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When Harmful Tax Expenditure Prevails over Environmental Tax: An Assessment on the 2014 Mexican Fiscal Reform

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Abstract: This article examines the role of environmental taxation in mitigating environmental problems and contributing to sustainability in Mexico. It focuses on environmental tax revenues and tax expenditures since the 2014 Public Financial Reform (PFR), according to pro- or anti-environmental orientation. The research carried out combines the study of the regulation of the selected tax instruments, their classification and the empirical analysis of the tax revenues and tax expenditures associated with the different taxes over the periods of validity of the taxes and benefits studied, using the databases of the CIAT and the Mexican SHCP. A critical analysis addresses the weak environmental function of environment-related taxes (IEPS, ISAN . . .), as well as the late implementation and reduced impact of the carbon and pesticide taxes introduced in 2014. The evolution of tax incentives and expenditure is thoroughly examined by examining both environmental measures, which have evolved positively but within a very reduced level, and the most prevalent tax expenditure measures, with harmful impacts to the environment. Based on the results obtained, long-term structural changes in the Mexican tax system are suggested. As for the short to medium term, profound changes in tax expenditure are proposed to eliminate of those tax benefits harmful to the environment, introduce of tax benefits for circular activities (e.g., repairing, reusing and remanufacturing) and broaden the carbon tax base and rates. The conclusions include recommendations for moving towards a systemic green tax reform that assists the transformation towards a sustainable economy.

Keywords: environmental taxation; tax benefits; tax expenditure; carbon tax; harmful tax expenditure

JEL Classification: E62; H22; H23; H24; H25

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1. Introduction

Environmental problems are increasingly prominent and currently figure among the most important and urgent items on the global agenda, and consequently in Mexico also [1–7]. In fact, in successive reports by the Intergovernmental Panel on Climate Change [5] scientific teams warn that both greenhouse gas (GHG) emissions and climate change have been accelerating at a strong pace in recent years. An exhaustive analysis by Rockström et al. [2] of the nine main planetary boundaries, indicates that we have already exceeded three of those boundaries (rate of biodiversity loss, nitrogen cycle and climate change) and are approaching the point of no return on several others (phosphorus cycle, ocean acidification . . .). Meanwhile, studies on the evolution of the circularity gap estimate that the circular economy will account for merely 8.6% of the global economy in 2019 [8].

The market does not generate the appropriate corrective mechanisms, nor do policies subordinated to market imperatives [9]. In fact, a recent study by the International Monetary Fund clearly warns that "markets alone cannot provide sufficient mitigation. Market failures, unaddressed and exacerbated by government failures, prevent an adequate market response to the challenge of climate change mitigation" [7]. The problem lies in the essential characteristics of the current economic system. The very dynamic capitalist production model also turned out to be extremely intensive in the use of raw materials, energy and oil, without internalizing the environmental costs derived from them [3,10–14].

While developed countries are certainly at the origin of most environmental problems, all countries have seen increases in their own environmental issues and their contribution to global problems. Within this dynamic, Mexico has also become a country with serious environmental challenges [4,15]. In fact, Mexico is in 12th place in CO_2 emissions in the world (significantly lower in per capita terms), and emissions of CO_2 have increased by almost 74.5% since 1990, although moderating in pace in recent years [15]. Environmental policy in Mexico has gone through different transformations that began in the 1980s and generally correspond to global trends and the successive international agreements signed by Mexico (Rio Agreement, Kyoto Protocol, Paris Agreement . . .). The aim has been to combat environmental pollution through direct regulation, soft technological and ecological measures, voluntary instruments (environmental certifications), and some fiscal measures (mainly, subsidies and benefits) [16–18]. A new step was taken with the 2014 Public Finance Reform (PFR), when environmental taxes on fossil fuels (CO_2) and pesticides were set up for the first time [19].

This paper seeks to contribute to the existing literature on environmental taxation in two directions: on one hand, by analyzing the situation and the changes introduced in a large country with an intermediate level of development; on the other hand, it tries to balance the efforts for the introduction of new environmental taxes (carbon tax and pesticides) and those related to the environment against the measures focused on tax benefits on the major taxes of the tax system (VAT, corporate, income, etc.). The aim is to examine particularly the latter in order to test the hypothesis that these tax benefits have an enormously greater weight in the revenue of public finances than environmental and environment-related taxes, with the aggravating factor, moreover, that the former are for the most part tax benefits that are harmful to the environment.

This article provides an analysis of the more recent changes. Following the introduction in Section 1, we review the theoretical and empirical literature on environmental taxation in Section 2, highlighting the advantages and limitations of these environmental policy instruments. Section 3 gives information on the databases used for the empirical study on Mexico. In Section 4, we analyse the implementation of environmental taxation in Mexico, particularly from 2014 onwards, giving attention to tax revenues and tax expenditure. In Section 5, we summarize the main results, and Section 6 offers some conclusions and recommendations.

2. Literature Review on Environmental Fiscal Policy

Environmental fiscal policy is directly aiming at creating economic incentives to promote positive environmental behaviour by the various economic actors (producers, dealers, retailers, consumers, public institutions, finance . . .). It is transmitted to economic agents through tax instruments, public expenditure and fiscal or tax expenditure, including subsidies, reductions and benefits [7,20–22]. Tax expenditure differs from public spending in that the former involves the renunciation of public revenue that is made operative through the existence of incentives or benefits that reduce the direct or indirect tax burden of certain taxpayers in relation to a reference tax system or 'benchmark' [23].

Most of the literature analysed on fiscal policy and environmental problems starts with the so-called Pigouvian taxes [3,24–33]. To Pigou and the environmental fiscal literature, taxation by the public sector is the best way of internalizing, through prices, the social cost of negative externalities that were not reflected in the market price. This idea was firstly developed in the theoretical framework of welfare economics [24], which, though often overlooked, poses analytical conditions that are difficult problems to solve in real implementation and practice. A precise calculation of externality would be required to establish an optimal tax, one equivalent to the social cost and added private benefit. The idea has been transferred to the debate on environmental policies in a more general and pragmatic formula: the polluter pays principle. One way of making this happen is through environmental taxation [26,32].

