The Environmental Taxation System

Alejandro Pinzón Naranjo[1]

1. Introduction

This paper presents a framework for understanding environmental taxation. In general terms, environmental taxation refers to a set of policy tools aimed at promoting a sustainable environment through charges[2], limits, or tax incentives. However, there is no universally accepted definition of what constitutes an environmental tax.

The purpose of this paper is to explain the goals of environmental taxation and the fiscal instruments used to achieve them. It begins by outlining the main aims

1 In the preparation of this thesis, I made use of the AI tool ChatGPT (developed by OpenAI) as a writing assistant. Specifically, I used it to improve the clarity, coherence, and academic tone of my writing. All content generated with the assistance of ChatGPT was critically reviewed and edited by me to ensure accuracy, academic integrity, and alignment with my research objectives. No AI-generated text was used without proper verification and adaptation. Also, I asked ChatGPT to make this statement.

2 In this paper, the word "charge" is used as a synonym to payment or financial burden (as defined in a dictionary). See Merriam-Webster, *Charge (1)*, Merriam-Webster.com Dictionary, 2024, https://www.merriam-webster.com/dictionary/charge accessed 4 June, 2025.

of environmental taxation then distinguishes between different types of environmental taxes, namely, explicit taxes (such as carbon and energy taxes) and implicit taxes (including emissions trading systems and carbon border adjustment measures). It also considers environmental tax incentives with a particular focus on their interaction with the OECD's Pillar Two framework. The paper ultimately seeks to provide a comprehensive overview of environmental taxation by examining (i) its objectives, (ii) the distinction between explicit and implicit taxes, and (iii) the role of tax incentives.

The following table presents the structure used in this article to categorize the main components of environmental taxation. It distinguishes between two groups: environmental taxes[3] and tax incentives. This distinction is important. Environmental taxes impose a charge, either explicitly or implicitly, on activities that harm the environment while tax incentives encourage environmentally beneficial behavior by reducing tax burdens. In this sense, environmental taxes can be seen as a "negative" approach and tax incentives as a "positive" one.

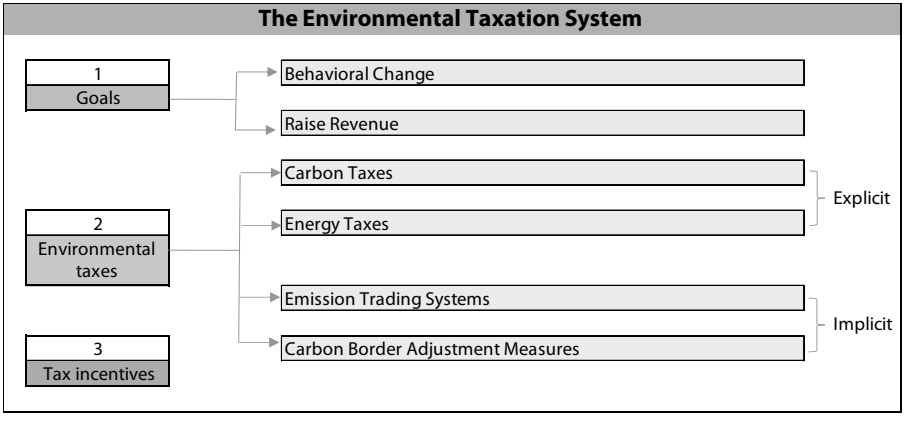

Figure 1: The Environmental Taxation System

2. What does environmental taxation want to achieve

Environmental taxes generally serve two main purposes: encouraging behavioral change and/or generating tax revenue. While influencing behavior is beneficial, particularly when it leads to a more sustainable environment, it creates a paradox. If the tax is effective in changing behavior (e.g., reducing pollution), the revenue it generates will likely decline.

3 Consider that there are other environmental taxes in addition to carbon taxes and energy taxes. These two were selected for the purpose of this article.

2.1. Behavioral change

Environmental taxes can influence behavior by encouraging the private and public sector to adopt alternatives that are more efficient and sustainable. These taxes affect decision making by making environmentally harmful options more costly thereby promoting cleaner choices. As a result, environmental tax policies are considered market-driven[4], meaning that actors make choices based on the market conditions, and environmental taxes and environmental incentives are a part of these market conditions.

Pigouvian taxes[5] are a key example of how environmental taxation can drive behavioral changes. When a negative externality (such as pollution) is not reflected in the price of a good or service, neither buyer nor seller account for its social cost (the negative externality). However, by applying an environmental tax that incorporates this externality into the market price, the distortion can be corrected (assuming no other market failures remain unaddressed)[6].

