4i TRACTION
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National case study report # 7

The role of energy and environmental taxes in Spain

An ex-post assessment of the 2005-2020 period

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Abstract

This case study examines the implementation of energy and environmental taxes in Spain and their role in climate change mitigation from 2005 to 2020. While the EU views environmental taxation as important to achieve decarbonization, lack of harmonization has led to uneven implementation among Member states. Spain's implementation of these taxes is complicated by jurisdictional complexity due to taxation distribution among central, regional, and local governments. This has led to a multiplicity of instruments that do not follow a coordinated strategy, and the environmental ambition of which is often limited. The study raises questions about the effectiveness of EU legislation in harmonizing environmental taxation, and the successful implementation of environmental taxes in Spain, their distributional effects, the role of jurisdictional levels, and harmful subsidies. The study finds that environmental taxation rates in Spain remain among the lowest in the EU and the implementation of the taxes focuses mainly on revenue generation rather than environmental impact. The study also suggests that distributive compensations should be established to achieve a fair transition to a decarbonized economy, and that greater coordination is needed among jurisdictions to ensure coherence.

Acknoledgements: We thank Katri Varis and Fernando León-Mateos for reviewing the document.

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List of abbreviations

AEAT	Spanish Tax Agency
CERMFA	Commission of Experts for the Review of the Autonomous Communities Financing Model
CERSFL	Commission of Experts for the Review of the Local Financing Model
CERSTE	Commission of Experts for the Reform of the Spanish Tax System
CETE	Commission of Experts on Energy Transition
CO_2	Carbon dioxide
CPEELBRT	Committee of Experts to Draft the White Paper on Tax Reform
CPLC	Carbon Pricing Leadership Coalition
EC	European Commission
ED	Excise Duty
EEA	European Environment Agency
ESR	Effort Sharing Regulation
ETD	Energy Taxation Directive
EU	European Union
EU ETS	European Union Emissions Trading System
g	Gram
GCV	Gross Calorific Value
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GJ	Gigajoules
JCJEU	Judgment of the Court of Justice of the European Union
IEA	International Energy Agency
IEDMT	Special Tax on Certain Means of Transport
IISD	International Institute for Sustainable Development
IMF	International Monetary Fund
INE	Spanish National Statistics Institute
IVPEE	Special Tax on the Value of Electricity Production
IVTM	Tax on Motor Vehicles
kg	Kilogram

km	Kilometre
l	litres
LPG	Liquefied Petroleum Gas
MS	Member States
MWh	Megawatt hour
n.a.	Not Available
NECP	National Energy and Climate Plan
NH_3	Ammonia
NOx	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
REAF	Register of Tax Adviser Economists
SOx	Sulfur oxides
TFEU	Treaty on the Functioning of the European Union
VAT	Value Added Tax
VOC	Volatile Organic Compound

Executive summary

This case study focuses on the implementation of energy and environmental taxes in Spain and its role in climate change mitigation in the 2005-2020 period. From the EU policy perspective, although this type of taxes are considered an important instrument to contribute to the decarbonization of economies, the lack of greater harmonization of environmental taxation leads to an uneven implementation at Member state level.

Spain provides an interesting case in which the challenges and complexity of the use of these instruments can be observed. One of the most characteristic features of the Spanish case is the jurisdictional complexity created by the distribution of competencies in taxation among the central government and the regional and local governments. This has led to the existence of a multiplicity of instruments that do not necessarily follow a coordinated strategy and the environmental ambition of which is often limited.

In order to further assess the impact of environmental taxation as a climate change mitigation instrument, the following research questions have been defined:

- How effectively has EU legislation managed to harmonize environmental taxation? How has the legislation impacted MS (and specifically Spanish) taxation policies?
- Have environmental taxes in Spain been implemented successfully and contributed to advance towards climate change mitigation?
    a. What have been the distributional effects of the policies?
    b. How have the different levels of jurisdiction (local/regional/central) affected the policies and its results?
    c. What has been the role of harmful subsidies?
- What are the implications/lessons from the 4i perspective: Integration and Innovation?

The research conducted in the case study has led to the following main conclusions.

From the EU perspective, the use of environmental taxation is considered important as part of the policy mix to achieve climate neutrality and that its increased use is encouraged. However, the decision-making processes in certain aspects such as taxation, which require a unanimous vote, have limited the actual capacity of the EU in regulating and influencing Member States' policies in that area. We have observe that the scope of the ETD is reduced to energy taxes and the environmental goal only has a secondary role leaving much of its implementation to the will of each Member State. Also, the only mechanism allowing to enhance its environmental potential was through the use of exemptions to specific sectors or technologies, but exemptions were also available to address competitivity issues which could lead to inconsistencies within the policy.

Additionally, the lack of review of the taxation rates since its implementation in 2003 further limited its environmental capacity.