Environmental taxes are defined in the literature as compulsory tax payments at a fixed or variable rate, which must be paid by polluting agents based on facts related to the pollution caused by their production or consumption. These facts set the tax base for using the mechanism of environmental taxation to address pollution problems and social costs. While there is no single definition, the environmental tax is expected to re-orient production patterns and alter consumption patterns, regardless of the destination of the revenue obtained [3,21,32,34–37]. Environmental taxes are economic instruments to the extent that they affect the cost and price of goods, and by that means influence their consumption. In other words, the environmental tax works as a price altering agent to discourage uses and consumption that pollute the environment and encourages innovations in a more environmentally friendly direction. Environment tax instruments can create market incentives to develop and invest in emission-reduction technologies, to encourage behavioural changes in consumption and production and to achieve least-cost solutions. Moreover, according to the double dividend argument, the tax instruments can generate revenue that could be used to finance environmental expenditures or to mitigate adverse impacts on the diverse social groups [27,28,36,38].

Although the environmental taxes are preferable to pollution market [3,29,38–44], taxes also have some critical flaws. Current environmental taxation focuses on penalizing pollution through price, but does not prevent it. The implementation of the Pigouvian approach resulted in the first generation of environmental taxes, leading to set a tax for each specific environmental problem (different chemical pollutions, energy, NO_x, CO_2 ...). Such an approach generated a multitude of scope-limited proposals that eventually proved ineffective in addressing growing, complex and interrelated environmental problems [5,6,28,45,46].

Though taxation is increasingly recognized as an important environmental policy instrument, real progress in implementing environmental fiscal policies have been modest in Mexico and around the world [6,20,28,47,48]. Indeed, the numerous environmental taxes that have been implemented in recent decades—probably more than a hundred—have not met their environmental objectives [5], and their use is currently limited. According to Groothuis [45], "over the past 15 years, environmental tax as a share of GDP has declined in 52 out of 79 countries in the Organization for Economic Co-operation and Development (OECD) database. In addition to relatively low green tax levels, global fossil fuel subsidies amounted to $373 billion in 2015."

The real evolution of the most serious environmental problems, such as climate change or urban and ocean pollution, show the insufficiency or failure of the measures that have been adopted in the last three decades. This applies to emissions market mechanisms especially, but also to CO2 taxes insofar as they have been implemented.

A recent paper issued by Best et al. [49] ran a cross-country empirical study on the efficacy of carbon pricing, showing that "a negative association between carbon pricing and the subsequent CO_2 emissions growth rate, with a one euro increase in the effective carbon price rate per tonne of CO_2 emissions being associated with a 0.3 percentage point reduction in the annual rate of emissions growth." At the same time, the most recent scientific reports unequivocally indicate that CO_2 and other GHG emissions have increased and even accelerated in the years since the 1997 Kyoto Protocol, and despite the launching of the EU Emissions Trading Scheme (EU ETS) in Europe and other countries, with only a brief and apparent respite caused by the Great Recession at the end of the last decade [5]. This disappointing result could suggest that carbon taxes (and other market solutions) run the risk of failing if the taxable events are narrow and the tax rates very low. Through the influence of companies and interest groups, carbon prices end up being set so low that they are ineffective in curbing emissions [13,46]. "The problem is in the economy: if the tax is very moderate, it fails to remove enough fossil fuel to help the climate; but if it is high enough to actually reduce it, then business and consumers resist the tax—because without some safety cushion for business and consumers, the whole problem falls on them and they rationally resist—to save profits and jobs" [46].

As previously stated, the environmental tax policy includes other relevant instruments, particularly public and tax expenditures. Tax benefits (or tax expenditure) materialize into government fiscal waivers [50–53] which can be granted to economic agents in very diverse ways (incentives, tax relief, deductions, accelerated depreciation, etc.). From an economic point of view, justification for these tax benefits may be linked to industrial and trade policies favouring certain economic activities or supporting some consumption patterns, as part of a social or redistributive policy [52,54]. The usage of tax benefits as an incentive—a carrot—to promote environmental objectives is well established, in fact, is one of the first instruments of environmental tax policy [52,55,56].

Tax expenditure is an opaque and little-studied subject, instead of existing estimates placing tax expenditure at between 14–24% of total revenue in most countries and, in some cases (e.g., US, UK) that proportion exceeds 30%; as a proportion of GDP, the available estimations go from 3.7% in the Latin American countries to 8% in the US. Mexico also makes extensive use of tax expenditure measures, reaching up to 23.8% of total revenues and 3.15% of GDP in 2019 [23,57]. The question here concerns whether these instruments have been used in environmental policy to correct the negative environmental impacts caused by the various economic sectors, or the other way around. The literature on this issue is scarce, is mostly focused on discussing which tax expenditure instruments have an environmental purpose and, where appropriate, is concerned with assessing their effectiveness, either theoretically or empirically. However, the above-mentioned literature does not take stock of tax expenditures that serve other purposes and have a harmful impact on the environment.

This article attempts to fill this gap and provides empirical evidence of the evolution of the environment tax policy in Mexico in recent years, balancing the evolution of taxes and the benefits, including both environmental-friendly benefits and harmful ones.

3. Databases

The database used for this empirical study includes official sources such as the Inter-American Center of Tax Administrations (CIAT) [58,59] for revenues (1990 to 2018) and tax expenditure (2014 to 2018), updated with 2019 information from the SHCP and the SAT (Tax Administration Service-Government of Mexico). In addition, the statistics corresponding to the IEPS on fossil fuels (CO_2) (2016 and 2017) were adapted according to the SHCP methodological note on carbon [60]. We focused on environmental fiscal instruments (taxes, incentives and tax benefits). An overview of environment-related taxes (1990–2019) is also developed, including information on six different taxes collected at the federal level (Figure 1).

The tax expenditure statistics (2014–2018) were compiled from CIAT data using dynamic tables. The incentives and benefits were classified by type (exemptions, reduced rates, depreciation, deferral, deductions, etc.). To identify the categories in the working database, we applied the following process: the filtering of the data group of environmentally friendly and environmentally harmful tax measures was done based on the description of the regulatory source (tax law for each tax instrument and Mexican federal income law) and according to the tax measure included in the tax expenditure database for each indicator or tax (VAT, ISR, ISAN and IEPS). Thus, the categories (a) environmentally friendly (including all measures with clear environmental characteristics and/or renewable components) and (b) environmentally harmful (fiscal measures that stimulate non-environmental investment opposed to the purposes of environmental policy and incentives that generate stimuli for consumption of products such diesel and fossil fuels) were obtained. The classification of the category by type of tax expenditure was made according to [23,62,63].