For example, one study found that increasing carbon taxes by USD 10 per ton[7] of CO_2 can reduce per capita CO_2 emissions by 1.3% in the short term and by 4.6% in the long term[8]. Similarly, taxing gasoline is another potential measure. Some authors argue that, to fully account for the negative externalities associated with gasoline use, its price would need to nearly double.[9] Such a price increase could trigger behavioral changes, encouraging taxpayers to shift to alternative modes of transportation.

However, behavioral change can also be encouraged not only by taxing harmful behavior, but by offering environmental tax incentives for environmentally beneficial actions. In this way, environmental tax policies can also operate through positive reinforcement. These incentives influence market decisions by making sustainable choices more attractive or financially advantageous. Like Pigouvian taxes, such measures are market-driven in the sense that they shape behavior by altering relative costs and benefits, ultimately supporting a transition to a more sustainable economy.

4 Milne. Janet E., *A Bird´s Eye View of Environmental Taxation*. In, Tax law and the environment: a multidisciplinary and worldwide perspective. Eds. Roberta F. Roberts, Tracey M. Mann, Roberta F. Roberts, Tracey M. Lanham, Lexington Books. 2018. P. 3

5 Explained in section 3.2.1.

6 Roberton C Williams III, *Environmental Taxation*, NBER Working Paper No 22303, 2016, P. 3.

7 The pricing of carbon is analyzed in section 3.2.2., and it will show that USD 10 per ton CO_2 is undervalued. Nonetheless, here it refers to an increase of USD 10 per ton CO_2 and not to the total price.

8 Kohlscheen. Emanuel, Moessner. Richhild, Takáts. Előd, *Effects of carbon pricing and other climate policies on CO_2 emissions*, Bank for International Settlements. 2024, https://arxiv.org/abs/2402.03800v1 accessed 5 June 2025.

9 West. Sarah E., Williams III. Roberton C., *Estimates from a Consumer Demand System: Implications For The Incidence Of Environmental Taxes*, NBER Working Paper No. 9152, 2002. P. 3.

2.2. Revenue Raiser

In addition to promoting behavioral change, environmental taxes can also function as a source of public revenue. Some authors say that they are more efficient than income taxes in this regard since income taxes often suffer from base erosion due to deductions, credits, and exemptions which are issues that typically do not affect environmental taxes.[10]

The concept of a "double dividend" is relevant when it comes to raising revenue through environmental taxes. It refers to the idea that environmental taxes can achieve two goals simultaneously: (1) an environmental dividend by improving environmental outcomes by discouraging pollution, and (2) a fiscal or efficiency dividend by improving economic fiscal efficiency by using tax revenues to reduce distortionary taxes (like income or payroll taxes).[11] In other words, creating a more sustainable environment (first dividend) and the possibility to cut distortionary taxes by replacing them with environmental taxes (second dividend).

Using environmental taxes to cut other taxes can certainly generate benefits, and this is known as the *revenue recycling effect*.[12] However, these gains may be counterbalanced by negative consequences known as tax interaction effects.[13] For instance, higher energy prices resulting from the carbon tax could reduce employment and discourage investment.[14]

However, a well-designed environmental tax that successfully discourages environmentally unsustainable activities should lead to a decline in revenue over time. This presents a challenge for policymakers who may rely on these taxes as a long-term source of income. As behavior adjusts in response to the tax, revenue is likely to shrink and may eventually need to be replaced by other funding sources.

Environmental taxation operates on the principle that, once a tax is embedded in the price of a good or service, individuals and businesses will choose either to pay the tax or to avoid it by changing their behavior. A drop in revenue over time is therefore a signal of the tax's success in altering behavior.[15] This fact raises doubts on the double dividend theory previously explained[16] in the sense that it questions

10 Roberton C Williams III, *Environmental Taxation*, NBER Working Paper No 22303, 2016, P. 6.
11 Lawrence H Goulder, *Environmental Taxation and the Double Dividend: A Reader's Guide,* International Tax and Public Finance, 1995, P. 157.
12 Partnership for Market Readiness, *Carbon Tax Guide: A Handbook for Policy Makers*, World Bank, 2017. P. 118.
13 Partnership for Market Readiness, *Carbon Tax Guide: A Handbook for Policy Makers*, World Bank, 2017. P. 119.
14 Partnership for Market Readiness, *Carbon Tax Guide: A Handbook for Policy Makers*, World Bank, 2017. P. 119.
15 European Parliamentary Research Service. *Understanding Environmental Taxation*. European Union, 2020. P. 5.
16 Specifically, the second mentioned dividend (cutting distortionary taxes and replacing them with environmental taxes).

environmental taxes as being a reliable source to cut other taxes, especially in the long term.

