the study, practical recommendations have been developed focusing on the future of the environmental taxation of greenhouse gas emissions.

The results of this study can be used by government authorities and a wide range of stakeholders involved in the elaboration of solutions to create and implement the environmental taxation policy.

Sponsored by

Federal Republic of Germany
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Published by:

Zentrum Liberale Moderne
Reinhardtstrasse 15
10117 Berlin
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