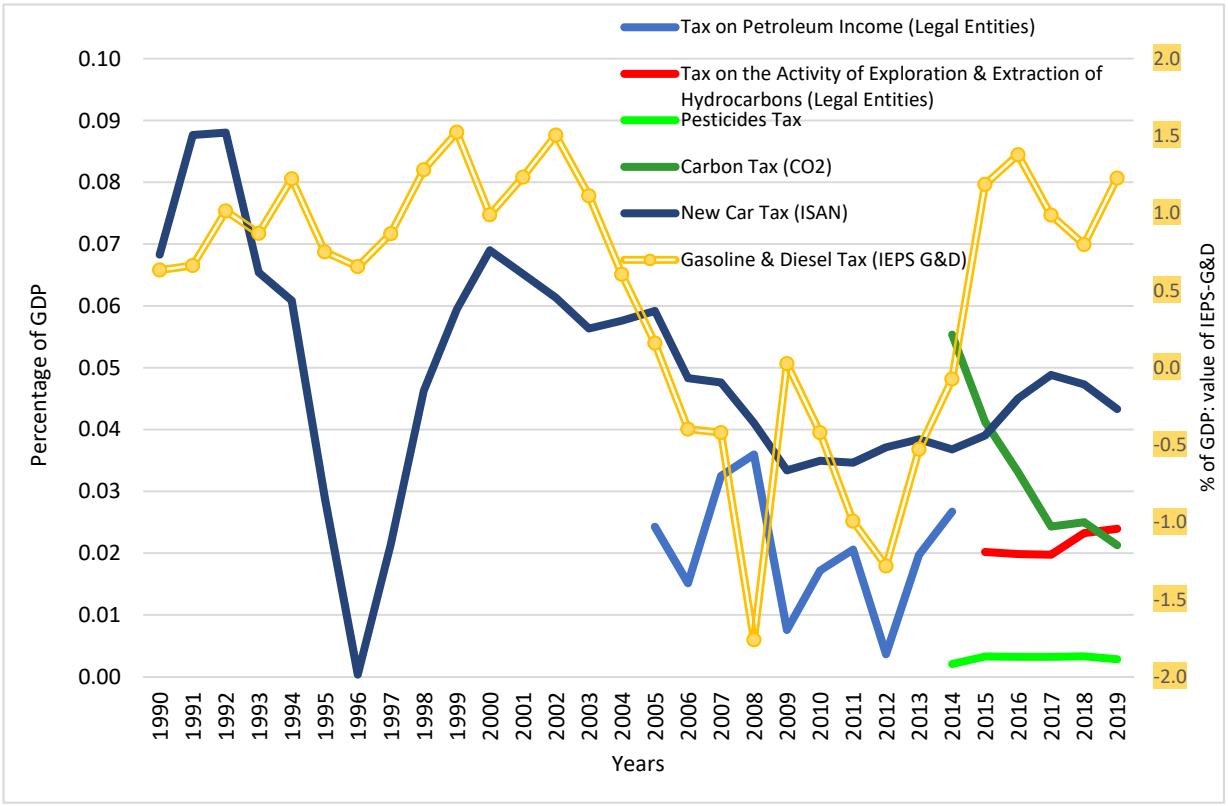

Figure 1. Evolution of environment-related taxes in Mexico, 1990–2019 (IEPS-G&D right scale) (Units: Percentage of GDP). Source: prepared by the authors, based on [58,61].

4. Implementation of Environmental Taxation in Mexico

4.1. Environmental Tax and Environmental-Related Tax in Mexico

Environmental fiscal policy took its very first steps in the form of tax expenditure (stimulus, incentives and tax benefits) in the early 1980s, as a second-order instrument to reinforce the environmental objectives being implemented through national development programs. In 1981, a government decree established the Fiscal Incentives for the Promotion of the Preventive Activity of Environmental Pollution [64]. In addition to direct regulation measures and voluntary instruments (ecological certifications), fiscal instruments were introduced to provide incentives for the immediate depreciation of investments in equipment for controlling and preventing pollution, along with tariff reductions on imported industrial equipment of this type. Some taxes and fiscal instruments concerning the use of energy resources or specific consumption, which are sometimes considered environmentally-related taxes (e.g., IEPS-G&D, ISAN), have been around for decades. However, environmental taxes that were explicitly designed as such appeared in 2014, resulting from the country's commitments to international agreements on climate change. The 2014 Public Finance Reform (PFR) established nine major objectives for improving the state's income capacity, promoting equity and reducing tax evasion and abuse by reducing existing fiscal incentives and expenditures and creating conditions for the liberalization and privatization of the energy and hydrocarbon sector. The environmental goals behind the measures included "fighting obesity and protecting the environment: fiscal provisions are established to discourage the consumption of goods that are harmful to health and the environment." In particular, two new green taxes were introduced: a tax on fossil fuels, or a carbon tax (quota per CO_2 content of various energy products), and a tax on pesticides (according to the level of toxicity), categorised as IEPS-Other consumption [16,19,65].

A conceptual and terminological clarification is needed before entering into data analysis. The OECD and the European Union have agreed to distinguish environmental taxes from so-called environment-related taxes, as a broader category that includes taxes

"whose basis is a physical unit (or a proxy of a physical unit) of something that has a specific and proven harmful impact on the environment [66], in accordance with the tax base, regardless of whether the tax is intended to change behaviour or is imposed for another reason." In practice, these two categories are used interchangeably, which undoubtedly causes some confusion. Arlinghaus and van Dender [16] distinguish four subsets of environment-related taxes: energy taxes, transport taxes, pollution taxes and resource taxes. For its part, the CEPAL [20] distinguishes three conventional categories for classifying all taxes as environmentally related according to the tax base under consideration: (i) energy taxes, which include taxes on products related to energy generation with polluting effects, such as fossil fuels and electricity, in addition to those used in transport, such as gasoline and diesel; (ii) taxes on transport, which includes the full range of taxes on motor vehicles and other motorised means of transport by virtue of their marketing (domestic or imported), ownership (recurrent taxes), registration and circulation permits or road use; and (iii) other taxes on pollution and the use of natural resources. The latter include many of the least developed, least used instruments, regionally and internationally, along with taxes on gaseous substances, water extraction and disposal, extraction of natural resources, and pesticides and fertilizers, among others.