In this context, neither tax incentives nor environmental taxes are ideal for sustained revenue collection. Incentives, by nature, do not raise revenue. And environmental taxes, if effective in changing behavior, will tend to generate decreasing returns. For this reason, environmental taxation should be viewed primarily as a tool for promoting behavioral change and not as a long-term revenue-raising instrument.

That said, not all taxes classified as "environmental" are designed to change behavior. For example, taxes on inelastic goods like gasoline often function primarily as revenue-generating tools. Because demand for these products remains relatively stable despite price increases, they provide a reliable source of income. Unless there is a significant price increase (some experts suggest gasoline prices would need to double[17]) or a technological shift that reduces dependence on such fuels, these taxes are unlikely to alter consumer behavior. In such cases, the environmental rationale is arguably weaker as the taxes do not effectively promote a more sustainable environment even if they meet the technical definition of environmental taxes.[18]

Finally, the presence of numerous environmental taxes in a country does not necessarily indicate that it is environmentally friendly.[19] Some countries may rely more on environmental policies.[20] Other countries may use a broad definition of environmental taxes[21] allowing many types of "charges" to be included while some adopt a narrower definition that excludes certain "charges" that would otherwise qualify.[22]

17 West. Sarah E., Williams III. Roberton C., *Estimates from a Consumer Demand System: Implications For The Incidence Of Environmental Taxes*, NBER Working Paper No. 9152, 2002. P. 3.

18 According to the OECD definition, environmental taxes are environmentally related tax revenues. This will include taxes that are "environmentally related" and that are introduced solely to raise revenue even if they do not pursue a more sustainable environment. See: OECD, *Environmental Tax*, OECD, 2024 https://www.oecd.org/en/data/indicators/environmental-tax.html accessed 27 May 2025.

19 OECD, *Environmental Fiscal Reform: Progress, Prospects and Pitfalls*, OECD Publishing, 2017. P 18.

20 For example, the United States addresses environmental issues through environmental policies such as the Clean Air Act and Clean Water Act (which regulate the amount of pollution that can be discharged into the air or water, respectively).

21 The OECD applies environmental taxes to the following domains: energy products (including vehicle fuels); motor vehicles and transport services; measured or estimated emissions to air and water, ozone depleting substances, certain non-point sources of water pollution, waste management and noise, as well as management of water, land, soil, forests, biodiversity, wildlife and fish stocks. (See: OECD, *Environmental Tax*, OECD, 2024 https://www.oecd.org/en/data/indicators/environmental-tax.html).

22 The Congressional Budget Office of the United States does not classify the excise taxes on the sale of motor fuels as an environmental tax (it does not serve an environmental purpose) but as a tax that funds transportation infrastructure. See Congressional Budget Office, *Baseline Projections for the Highway Trust Fund Accounts*, CBO, 2024, https://www.cbo.gov/publication/60734 accessed 27 May 2025.

3. Environmental taxes

3.1. Definition of environmental taxes

What classifies as an environmental tax varies widely depending on who is asked. Jane E. Milne, an influential author on environmental taxation, considers that, very basically, an environmental tax is a price attached to activities that have a negative effect on the environment.[23]

Milne states that environmental taxes have three characteristics that distinguish them from other environmental policies. The first is that they are usually included in tax codes which means that, typically (if they are part of the general tax system), they are not part of the legal environmental regime but of the tax regime.[24] The second is that tax authorities oversee the compliance and enforcement of these taxes and the third is that the tax is a fixed price set out by law.[25]

In this paper, environmental taxes are classified as explicit or implicit.

Explicit environmental taxes are those that meet the following criteria: (i) they are imposed on goods or services that harm the environment; (ii) they aim to reflect the social cost of the negative externalities they cause; (iii) they are typically directed toward environmental goals, though not always explicitly; and (iv) they are designed to encourage or effectively lead to behavior that is more sustainable.[26] Examples include carbon taxes (e.g., a fixed amount per ton of CO_2 emitted) or energy taxes (e.g., per liter of fuel consumed). These taxes directly link the tax burden to the polluting activity.