However, the ongoing review of the ETD although still limited in scope, fixes some of the main shortcomings identified by first, linking the rates to the environmental impact of each of the products and establishing an automatic mechanism to update rates to match inflation.

The issue remains, however, in the lack of further harmonization of environmental taxes that fall out of the scope of the ETD. This is, as shown in the study, the case in Spain where only a handful of instruments on fuels and electricity are harmonized.

Focusing on the case of Spain, we see how the levels of environmental taxation during the 2005-2021 period have remained among the lowest of the EU Member States. Although there are instruments that by definition are considered environmental taxes, their environmental effectivity remains quite low. In the study we identify how there are challenges regarding both the ambition and the design of the instruments. In general, most taxes although they might have a modest capacity to influence behaviours towards more environmentally responsible ones, the main focus has remained the revenue generating one. Thus, the general conclusion at the national level is of a missed opportunity to take advantage of the potential of environmental taxes to contribute to achieve decarbonization goals.

The study also analyses the case of the taxes implemented at the regional level. We identify that the motivation to use of such instruments at the autonomous region level often responds to the need to find complementary revenue sources by seizing the opportunity to regulate in areas where the central government had not and thus were available. We also observe limited impact due to design flaws that do not adequately deal with the externality in a way to minimize its impact.

The undesired negative social effects, specifically on most vulnerable sectors of the population, related to the implementation of environmental taxation are also assessed. We study how the different energy and environmental taxes in Spain affect different population sectors. Using the revenue generated by energy-environmental taxation to establish distributive compensations is key to achieving a fair and successful transition to a decarbonised economy. To this end, it is first necessary to carry out a rigorous analysis to identify losers and winners, as well as the impacts of existing alternatives to compensate households. These compensations cannot be linked to energy consumption, in order to incentivise energy savings and efficiency, and should be targeted, whenever possible, to particularly affected households.

In terms of **innovation** although the academic literature supports that one of the ways in which environmental taxation contributes to decarbonization is by incentivizing technological innovation, the impact in the case of Spain can be considered modest at best. The lack of availability of specific data makes it hard to quantify with precision the extent of this impact, but what seems clear is that its full potential is missed. This is coherent with the conclusions presented in the study on the shortcomings of the existing instruments in particular and of the system as a whole.

Related to **integration**, one of the main challenges is related to the coordination and coherence among jurisdictions. This lack of coherence seems to be partly due to the intrinsic complexity of coordinating a large number of institutions with particular political and social agendas. But also during the reviewed period, there did not seem to be a clear ambition from the central government to use this type of instruments and to search for coordinated action with the regional governments, not from the regional governments to seek for coordination amongst themselves.

Another important aspect that the analysis has revealed is the potential conflict among instruments targeting to mitigate different externalities. We have cited the example of taxes targeting the visual impact of wind energy infrastructure which can put this technology in a disadvantaged position compared to more polluting ones from an emissions perspective. In this case, again, better coordination and better policy design are needed to try to mitigate these undesired effects.

1. Introduction

Climate change is one of the biggest challenges faced by society. The EU and its MS have increasingly focused on how to mitigate it with the ultimate goal of reaching climate neutrality by 2050. The EU has been a leading actor internationally in climate change policies (Oberthür & Dupont, 2021), but its institutional framework adds complexity to climate change governance as there is a mix of policy instruments and the jurisdiction is shared between the EU and the MS.

Among the different policy instruments to contribute to the abatement of GHG emissions, energy and environmental taxes are quite consensually considered a useful tool (Shahzad, 2020). The use of this type of taxes, in the form of a carbon tax, was considered at the EU level, but the lack of agreement among MS impeded its implementation. However, energy and environmental taxes are widely used at the MS levels albeit with different intensities and results. Harmonization of some of the taxes included in this category was attempted via the ETD from 2003 (EC, 2003) but as it will be further discussed in the study the effectiveness has been limited.

Although environmental taxes are currently in use in many European Countries, there is also an increasing awareness that current tax systems require in most cases a substantial reform to be able to properly address current environmental, social and economic challenges (EAA, 2022). In this regard, an important element to design and implement new taxations systems is to conduct ex-post assessments to better understand what have the main shortcomings and flaws been as well as the strong points in current systems.

In this context this case study focuses on the implementation of energy and environmental taxes in Spain and its role in climate change mitigation in the 2005-2020 period. As it will be argued below, Spain provides an interesting case in which the challenges and complexity of the use of these instruments can be observed. One of the most characteristic features of the Spanish case is the jurisdictional complexity created by the distribution of competencies in taxation among the central government and the regional and local governments (OECD, 2023a). This has led to the existence of a multiplicity of instruments that do not necessarily follow a coordinated strategy and the environmental ambition of which is often limited.