According to this definition, the following environment-related taxes exist in Mexico: gasoline and diesel tax (IEPS G&D), tax on petroleum income (Legal Entities), tax on the activity of exploration and extraction of hydrocarbons (Legal Entities), new car tax (ISAN), and of course, the carbon tax (CO_2) and pesticides tax (Figure 1). However, a more detailed analysis reveals that some of them (the first four) are not environmental taxes, since they were designed for increasing public revenues or to adjust the price of certain resources to scarcity perspectives and not to reduce pollution or other harmful effects. Their taxable fact and taxable base do not include explicit incentives to modify the agent's economic behaviour. Moreover, some benefits applied to these taxes are clearly anti-environmental. Consequently, they do not really work as environmental taxes.

In this section, we will review the entire family of taxes in force in Mexico, starting with those which are environment-related (IEPS-G&D, ISAN, Petroleum and Hydrocarbons), and then the environmental ones (IEPS-Pesticides and CO_2) (See Figure 1).

The IEPS G&D was introduced in 1980. Despite being a tax on a highly polluting products—with CO_2 and other GHG emissions and effects on urban pollution and human health—its specific design clearly does not present environmental tax features and the evolution of revenues does not fit with the environmental policy objectives. The IEPS rate would be calculated according to the following formula as presented by Hernández and Antón (2014): IEPS rate = (αi,j PVP − C − F − PP)/PP, where αi = 0.9091 when VAT = 11% and αj = 0.8696 when VAT = 16%. PVP is the public price of gasoline, F is the freight and transport cost, and C is the commission to distributors, PP is the final producer price (PP = PS + AC + CT + CM, where PP is the final producer price, PS is the spot reference price (average US Gulf Coast gasoline price), AC is the quality adjustment, CT is the transport cost and CM is the handling cost). The saw shape of the curve over the period analysed—including a decade of negative revenues—is conditioned by the international crude oil reference prices, since the IEPS-G&D was designed with this complex formula that seeks to adjust the differences between international and national prices but does not really seek to reduce consumption [67].

There are also a number of subsidies that are implicit in the consumption of these products and clearly encourage pollution [16,48]. These strong subsidies explain the negative fiscal revenues from 2005 to 2014 (see Figure 1). Therefore, the reduced price does not provide sufficient signals for a reorientation of the consumption and production patterns that would lead to reductions in the pollution generated by these activities. In fact, the main specific changes of the 2014 Energy and Tax Reform were the gradual elimination of diesel subsidies in the transport sector [68]. These changes partially explain the evolution of the fiscal revenue curve, which takes positive values after 2014, reaching a maximum of 1.4% of GDP in 2016 (right axis), then falls in 2017–2018 and rises again in 2019 up to 1.2%.

This analysis of the characteristics of the IEPS-G&D and its revenue trend, including a decade of negative results, lead us to question its classification as an environmental or environment-related tax by the OECD, CEPAL or the World Bank. In fact, it does not really even qualify as an actual tax, as its special design makes it a pseudo-tax [57]. This reconsideration would imply that the implementation of environmental taxation in Mexico is still in a very incipient state. If this tax is excluded from the group of environmental taxes, an evaluation of the degree of compliance with international environmental commitments would reveal a much more critical state than that indicated by the OECD report on the carbon pricing gap (CPG) [69]. In fact, the estimated CPG for Mexico indicates that 69% of the parameters established for the 2030 scenario have not been met. Obviously, if we exclude this tax, which brings in the highest revenues of all those considered "environmental" by that organization, then the carbon pricing gap for that year would be much higher than the current OECD estimate [69].

ISAN is a tax on the purchase of new cars and applies a progressive rate to the purchase of luxury cars. Revenue from this tax reached 0.04% of GDP in 2019. As a tax that implies purchasing power, economic growth informs the evolution of fiscal revenues (falling down during the tequila crisis of 1994–1996 and the financial crisis or Great Recession of 2008). This instrument mainly taxes luxury goods, but does not incorporate the achievement of environmental objectives.

The tax on Petrol Rent and the Exploration and Extraction of Hydrocarbons is a unique case in Mexico, a nationalized producer of crude oil and hydrocarbons that is organized through the public company Pemex. This tax is not related to conventional income tax (since Pemex is exempt from it) and revenues are linked to Pemex control mechanisms and operational management [70]. Environmental motivation in the resource appropriation policy still very marginal, given that Mexico has prioritized a policy of economic growth that has always been supported in this sector in times of boom [71].

In any case, all environmental and environment-related taxes show a very limited revenue-raising capacity. Recent CEPAL [20] and OECD et al., [72] reports show that revenues from environmental taxes in the 23 Latin America and the Caribbean countries averaged 1.1% of GDP in 2018 (and 1.3% since 2006), which is considerably lower than the also-modest 2.3% average for OECD nations as a whole for the same year. Mexico is well below the OECD average, slightly below the Latin American Countries (LAC) average, and behind countries such as Costa Rica, Chile, Uruguay or Argentina. Even so, energy taxation is the most prominent component in the Mexican case, given the minimal presence of the other three tax bases (pollution, resources and transport).

IEPS-Other consumption includes a conglomerate of specific taxes applied to different products that are intended to provide a price disincentive to harmful consumption. With PFR 2014, two environmental taxes were created in this group: the tax on fossil fuels, or carbon tax (CO_2) and the tax on pesticides. The first was determined following the IPCC Guidelines for National GHG Inventories, which is part of the strategy to reduce CO_2 and other greenhouse gas emissions. The second, the tax on pesticides, was determined using rates ranging from 0 to 9 percent, according to the level of acute toxicity from exposure to these products, and is subject to the parameters established by the Official Mexican Standard NOM-232-SSA1-2009 for pesticides, "which establishes the requirements for the packaging, packing and labelling of technical grade products and for agricultural, forestry, livestock, gardening, urban, industrial and domestic use" [73]. This proposal will induce the replacement of more toxic agrochemicals with others that are less harmful.

The environmental taxes on CO_2 and pesticides were established with two central objectives: (1) to reduce pollution levels (of GHG emissions and harmful products, respectively), and (2) to increase tax revenues (designated to the general budget). Here we will look at the extent to which these objectives have been met. The carbon tax (CO_2) is levied on a quota linked to the amount of CO_2 in each fossil fuel and based on exchange quotes for the main carbon markets. The petrol tax, for example, was set in 2014 at 10.3 cents peso per liter, diesel at 12.6, fuel oil at 13.4 and coal at 27.5 per ton. This tax amount will remain

constant in real terms, as it is adjusted annually by the variation in the National Consumer Price Index (INPC in Mexico). However, natural gas and turbosine were exempted from the tax at the express request of the private sector, which effectively undermines emissions reductions in large sectors of the economy. The CO_2 tax is also not applied when oil is used for manufacturing, e.g., for the production of plastics, rather than combustion [74]. In fact, Mexico shows a low effective carbon rate, taxing above EUR 30 per tonne of CO_2 for only the 30% of emissions from energy use (mainly from road transport sector), with most of emissions (68%) from industry, electricity, and the residential and commercial sectors remaining unpriced [68].