The European Union defines environmental taxes as "*a tax whose tax base is a physical unit (or a proxy of a physical unit) of something that has a proven, specific negative impact on the environment*".[27] For the European Commission, environmental taxes include "*taxes on energy, transport, pollution and resources*",[28] and the European Environmental Agency considers environmental taxes as a tool to raise revenue.[29] Note that these elements are included in the definition provided in the previous paragraph.

23 Milne, Janet E. Environmental Taxes, in Elgar Encyclopedia of Environmental Law, 2020. P. 171.

24 Some environmental taxes are not included in a tax code but rather, for example, in specific laws that are outside the tax code.

25 Milne, Janet E. Environmental Taxes, in Elgar Encyclopedia of Environmental Law, 2020. P. 171.

26 These characteristics of an environmental tax are found in: Cécile Remeur, *Understanding Environmental Taxation,* European Parliamentary Research Service, European Parliament Briefing PE 646.124, 2020. Also see: Roberton C Williams III, *Environmental Taxation,* NBER Working Paper No 22303, 2016.

27 European Parliamentary Research Service. Understanding Environmental Taxation. European Union, 2020. P. 5.

28 European Commission, *Green Taxation* (European Commission, 2024) https://taxation-customs.ec.europa.eu/taxation/other-taxes/green-taxation_en accessed 30 January 2025.

29 European Environmental Agency, *The role of (environmental) taxation in supporting sustainability transitions*, Publications EEA. 2022.

In contrast, implicit environmental taxes do not apply a fixed rate nor are they directly levied on specific goods or services. Instead, they operate through market-based mechanisms in which charges and prices arise from regulatory frameworks. For example, in emissions trading systems (ETS),[30] the cost of pollution is determined by the market price of emission allowances. Likewise, carbon border adjustment measures (CBAM) increase the cost of imports based on embedded emissions thereby indirectly reflecting environmental costs. Although these instruments are not formally defined as taxes, they can produce tax-like effects by internalizing environmental harm through fluctuating price structures. Nonetheless, some authors argue that ETSs differ fundamentally from environmental taxes as they function primarily by setting quantitative limits on emissions through allowances.[31] As previously noted, what constitutes an environmental tax can vary depending on who is asked.

3.2. Explicit environmental taxes

Pigouvian taxes, carbon taxes, and energy taxes are common examples of explicit environmental taxes, and they are explained below. However, many other types of taxes can also be classified as environmental taxes including air and water pollution taxes, waste taxes, resource extraction taxes, taxes on chemicals and pesticides, and noise taxes, among others.[32]

3.2.1. Pigouvian taxes

The term Pigouvian taxes comes from a British author called Arthur Cecile Pigou. In environmental taxation literature, Pigou is a founding father. Some authors even consider Pigou to have given birth to environmental tax theory.[33] In his famous book The Economics of Welfare (1920), he refers to the matter:

> "I now turn to a group of causes of divergence between social and trade net product which are not dependent on this peculiar condition. Here the essence of the matter is that one person A, in the course of rendering some service, for which payment is made, to a second person B, incidentally also renders services or disservices to other persons C, D and E, of such a sort that technical considerations prevent payment being exacted from the benefited parties or compensation being enforced on behalf of the injured parties."[34]

30 Also known as cap-and-trade regimes.

31 See: Milne. Janet E., A Bird's Eye View of Environmental Taxation. In, Tax law and the environment: a multidisciplinary and worldwide perspective. Eds. Roberta F. Roberts, Tracey M. Mann, Roberta F. Roberts, Tracey M. Lanham: Lexington Books. 2018. P. 6.

32 The classification of a tax as an environmental tax depends on the applicable law, that varies from country to country.

33 Milne. Janet E., A Bird's Eye View of Environmental Taxation. In, Tax law and the environment: a multidisciplinary and worldwide perspective. Eds. Roberta F. Roberts, Tracey M. Mann, Roberta F. Roberts, Tracey M. Lanham: Lexington Books. 2018. P. 3.

34 Pigou. Arthur Cecile, *The Economics of Welfare*. Macmillan. 1920. P.159.

The idea is that, for every good sold or service rendered, there is a negative externality (e.g., pollution) that no one pays *directly* in absence of a Pigouvian tax. Pigou talks about damage to other people that should be compensated on behalf of the injured parties, and this has become to be known as a Pigouvian tax.