The case study is structured as follows. In section 2 the main elements of the design of the case study are presented. This includes a short background and justification of the relevance of the proposed case, the definition of the research questions and the methodology used. In section 3 the main analysis is presented. First the current EU regulation on environmental taxation is assessed. Then the Spanish case is analysed. First by mapping and describing the existing instruments and its impact in terms of climate change mitigation. We then go into specific aspects such as the role of harmful subsidies and also provide an analysis from a social perspective by looking at the distributional effects of current policies. To close this section an assessment from the perspective of the role of innovation and integration is provided. To close the case study we provide some summarized conclusions, some recommendations for action and identify future lines of research.

2. Case study design

2.1 Background

The role of taxation as an important part of the policy mix to achieve climate neutrality is quite consensual. However, the lack of greater harmonization at the EU level leads to an uneven implementation at Member state level. In the case of Spain, the ETD (EC, 2003) has been to a certain extent influential in reforming and defining some of the studied instruments, but some of the relevant instruments that conform the climate related environmental taxes in Spain fall outside the Directive's scope.

As the scope of the 4I-Traction project is on climate change mitigation, our study deals mainly with energy and transportation taxes. Namely, taxes on electricity, on fluorinated gases, on fuels (hydrocarbons, natural gas, coal), and related to the purchase of vehicles. However, we also include in the analysis other taxes that although targeting different externalities, play an important role as they also end up impacting the effectiveness of certain instruments and the capacity of the tax system as a whole to contribute to climate change mitigation.

We look at national level taxes but also to some of the instruments applied at regional and local levels. In terms of jurisdiction, some of the taxes can only be regulated at the national level. Within these, some are directly implemented by the national government and others have been delegated to the regions. Also, in certain subjects where the national government has not legislated, regions and local authorities can also create new taxes. This complex jurisdictional structure has created some coherence and coordination challenges. This lack of a common and coordinated strategy also can be one of the factors limiting the impact of these policies.

In the analysis we point out how most taxes were pre-existent to harmonization or to the inclusion of climate considerations in the overall policy priorities. Thus, in many instances, the revenue generating goal seems to take precedence over climate considerations. In a few instances, the taxes have been reformed to include environmental aspects. For example, this is the case with the car registration tax which was revised o to include a progressive rate linked to pollution levels of the vehicles. The fact that these taxes have not originally been designed as climate policy instruments partly hinders their capacity to achieve decarbonisation goals and also to account for and deal with some of the distributional impacts they generate.

Although the main shortcomings of the environmental taxation system in Spain have been identified by the academia (Gago et al., 2021) and proposals to reform some of the existing instruments have come from several groups of experts seconded by the government, no relevant reforms have been carried out to date.

2.2 Research questions

Based on the context provided above and a literature review on the different topics that the case touches upon the following research questions have been defined:

- **How effectively has EU legislation managed to harmonize environmental taxation? How has the legislation impacted MS (and specifically Spanish) taxation policies?**
- **Have environmental taxes in Spain been implemented successfully and contributed to advance towards climate change mitigation?**
  a. What have been the distributional effects of the policies?
  b. How have the different levels of jurisdiction (local/regional/central) affected the policies and its results?
  c. What has been the role of harmful subsidies?
- **What are the implications/lessons from the 4i perspective: Integration and Innovation?**

2.3 Relevance for transformative climate policy

The 4I Traction projects identifies four key challenges to advance towards a transformative climate policy that move away from incremental improvements and that allows to achieve the carbon-neutrality goal by 2050. These challenges are Innovation, Infrastructure, Investment and Integration. For this case study we focus on two of the Is, Innovation and Integration.

2.3.1 Innovation

For innovation we use the definition and classification established in WP1 of the 4I-Traction project, in deliverable D1.1 (Görlach et al., 2022) which differentiates among three types of innovation: Technological, business model and policy innovation. Although the role of social innovation is acknowledged, it falls out of the scope of the current project.

Regarding technological innovation, from a theoretical perspective, environmental taxes provide a price signal that incentivizes either the improvement in terms of efficiency of existing technologies or stimulate the development of new less carbon-intensive technologies.

In terms of business model innovation, similarly, the increase in price generated by the tax can act as a catalyser to change specific parts of the business model to obtain efficiency gains or may also lead to the creation of entirely new business models. For example, it is a possibility that with the existing carbon pricing instruments a specific product is no longer profitable and the company decides to shift to other products or services with a smaller environmental impact. An existing

trend regarding business model innovation has been the shift towards servitization. That is, moving from product-centric approaches to service-oriented ones. This type of innovation is closely related to technological innovation as often the change is enabled by digital tools (Paiola & Gebauer, 2020). This servitization can be found in industrial value chains but also oriented to new services for end-users. A clear example could be car-sharing services.

In terms of policy innovation applied to environmental taxation, the innovation in the design of the instruments can lead to better environmental impact. Also it can serve to mitigate some undesired effects such as distributional effects.

2.3.2 Integration

The 4I-Traction project defines two types of integration in relation to climate policies. On the one hand, integration as climate policy mainstreaming. On the other hand, sectoral integration which aims at linking and coordinating the efforts in different sectors. One of the key areas for this type of integration is the energy system (Görlach et al., 2022).