Environmental taxes are barely significant in collecting revenues and even show decreasing performance (Table 1). Revenues from these taxes represented a meagre 0.024% of GDP in 2019 (0.003% from pesticides and 0.021% from the CO_2 tax). Even more relevant is the continuous decrease in the capacity of CO_2 tax to create resources over time (Figure 2). Revenue in 2019 amounted to 53.3% of what was obtained in its first year. Meanwhile, the pesticide tax has been basically irrelevant as far as revenue is concerned. Arlinghaus et al. [16] observed that the effectiveness of pesticide taxes in reducing the use of harmful products is hard to establish due to a relatively dynamic market, the wide variety of products, storage behaviour prior to tax increases, large seasonal and geographical variations in the intensity and frequency of treatments, and the effects of competing regulations.

Table 1. Annual revenues from environmental taxes (CO_2 and pesticides) in Mexico, 2014–2019. Source: Prepared by the authors, based on [58,61,75].

Periods/ Environmental Taxes	(In Millions of Pesos)		(In % Total Tax Income of Country)		(In % of GDP)		GDP (% Annual Growth)
	Pesticides	CO_2	Pesticides	CO_2	Pesticides	CO_2	
2014	358.61	9670.35	0.016	0.425	0.002	0.055	2.85
2015	606.93	7648.51	0.021	0.267	0.003	0.041	3.59
2016	647.24	6657.74	0.020	0.205	0.003	0.033	2.63
2017	705.24	5325.17	0.021	0.156	0.003	0.024	2.11
2018	775.06	5883.55	0.021	0.160	0.003	0.025	2.19
2019	687.00	5153.20	0.018	0.136	0.003	0.021	−0.055

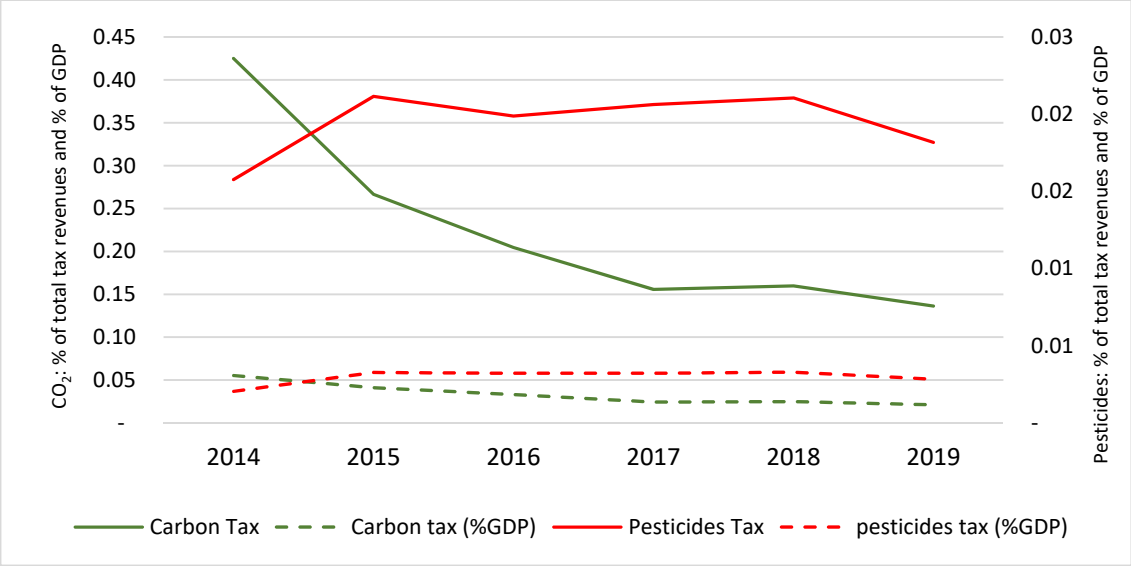

Figure 2. Trend of environmental taxes in relation to total revenues and GDP (left-CO_2 and right-Pesticides) in Mexico, 2014–2019. Units: percentage; source: prepared by the authors, based on [58,61].

Regarding the actual evolution of the emissions burden, long-term data series show that CO_2 emissions in Mexico have increased by almost 74.5% since 1990, albeit moderating

in recent years [15]. It is interesting to observe the parallel evolution between the drop in CO_2 tax revenue both in absolute terms and as a proportion of GDP and the drop in the GDP growth rate over this period. Indeed, there is a very close statistical correlation of $R^2 = 0.446$ between the two variables, which suggests several hypotheses (Figure 3). First of all, the design of the CO_2 tax in Mexico applies to a reduced tax base (a limited number of activities) and has a very low price per ton of CO_2. Second, its evolution seems to be directly dependent on the growth rate, since growth deceleration is most strongly reflected in CO_2 emissions and in tax revenues. This also reveals how fossil fuel consumption is extremely sensitive to the country's economic progress. Thirdly, the evidence suggests that the implementation of a carbon tax with this specific design has had no significant effect on the evolution of emissions or economic activity.

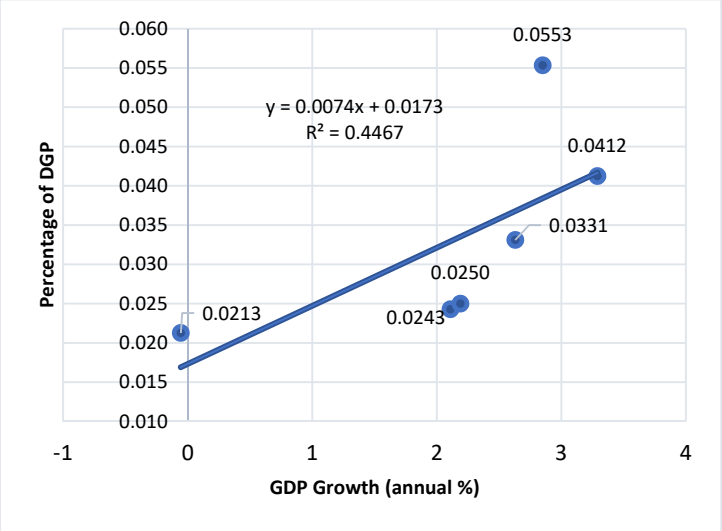

Figure 3. CO_2 tax revenue (% GDP) and annual GDP growth (right axis) in Mexico, 2014–2019. Source: prepared by the authors, based on [58,75].