If a charge is imposed equal to the negative externality of the good or service, this charge can compensate the negative externality and

> "[i]f the tax rate is set equal to the marginal external damage (the total harm to parties other than the buyer and seller from one additional unit of the good), it brings that external cost into the transaction, ensuring that the buyer pays the full marginal social cost of the good".[35]

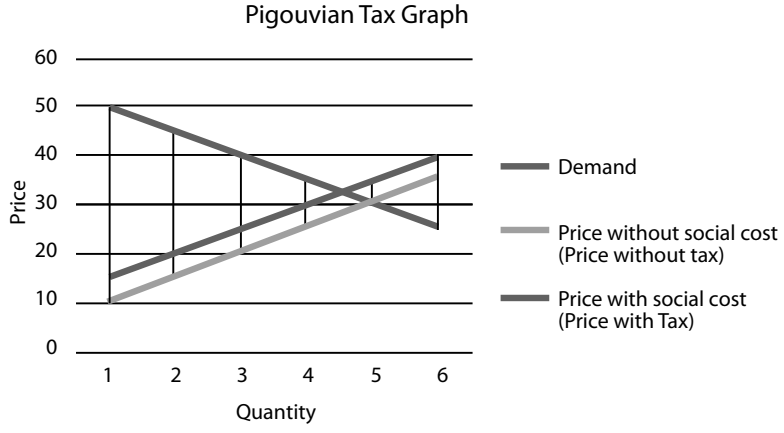

Figure 2: Pigouvian Tax Graph

This chart illustrates that the price of a good or service increases when a Pigouvian tax is applied. In theory, the tax should match the social cost of the negative externality caused by the good or service. However, accurately determining the full value of all relevant social costs is challenging. In most cases, the best that can be achieved is a reasonable approximation.

One of the main challenges associated with Pigouvian taxes is the difficulty of accurately quantifying the negative externality they are meant to address. For instance, how do we determine the precise environmental damage caused by plastic? What indicators should be considered in such an assessment? Should the valuation account only for harm to current human populations, or also include future generations and the degradation of ecosystems? The reality is that our ability to measure environmental damage is constrained by limited information, evolving technology, and incomplete scientific understanding.

35 Roberton C Williams III, *Environmental Taxation*, NBER Working Paper No 22303, 2016, P. 2-3.

However, this limitation does not undermine the usefulness of Pigouvian taxation. On the contrary, acknowledging the practical difficulty of calculating the exact cost of environmental harm allows policymakers to set goals that are more achievable and pragmatic. Rather than insisting on a precise valuation, it is more feasible to rely on well-informed estimates when designing environmental taxes.[36]

Accepting that it is nearly impossible to assign an exact price to every negative externality can help shift the focus of the discussion. Instead of debating precise figures, discussions can concentrate on identifying goods and services that cause significant environmental harm and determining a reasonable estimated cost to internalize their external effects. This approach makes environmental policy both more practical and more actionable.[37]

3.2.2. Carbon Taxes

Carbon taxes impose a charge on greenhouse gases (GHG)[38] and not only carbon emissions. Here, it is relevant to note that greenhouse emissions include Carbon Dioxide (CO_2) and Methane (CH_4) as well as Nitrous Oxide (N_2O) and Fluorinated Gases (also F-gases)[39]. Technically, carbon taxes can cover all greenhouse emissions and not only carbon emissions, yet, they are commonly referred to as carbon taxes.

Carbon taxes first appeared in the 1990s in the Nordic countries with Finland being the first country to adopt a carbon tax in 1990. A carbon tax seeks to mitigate climate change. Unlike emission trading systems that are conditioned by the market, a carbon tax puts a fixed price on a unit of greenhouse gas emissions, for example, on a fossil fuel depending on the amount of carbon it has.[40] Japan has a carbon tax (the Japanese Global Warming Tax) imposed on the use of fossil fuels such as petroleum, gas, and coal.[41]

36 This follows the idea proposed by William Baumol and Wallace Oats to establish an estimated price (or tax) to achieve specific acceptable standards. See: Baumol. William, Oats. Wallace, *The use of standards and prices for environment protection*, The Swedish Journal of Economics, 1971, P. 44-50.

37 The idea that we should accept the difficulty of assigning an exact price to every negative externality and instead focus on identifying environmentally harmful goods and estimating a reasonable cost to internalize their effects is expressed in: Roberton C Williams III, *Environmental Taxation*, NBER Working Paper No 22303, 2016.