Both types of integration are relevant from our case study perspective. In terms of policy mainstreaming, environmental taxes can be an instrument to transfer climate considerations into different sectors. However, as it will be further detailed in the study, the lack of a clear coordinated strategy can lead to suboptimal impacts and also contradictory effects. The complexity of implementing a coherent environmental system is increased by the fact that taxes are legislated and implemented at different jurisdictional levels (central, regional, local).

2.4 Methodology used in case study

The methodology used in this case study is based on desk research. The first step has been an extensive literature review on environmental taxes in EU policy, environmental taxes in Spain, environmental taxes as a policy instrument, and also the literature on innovation and integration applied to climate policy, to carbon pricing and specifically to environmental taxation. The review has served for the final definition of the scope of the study and of final the research questions.

Then the analysis has been conducted through the use of secondary sources identified in the literature review and the use of primary sources and data. Among the primary sources used are the different legal documents at the EU, national and regional levels. Also, data from revenues from Eurostat and from the Finance Ministry. Additionally, data from the INE has been used to assess the impact on innovation and to analyse the impact of distributional effects.

This study is predominantly a qualitative study, but some descriptive statistics have also been used to better understand some of the implications related to the distributional effects and the impact on innovation. The results of the research and analysis are presented in this study which includes a final section on conclusions and lessons learned that are formulated taking into account the need to provide actionable results useful for policymaking.

One of the contributions of this study has been the use of the lens of the Is, specifically Innovation and Integration. Although we found a few examples of previous research linking environmental taxation to innovation and to certain aspects of what we define as integration, our work deals with the two I in a more direct way and, for the first time, specifically targeting the whole environmental tax system in Spain.

Finally, a methodological clarification is required related to the concept of environmental taxes. According to the EU Environmental Taxes Statistical Guide (Eurostat, 2013) an environmental tax is "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". This definition is shared also by the OECD and the IEA.

This definition focuses on the tax base to establish what is an environmental tax, considering it an objective way to facilitate international comparisons of instruments. The guide states that other possibilities like the purpose stated by the legislator, name or earmarking the revenue for environmental purposes are considered less suitable and more complex for the mentioned comparison purposes. This definition, thus, does not take into account the intentionality of the tax as it is considered that independently of the purpose, the effect of the tax is the same, which is the impact on the relative prices of the product or activity subject to it.

Although the argument about the need to find an objective and comparable definition is clear, the assumption that the effect is the same, no matter the purpose, seems a bit more problematic. This will indeed be one of the aspects covered in this study. In this regard, it can be argued that the goal of the tax does affect the design of the instrument and, consequently, its impact. The goal does not necessarily need to be a single one (environmental or revenue generation), but the balance among these will have different outcomes in terms of the type of instrument implemented. As we use data from official sources following this definition, and so does most of the reviewed literature, we mainly refer to environmental taxes with this same meaning. However, during the assessment one of the assessment elements is the environmental ambition and effectivity of the instruments.

3. Results

3.1 Case findings

3.1.1 The role of EU legislation in shaping energy and environmental taxation in EU Member States

One of the key aspects of our analysis is to understand what the role of the EU law in has been in shaping the environmental tax system in Spain. In this sense it is important to assess the characteristics of the instruments and regulations related to the harmonization of environmental taxes in the EU. Additionally, we assess how the regulations that have emerged, mainly the ETD from 2003 has influenced the definition and reformulation of environmental tax instruments in Spain. We also provide a glance to the revised version of the ETD currently undergoing the ordinary legislative procedure and whether it addresses, and to what extent, some of the identified shortcomings in terms of environmental protection capacity of the previous directive.

The ambitions of the EU in terms of environmental action became clear as the Single European Act (ref 1986) added an Environmental Title to the Treaties. In this title the "polluter pays" principle was established as one of the guiding principles and the "integration clause" was included. This clause, now included as article 11 of the TFEU[1], establishes that "Environmental protection requirements must be integrated into the definition and implementation of the Union's policies and activities, in particular with a view to promoting sustainable development".

However, in terms of taxation, it proved challenging to find the level of agreement required among Member States to introduce meaningful environmental provisions. Taxation capacity remains in the hands of Member States with the EU having only limited competences. Thus, taxation policies at the EU level require the consensus of all Member States to be adopted. This has prevented to establish environmental taxation instruments at the EU level and has limited the extent of the environmental approach within tax harmonization regulations.

In this regard, the idea of establishing a carbon tax at the EU level was entertained and proposed by the commission in 1992[2], yet the mentioned consensus could not be achieved and the proposal was finally withdrawn. As an alternative, since environmental policies fall in the EU competence level, the instrument that could be agreed on was carbon pricing through an emissions trading system, the EU ETS. This, as pointed out by Pirlot (2020), reflects the important role that the institutional framework of the EU, and its decision-making rules, have had in the definition of environmental tax measures and, extensively, in the broader definition of the EU climate policy.