These hypotheses suggest some nuances relative to the empirical literature on the topic. The meta-regression study conducted by Galindo et al. [76] on the potential effects of a CO_2 tax in Latin American countries shows that the impact of implementing a CO_2 tax on GDP will depend on the structural conditions of each country. For Mexico, all the estimated long-term results show negative impacts [48]. However, these results seem to be associated with being evaluated as an OECD member country and applying the OECD coefficients (the same happens for Chile). Alatorre et al. [77] conducted a study to determine the effects of the CO_2 tax on economic, social and technology transfer variables through a recursive system of equations. That author suggests that for LAC, the effect of the tax on these three variables depends largely on the non-linear relationship between the increase in relative energy prices and per capita GDP. Thus, in a context of low prices, economic and social policy would have negative effects, while a context of high prices would result in greater environmental benefits. In order to reduce the negative effects associated with the tax, both studies [76,77] suggest a combination of mitigating policies (e.g., tax reductions on the labour factor). They also highlight the importance of applying a CO_2 tax in order to encourage the implementation of new technologies (energy efficiency), the development of less-energy-intensive sectors and the generation of jobs that improve environmental conditions.

To sum up, the introduction of the carbon tax in 2014 made Mexico the 27th world jurisdiction to implement a CO_2 tax in accordance with the Kyoto Protocol and the Paris Agreement, both signed by Mexico. Mexico was the pioneer in the LAC region, followed by Chile (in 2017), Colombia (in 2017) and Argentina (in 2019) [78]. However, the price established per type of fossil fuel was too marginal to influence the behaviour of economic agents (the minimum threshold is suggested around EUR 30 per ton of CO_2, including all

activities, and preferably above 100 in the rich countries). After 6 years of implementing both environmental taxes, the initial objectives are very far from being met. The taxes have been ineffective in both reducing pollution levels (GHG emissions and harmful products) and increasing tax revenue beyond a symbolic level which; it is actually declining. So, the empirical results show that environmental taxation in Mexico has not achieved any of the objectives that were established in the 2014 General Economic Policy Criteria [19] and still has a very wide gap to reduce in terms of pollution levels.

However, this problem is not exclusive to Mexico; it is general and global, as emphasized by different global reports. "After a quarter century of academic debate and experimentation, a gap persists with respect to the 'carbon price change' needed to trigger rapid changes (. . .) The Mexico performance is relatively poorer as a result of the low-price set for each Tm of CO_2 emissions and the reduced range of sectors affected" [5].

Due to the environment taxation is failing in promoting a real change towards sustainability, we are dealing with other fiscal instruments such as tax expenditures in order to assess real performance.

4.2. Environmental-Frienly and Environmental-Harmful Tax Expenditure in Mexico

The many existing tax benefits can be classified from different perspectives [52,55]. Here we will focus on three main categories: the objectives pursued, their environmental effects (positive or negative) and all other objectives, be they social, cultural, employment, competitiveness, etc. The last categories were grouped into a single block and isolated them from the analysis, though they are more abundant in Mexico and in many other countries [23].

We are focusing here on incentives and benefits that affect consumption, investments that favour the environment or reduce environmental impacts, whether explicitly established or not. Meanwhile, we will also examine benefits granted for consumption and investments favouring activities harmful for the environment. By doing so for the period 2014–2019, we are providing an assessment of the real environmental content of the 2014 Public Financial Reform.

The benefits and incentives related to environmental protection apply, above all, to the investment cost (deductions and accelerated depreciation) for investments in fixed assets of electric vehicles, vehicles powered by rechargeable electric batteries, electric bicycles and machinery and equipment for generating energy from renewable sources. Together, these accounted for only 0.07% of tax revenue and 0.01% of GDP in 2018 (Table 2 and Figure 4). In examining the magnitude of the incentives and benefits at the level of each tax for the last available year, it can be seen that the environmental cut was granted mainly through the ISR (0.31% of the revenue from this tax) and, to a lesser extent, the ISAN (which represents 0.45% of revenue). Most of these were reductions for qualifying investments (0.05% of total revenue) and other deductions (0.02% of total revenue). For income tax purposes, the incentive consists of a 100% deduction of the investment in clean technology and the depreciation of renewable assets. This reduces the taxable base for determining profit, allowing companies to declare high investment costs, which could even be reflected as losses and thus be tax-free. Direct benefits are also granted through an ISAN exemption (it is not included in the payment) for the purchase of ecological cars.

On the opposite side is the group of fiscal measures promoting productive activities and consumption practices with clearly unsustainable components that contradict the objectives of environmental policy in Mexico [79–81]. These environmentally harmful benefits include incentives for diesel and fuel consumption, which generate CO2 emissions, or benefits for resource extractive industries and the consumption of materials (Table 2). This relatively more substantial group accounted for 1.66% of total tax revenue and 0.26% of GDP in 2018. Most represent IEPS benefits (5.02% of this tax) from the consumption of diesel, fossil fuels and gasoline in the agricultural and transportation sectors, corporate income tax (3.14% of this tax) from reductions on investments and other deductions, and ISAN exemptions that are applied to the purchase of high-priced vehicles (1.48% of this tax).

Similarly, the reduced VAT rate (1.41% of this tax) related to drinking water supply services is understood as a social-economic policy, but has been categorized as anti-environmental, as it is equivalent to tax-free use of a natural resource.

Table 2. Tax revenues and environmental-friendly and environmental-harmful tax expenditure in Mexico, 2018. Source: prepared by the authors, based on [59].