38 Also known as greenhouse emissions (GHE).

39 The emissions that comprise greenhouse gases can be found in:
(1) Tax Foundation, *Carbon Tax,* TaxEDU, 2023 https://taxfoundation.org/taxedu/glossary/carbon-tax/ accessed 20 May 2025.
(2) US Environmental Protection Agency, *Overview of Greenhouse Gases*, EPA, 2024, https://www.epa.gov/ghgemissions/overview-greenhouse-gases accessed 27 May 2025.

40 Partnership for Market Readiness, Carbon Tax Guide: A Handbook for Policy Makers, World Bank. 2017, P.27.

41 Kawakatsu. Takeshi, Rudolph. Sven, Lee. Soocheol., *A Japanese Carbon Tax*. In, Tax law and the environment: a multidisciplinary and worldwide perspective. Eds. Roberta F. Roberts, Tracey M. Mann, Roberta F. Roberts, Tracey M. Lanham: Lexington Books. 2018. P. 87.

To a large extent, CO_2 emissions are generated by burning fossil fuels (e.g., coal, oil, gas), CH_4 emissions are produced from agriculture (livestock digestion), landfills, and oil & gas extraction, N_2O emissions from agricultural fertilizers,[42] and F Gases emissions from refrigeration, air conditioning, and other industrial applications.[43] All of them are greenhouse emissions, and they can potentially be subject to a carbon tax.

In the case of CO_2 emissions, these are generally proportional to the carbon content of these fuels, so a tax based on carbon content is effectively a tax on CO_2 emissions.[44] Nonetheless, pricing a carbon tax depending on its greenhouse emissions can be problematic. For example, methane is more than 28 times as potent as carbon dioxide at trapping heat in the atmosphere but is short-lived compared to carbon dioxide so, although it is stronger, it lives less time in the atmosphere.[45] Consequently, taxing methane 28 times higher than CO_2 (simply because of its carbon content) would not seem reasonable considering that, over time, CO_2 outlives methane. Another option would be pricing a carbon tax depending on the energy content of fuel[46] or another would be taxing specific fuels (for example, British Columbia taxes 23 fuels, Mexico taxes coal and petroleum, and India taxes only coal).[47]

A relevant issue with carbon taxes is pricing them. The OECD estimates a carbon price of approximately EUR 120 per ton of CO_2 by 2030, accepts that EUR 30 per ton of CO_2 is a minimum price level to start triggering meaningful reduction efforts, and states that a price of EUR 60 for the 2020s is a benchmark.[48]

According to a European Central Bank blog post, Brand estimates an effective carbon price of EUR 140 per ton of CO_2 by 2030[49] while Breckenfelder suggests an optimal range of EUR 50 to EUR 100 per ton of CO_2.[50]

42 United Nations, *Chapter 2: An Introduction for Policymakers'* in *United Nations Handbook on Carbon Taxation for Developing Countries*, UN, 2020, P. 3.

43 The source of these mentioned GHG is found in: US Environmental Protection Agency, *Overview of Greenhouse Gases*, EPA, 2024, https://www.epa.gov/ghgemissions/overview-greenhouse-gases accessed 27 May 2025.

44 Bovenberg. Lans, Goulder. Lawrence, *Optimal Environmental Taxation in The Presence of Other Taxes: General Equilibrium Analyses*, National Bureau of Economic Research. 1994. P. 11.

45 US Environmental Protection Agency, *Importance of Methane,* EPA, 2023, https://www.epa.gov/gmi/importance-methane accessed 20 May 2025.

46 Partnership for Market Readiness, *Carbon Tax Guide: A Handbook for Policy Makers*, World Bank, 2017. P. 12.

47 Partnership for Market Readiness, *Carbon Tax Guide: A Handbook for Policy Makers*, World Bank, 2017. P. 75.

48 OECD, *Effective Carbon Rates 2021: Pricing Carbon Emissions through Taxes and Emissions Trading*, OECD Publishing, 2021, P. 6.

49 Brand. Claus, Coenen. Günter (and others), *Is green the new gold? The role of central banks in tackling climate change*, European Central Bank Blog, 25 May 2023 https://www.ecb.europa.eu/press/blog/date/2023/html/ecb.blog.230525~4a51965f26.en.html accessed 21 May 2025.

50 Breckenfelder. Johannes, Mackowiak. Bartosz (and others), *The Climate and the Economy*, European Central Bank Discussion Paper No 2793, March 2023. P. 15.