[1] Consolidated version of the Treaty on the Functioning of the European Union (link)
[2] Commission of the European Communities, Proposal for a Council Directive introducing a tax on carbon dioxide emissions and energy, Brussels, 30 June 1992, COM(92) 226 final. (link)

In this context the regulation of taxes with environmental implications has been reduced to the harmonization of energy taxes. This limitation of scope, as we will see in the Spanish example, leaves many instruments that either refer to energy but are not excise duties or that focus on other sources of GHG emissions out of the harmonization framework. In terms of energy taxes the ETD (EC, 2003) was passed in 2003 as the evolution of the first directives on the taxation of mineral oils from 1992.

The Directive defines a list of energy products that are subject to taxation and sets minimum taxation rates to harmonize them at the EU level. The ETD also regulates under which conditions exemptions and reductions can be applied. The original and primary objective of the directive is to ensure the proper functioning of the internal market. It does so by trying to avoid double taxation as well as other distortions of trade and competition. It is only as a secondary goal that we find environmental protection and climate change mitigation. The main instrument to pursue this goal is through exemptions and reduction that MS can implement on a voluntary basis.

Although it may be argued that from an environmental perspective the ETD was a step forward compared to the previous directives on mineral oils, its limitations are significant. Firstly, the rates established for each type of fuel are not related to their environmental impact. Secondly, as the Directive attempts to pursue several goals simultaneously, the exemptions and reduction of rates foreseen in the Directive are sometimes inconsistent with environmental goals. For example, among environmentally relevant exemptions we find those to electricity generated by renewable sources, combined heat and power generation, exemptions to public transportation. However, we also find other exemptions that pursue the competitiveness of the European industry, that are contrary to the environmental goals. In this regard we find the exemption to energy intensive industries or the exemption to air transport and sea shipping and other commercial activities. Additionally, the use of exemptions is optional and at the discretion of each Member State which waters down the actual enforceability of the measures that could have an environmental impact. Also, each Member State included in the ETD a list of its own, additional, exemptions which complicated the hindered the harmonization goal.

Aside from the flaws from its design, the lack of update of the rates associated with inflation has reduced its potential impact. Thus, while most Member States' rates are above the minimum established in the ETD, the environmental impact is below expectations. In sum, as stated in the evaluation of the ETD by the Commission[3] the evolution of energy markets, technologies, the EU legislative framework and political priorities over the years since the approval of the ETD in 2003 have reduced the capacity of the directive to effectively fulfil its purposes.

To assess the evolution of environmental taxation in the EU MS we compare the situation in 2005 and in 2021. We do so in two different ways. First by comparing environmental taxes' revenue to the total GDP (Figure 1). Then by calculating the share of environmental tax revenue over the

[3] COMMISSION STAFF WORKING DOCUMENT EXECUTIVE SUMMARY OF THE EVALUATION of the Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity {SWD(2019) 329 final} (link)

total tax revenue in MS (Figure 2). Using both metrics we get a consistent picture that in the majority of MS environmental taxes have lost proportional weight.