Taxes	Revenues as % of GDP	Tax Expenditure as % GDP	Benefits as % of Total Revenues	Environmental Benefits as % of Revenue	Environmental Harmful Benefits as % of Revenue
Corporate Income Tax	3.7	0.6	3.9	0.07	0.69
Personal income tax	3.4	0.9	5.8	0.0	0.0
VAT	3.7	1.5	9.5	0.0	0.35
Special tax on production and services (IEPS)	1.7	0.2	1.5	0.0	0.61
Other	3.1	0.0	0.0	0.0	0.0
Total	**15.6**	**3.24**	**20.70**	**0.07**	**1.66**

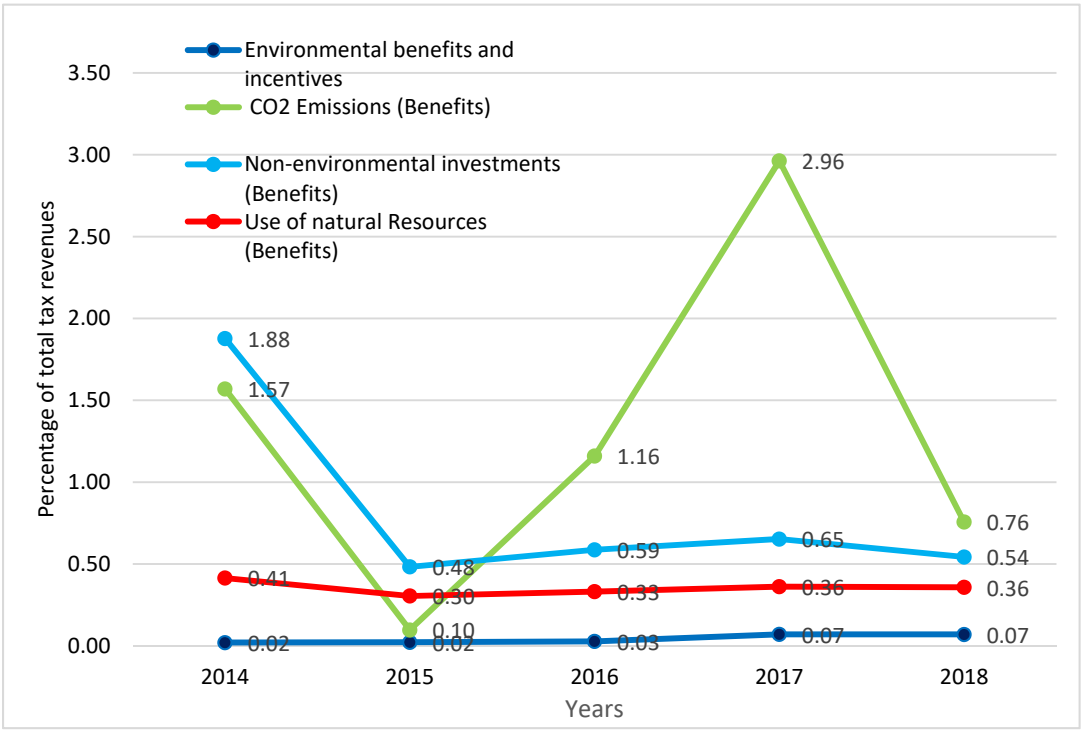

Figure 4. Environmental-friendly and environmental-harmful tax benefits as a percentage of total revenue in Mexico, 2014–2018. Units: percentage of total tax revenues; source: authors, based on [59].

Incentives for the consumption of new products, such as investment allowances or investment exemptions, especially when such benefits are not conditional on the use of the most environmentally friendly technologies, could encourage consumption practices that are undesirable from an environmental point of view. Such incentives encourage the consumption (and waste) of new materials, components and inputs from non-renewable resources. Accordingly, they are contradictory to the objectives of the circular economy, which seeks to extend the useful life of goods that can be repaired or maintained as long as possible. Although the investment incentives have declined significantly since the 2014 Reform in terms of GDP (from 0.24% in 2014 to 0.08% in 2018), more decisive cuts are

desirable. Furthermore, even when the 2014 Reform introduced the tax on fossil fuels (CO_2 tax), the benefits of this tax to the transportation and agricultural sectors remained in place at least until 2018 (reaching a peak in 2017: 2.96% of total revenue and 0.46% of GDP), only starting to fall after that year from the definitive withdrawal of diesel benefits for the transport sector.

In short, evolution in the period since the reform (Figure 4) shows a slow, partial, but progressive reduction of incentives and tax benefits that have a clear anti-environmental bias. Though slimmer than before, they continue to be very broad and carry much more weight than environmental incentives and benefits. The latter have quadrupled since the reform (with a very striking jump in 2017 when deductions increased for electric vehicles and bicycles, and clean technologies), but the absolute and relative levels of these incentives are still extremely low (0.01% of total revenue).

As we have already pointed out, most of the incentives and benefits granted for other purposes (social, culture, foreign trade, etc.) are difficult to classify using environmental criteria. These tax expenditures represent 18.97% of total tax revenues and 2.97% of GDP.

To summarize, the reality of tax expenditure in Mexico still disappointing. Tax benefits and subsidies have been used extensively to favour industrial activities with high consumption of material inputs and non-renewable resources, or even natural resource extraction activities (hydrocarbons and mining). Also, many subsidies to the consumption of fuel, diesel, energy use and water in homes and industries have been applied in Mexico before and after the 2014 Reform [23].

Therefore, most of the subsidies and tax benefits presently in use do not qualify as environmental policy, but on the contrary benefit activities harmful to the environment. This increases the urgency of the challenge to redirect or drop these incentives, especially because of their harmful effects on the environment, as suggested by Stahel [82] and Martínez and Roca [3]. This argument should be distinguished from other questionings of subsidies and benefits. In fact, the OECD [48] recommends they be eliminated because international experience shows that such instruments diminish tax revenues and the effective reallocation of resources, while their effective impact on growth, productivity and investment remains unclear. Anyway, the redistributive effect of eliminating subsidies and implementing carbon taxes on household income in Mexico should be considered (some studies suggest a progressive impact, e.g., Rosas-Flores et al., [83]).

5. Results

The examination of the available information regarding environmental and environmental-related fiscal instruments in Mexico since 1990, and particularly since the 2014 Public Financial Reform, allows us to highlight the following results:

Environmental taxes in Mexico are still underdeveloped when compared to European countries and other OECD countries, which also show a poor performance. The environment-related taxes are also quite lower than in European countries and, for years, the OECD countries. It is worth mentioning that Mexico is reaching the mean OECD countries in the very last years, but its evolution is highly dependent on the variability of the main tax, IEPS-G&D, whose classification as an environmental-related tax is highly debatable.