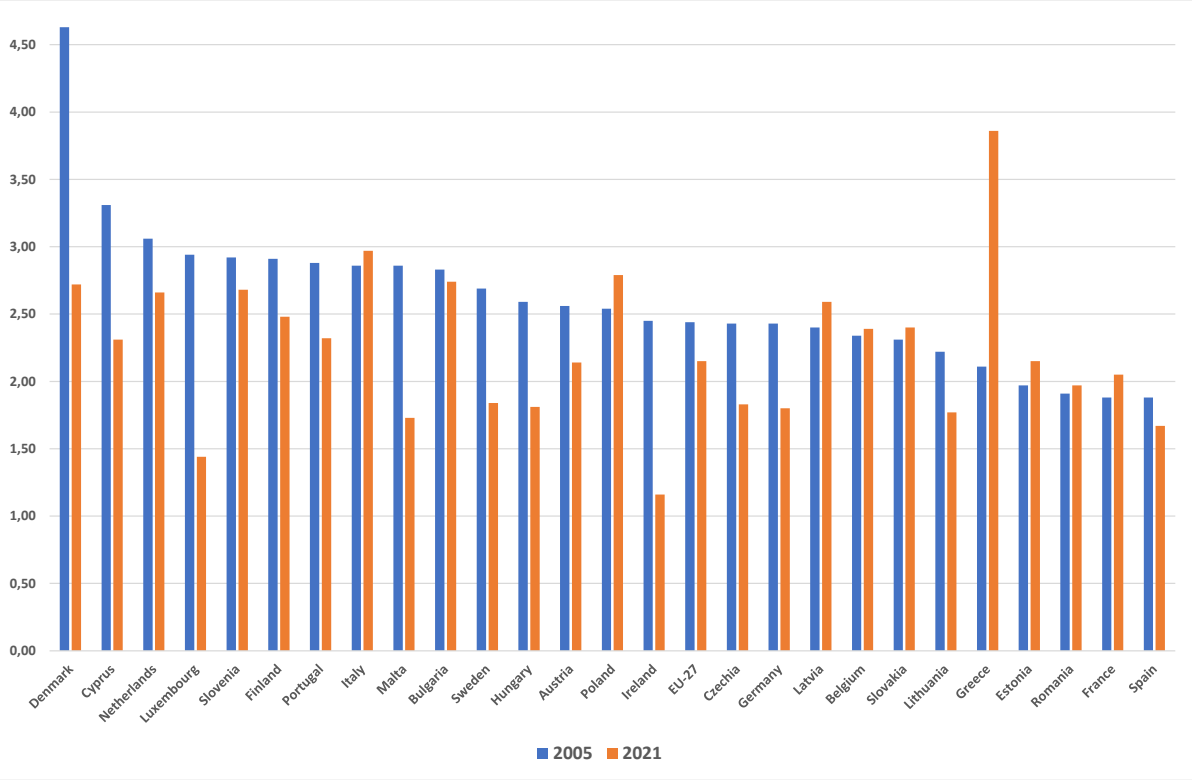

Figure 1. Share of energy-environmental taxation in the countries of the European Union. % GDP [4]

Source: Eurostat (2023a)

Additionally, Table 1 shows the weight in the final price of taxation on the main energy products in Spain and the main European countries in 2005-2018. It shows that in this period in Spain the weight of taxation on residential electricity, non-commercial diesel and natural gas increased, while the weight of taxation on industrial electricity, commercial diesel and gasoline decreased. In any case, in 2018 the weight of taxation in Spain was below the population-weighted average weight of the main European countries, a situation similar to what was the case in 2005, when it was only above average for residential electricity.

Although most of the shortcomings and problems with the ETD were identified early on, the lack of consensus, again, impeded a review. In this sense, in 2011, following an impact assessment report[5], the Commission put forward a proposal to modify some aspects including taxing products according to their energy content and CO_2 emissions instead of volume and also better

[4] Revenues from environmental taxes on energy and transport.
[5] COMMISSION STAFF WORKING PAPER IMPACT ASSESSMENT Accompanying document to the Proposal for a COUNCIL DIRECTIVE amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity {COM(2011) 169 final} (link)

coordination with the EU ETS. Although the European Parliament and the Economic and Social Council had issued positive opinions, MS could not reach an agreement and the proposal was withdrawn in 2015.