Revenue volatility in IEPS-G&D is caused by its very design as an external-internal price adjustment mechanism for hydrocarbons. Such a sui generis design converts this tax into a pseudo-tax and, as a consequence of a political price strategy in the hydrocarbon sector, it includes implicit subsidies to reduce the effects of high prices for consumption. It is characterized as an environment-related tax because the product being taxed (fuel) has clear environmental impacts involving the use of natural resources and the polluting emissions resulting from its consumption. However, this tax does not incorporate explicit environmental criteria or objectives (concerning emissions or other impacts); neither its design nor its implementation respond to an environmental purpose.

Since the 2014 Reform, steps have been taken in the implementation of environmental fiscal instruments, both on the tax side and on the fiscal expenditure side, but they are modest in scope and reflect the approach adopted in the first generation of environmental taxation. Tax revenues from environmental taxes (CO_2 and pesticides) reveal a very limited tax base and extremely low prices that barely reached 0.036% of GDP on average between 2014 and 2019. In current currency, the carbon tax has evolved negatively (revenues in 2019 were only 53.3% of those obtained in its first year), while the pesticides tax has shown a positive but insignificant trend.

There is a positive correlation ($R^2 = 0.446$) between the CO_2 tax/GDP ratio and annual GDP growth, with a stronger fall in GDP growth than in the CO_2 tax, suggesting that economic growth is the main variable explaining the pace of emissions (instead of the tax).

Since the 2014 reform, some anti-environmental incentives and tax benefits have diminished, but they are still very broad and outweigh environmental incentives and benefits, which, while growing, remain at very low levels. Incentives and benefits which promote practices harmful to environment represented 1.66% of total revenue and 0.26% of GDP in 2018, of which almost half (0.12% of GDP) corresponded to activities with high CO_2 emissions. Meanwhile, environmental-oriented benefits scarcely accounted for 0.07% of revenues and 0.01% of GDP in 2018, which makes their positive evolution practically irrelevant.

The highest percentage of ecologically harmful tax waivers were granted under ISR-business (0.11% of GDP in 2018), mainly in the form of investment deductions (0.06%) or tax credits, or other credits and reductions (0.04%).

6. Conclusions and Future Research

Environmental fiscal policy is a potentially effective and fundamental instrument for achieving environmental objectives. Beyond public spending (green public investments, green public procurement, subsidies, etc) to finance actions to mitigate or repair environmental damage, we are focusing on the importance of other fiscal instruments such as taxation and tax expenditure (a large range of tax benefits as exemptions, reduced rates, depreciation, deferral, deductions, etc.). Taxes and tax benefits are flexible instruments that can alter the prices of goods or services, generating price signals and incentives to reorient the behaviour of economic agents (producer and consumers) towards sustainable patterns. They have the potential for transversal impact along the economy and they can generate resources for financing public environmental spending or compensating the negative redistributive effects of such taxes. Moreover, they are relatively easy to manage by the tax administration.

The analysis of the tax regulation shows that, since the 2014 Public Finance Reform, Mexico has taken steps in using fiscal instruments to respond to environmental policy objectives. Environmental taxes (CO_2 and pesticides) have been incorporated and tax benefits and incentives have been reduced for some specific polluting and harmful activities and consumption. However, the empirical evidence provided in this paper shows that the modest aims and commitments expressed in the 2014 Fiscal Reform are far from being substantiated. The detailed analysis of measures and results suggest some explanatory factors to the modest performance. On the one hand, environmental taxes have minimal incidence and revenue capacity due to the narrow range of activities subject to the tax and the extremely low prices of carbon emissions. To reach some effectiveness it should be necessary to expand substantially the tax base of the carbon tax, including all relevant emitters, and increase the tax rate at an accelerated pace (taking as reference some successful countries, e.g., Sweden (see Sterner [84]), or the expert recommendation to start at about EUR 50 per ton of CO_2 (see Edenhofer [85])). On the other hand, the anti-environmental incentives and benefits still outpace those designed to safeguard the environment. These are key results that allow us to understand the clearly negative environmental bias of the current tax system and, at the same time, to identify the type of problems and instruments on which to focus efforts to change tax policy in an environmentally friendly direction.

There are many reasons why Mexico and other developing countries have not given the same level of priority to the environmental agenda and to implementing the same advanced, systemic environmental fiscal policies as some developed countries (e.g., the urgent need to address the problems of poverty, welfare and job creation, or the awareness that the major global environmental problems are primarily the responsibility of the growth and consumption patterns of the more developed economies). However, it is increasingly evident that past and current fiscal architecture reinforces the unsustainability of the economic model, everywhere. Despite the progress of last three decades, the global balance sheet remains openly unsatisfactory, even for official international bodies [86]. A key conclusion of this work is that particular attention should be paid to the relevant environmental harmful benefits, a huge and hidden share of the current tax system. The problem is not exclusive to Mexico, but general in nature.

Significant progress in this direction requires taking firm steps towards systemic green tax reform that can align fiscal policy design with environmental and climate challenges. It will be necessary to focus more on taxation than on expenditure, because taxes (and tax expenditures) are among the most cost-effective environmental policy instruments [24,28,41,87]. The point is that taxes have the potential to change the relative prices of goods and services, but to do so changes must be significant in order to change the cost structure of the economy. Otherwise, the success in reshaping behaviours of economic agents towards sustainability will be very unlikely. Far from neutral, the tax shifts should have an uneven impact on different sectors, depending on the elasticity of supply and demand and the capacity of companies to transfer the tax impact to suppliers, customers or consumers.

The analysis of environmental taxes and tax expenditures in Mexico suggests the basis for an environmental tax reform in the short term: (a) significantly increase the tax base of the carbon tax, extending its application to all activities that are major emitters of CO_2, (b) significantly raise the tax levied on tonnes of CO_2 emitted, (c) eliminate in the short term all tax benefits for activities or products with clearly negative effects on the environment, and, (d) establish fair and generous tax benefits in VAT or corporate income tax for all labour-intensive circular economy activities such as repair, reuse, remanufacturing or remediation.

Of course, further research is needed to address the issue of the negative effects on income distribution and the design of the appropriate instruments to cushion it [88]. If the carbon tax were able to generate significant resources, these could be used to implement redistributive policies to benefit the poorest households or to balance significant VAT benefits for basic consumption. Going even further, the transition towards a sustainable circular economy requires a deeper study of the most profound changes needed in the architecture of the current tax system, which is directly or indirectly supported by the taxation of labour [89].

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