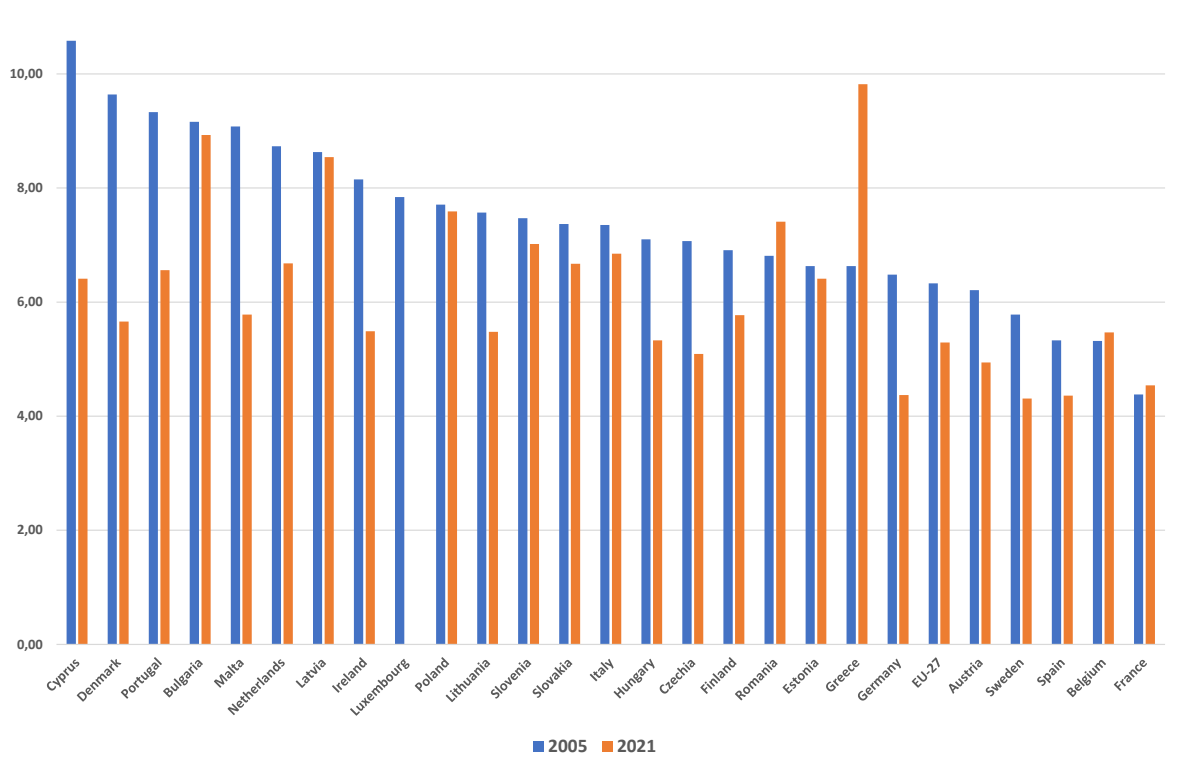

Figure 2. Share of energy-environmental taxation in the countries of the European Union. % total tax revenue6

Source: Eurostat (2023a)

Table 1. Percentage of taxes in energy prices in selected EU countries (% price of energy)

Country	Gasoline				Gasoline				Gasoline				Gasoline	
	Households		Industrial		Households		Industrial		Non-Commercial		Commercial			
	2005	2018	2005	2018	2005	2018	2005	2018	2005	2018	2005	2018	2005	2018
France	25.0%	36.2%	11.2%	22.1%	14.8%	27.0%	4.2%	16.2%	57.2%	59.0%	48.8%	50.8%	67.1%	62.5%
Germany	13.8%	53.8%	0.0%	49.1%	24.1%	24.4%	14.5%	15.7%	57.9%	51.7%	51.1%	42.5%	67.4%	60.7%
Italy	24.5%	32.8%	21.4%	34.7%	37.9%	35.8%	13.8%	11.9%	53.8%	59.5%	44.5%	50.6%	62.8%	63.6%

[6] Revenues from environmental taxes on energy and transport.

Spain	18.0%	21.4%	4.9%	4.9%	13.8%	20.2%	0.0%	2.1%	46.7%	47.8%	38.2%	36.9%	55.3%	53.1%
UK	4.7%	4.8%	4.6%	3.9%	4.8%	4.8%	3.5%	3.3%	66.7%	61.2%	60.9%	53.6%	69.2%	62.9%
Weighted Average[7]	16.8%	33.2%	8.4%	28.6%	20.5%	22.8%	9.4%	12.0%	58.8%	57.5%	51.3%	48.9%	66.7%	62.3%

Source: prepared by the authors with data from OECD (2015a, 2019a) and Eurostat (2023b).

New ETD proposal

As part of the Green Deal initiative and the Fit for 55 Package a new review ETD has been proposed which is currently undergoing the legislative process. As of December, there seems to be general agreement on the need to reform the Directive, but further work is needed to reach an agreement within the Council. As we have noted before in the case of the 2003 ETD, reaching consensus has proven to be a challenge in previous occasions.

If the proposed ETD (EC, 2021) comes into force, Spain would have to increase its taxation of several energy products (Table 2). Thus, in the case of motor fuels, taxation on diesel, LPG and natural gas would have to be increased. In the case of LPG and natural gas, currently the tax rates applied to their use as fuel are lower than the minimum level of the Directive (EC, 2003), because the Directive allows in its article 15 for reductions in the level of taxation of natural gas and LPG used as fuel. However, in the Proposal for a Directive, this exception disappears, while at the same time the minimum tax rates are increased, so that their taxation will have to be increased considerably.

In the case of heating fuels, the taxation of heavy fuel oil, LPG, natural gas, coal and coke will have to be increased. Electricity, although its tax rate was temporarily reduced from 5.11% to 0.5% from September 2021, had an effective tax level in 2022 that was still above the minimum level of the proposed Directive, which could be an opportunity for the reduction in the tax rate to be made permanent, thus favouring the electrification of the economy.

Additionally, it should be borne in mind that in the Proposal for a Directive the minimum tax rates would be automatically adjusted annually, according to the harmonised EU consumer price index (excluding energy and unprocessed food), to avoid the loss of real weight of these taxes over time, so that at some point the tax rates for all energy products will have to be increased. This is one of the revised aspects from the former ETD that will avoid additional reviews to update just to updated t to current prices.

Table 2. Energy Taxation Directive minimums and tax rates in Spain8

	2003/96/CE Directive	New Directive proposal		Units

[7] Weighted average of the population of Germany, France, Italy and the UK.

[8] As the Proposal for a Directive expresses all minimum tax levels in €/GJ, the conversion of units is carried out, as indicated in the Proposal for a Directive, according to Annex IV of Directive 2012/27/EU. As this Annex does

	01/01/2004	01/01/2010	01/01/2023	01/01/2033	**Current tax rate**	
Automotive fuels						
Unleaded petrol	359	359	350,37	350,37	472,69	€/1000l
Gas oil	302	330	390,08	390,08	379	€/1000l
Kerosene	302	330	377,89	377,89	378	€/1000l
LPG	125	125	329,82	494,5	57,47	€/1000kg
Natural gas	2,6	2,6	7,97	11,94	1,15	€/GJ GCV
Automotive fuels used in agriculture, horticulture, aquaculture and forestry; for stationary engines; in plant and machinery used in construction, civil engineering and public works; for vehicles intended for off-road use or not authorised to be used principally on public roads						
Gas oil	21	21	32,66	32,66	96,71	€/1000l
Kerosene	21	21	31,64	31,64	378	€/1000l
LPG	41	41	27,6	41,4	57,47	€/1000kg
Natural gas	0,3	0,3	0,67	1	1,15	€/GJ GCV
Heating fuels and electricity						
Gas oil	21	21	32,66	32,66	96,71	€/1000l
Heavy fuel oil	15	15	36	36	17	€/1000kg
Kerosene	0	0	31,64	31,64	78,71	€/1000l
LPG	0	0	27,6	41,4	15	€/1000kg
Natural gas	0,15 (Business use) 0,3 (Non-business use)	0,15 (Business use) 0,3 (Non-business use)	0,67	1	0,15 (Business use) 0,65 (Non-business use)	€/GJ GCV

not provide information on diesel and paraffin, the conversion factors of Commission Regulation 601/2012 of 21/06/2012 are considered. Finally, to convert kg of petrol, diesel and paraffin into litres, as well as to convert the net calorific value into gross calorific value of natural gas, the values of OECD/IEA/Eurostat (2004) are considered. In the case of electricity, since the tax rate is ad-valorem, the effective rate in the first half of 2022 is shown.

Coal and coke	0,15 (Business use) 0,3 (Non-business use)	0,15 (Business use) 0,3 (Non-business use)	0,9	0,9	0,15 (Business use) 0,65 (Non-business use)	€/GJ
Electricity	0,5 (Business use) 1 (Non-business use)	0,5 (Business use) 1 (Non-business use)	0,54	0,54	0,88 (Business use) 1,29 (Non-business use)	€/MWh

Source: Prepared by the authors with data from the EC (2003, 2021, 2023)

A final element to take into consideration about environmental taxation at the EU level is its role within the EU climate policy and its interaction with other instruments and, specifically, with the EU ETS. Although this escapes the scope of this study, it is worth noting a couple aspects. From a formal perspective, both instruments should be complementary and there is no overlap. The main reasoning for this is that while the EU ETS puts a price on emissions, environmental tax target other aspects such as the production or the use of a certain fuel. Also, up to now, although the ETS includes electricity within the regulated sectors, road transport and buildings were out of the scope. This will likely change when the proposed ETS2 enters into force in 2027 as both sectors will be included in this new market. While again, for the reasons mentioned above, there should not be problems of double taxation, coordination among the different instruments seems quite necessary. In this regard, as the EU ETS increasingly covers more sectors and the price signal becomes consistently higher, the role of the ETD can be seen more as a complementary measure that targets more clearly energy efficiency while also trying to contribute to the reduction of the dependency on fossil fuels. It makes sense to have a policy mix with different instruments that contribute to the same goal, but it is important that these instruments are implemented in a coordinated way so there is coherence and efficiency.

3.1.1.1 Energy and Environmental Taxation in Spain

The shortcomings of the harmonization and regulation of environmental taxes by the EU has in practice left the use of these instruments largely at the will of each Member State. In this section the different existing energy and environmental taxes are described and their impact from an environmental perspective is assessed.

In this sense, the role of energy-environmental taxation in Spain has been very modest up to the present day and has been fundamentally linked to revenue motives, as the central government has been reluctant to use these figures for years, citing alleged negative impacts on the

competitiveness and growth of the economy (Labandeira et al., 2009). However, revenue needs and the harmonisation of European excise taxation have sometimes forced it to increase the use of these figures, but in those cases environmental motives were incorporated in a limited and indirect way, only to solve specific regulatory or collection problems. This lack of interest on the part of the central government was taken advantage of by the Autonomous Regions to develop their own taxes, although these taxes, despite formally having an environmental character, have often been used as revenue-raising measures, with limited environmental effect.

As a result of all the above, Spain is at the bottom of the European countries in the use of energy-environmental taxation. Thus, in 2005, the weight of energy-environmental taxation in Spain was the lowest of all EU countries in terms of GDP and the third lowest in terms of tax revenue. Sixteen years later the situation has not changed much and the weight of environmental taxation in Spain is the third lowest in the EU in terms of GDP and the second lowest in terms of tax revenue (Eurostat, 2023a). In 2005, energy-environmental taxation in Spain represented 1.8% of GDP and 5.33% of tax revenue, compared to 2.44% and 6.33%, respectively, in the EU, while in 2021 these percentages had fallen to 1.67% of GDP and 4.36% of tax revenue, compared to 2.15% of GDP and 5.29% in the EU (Figure 3).

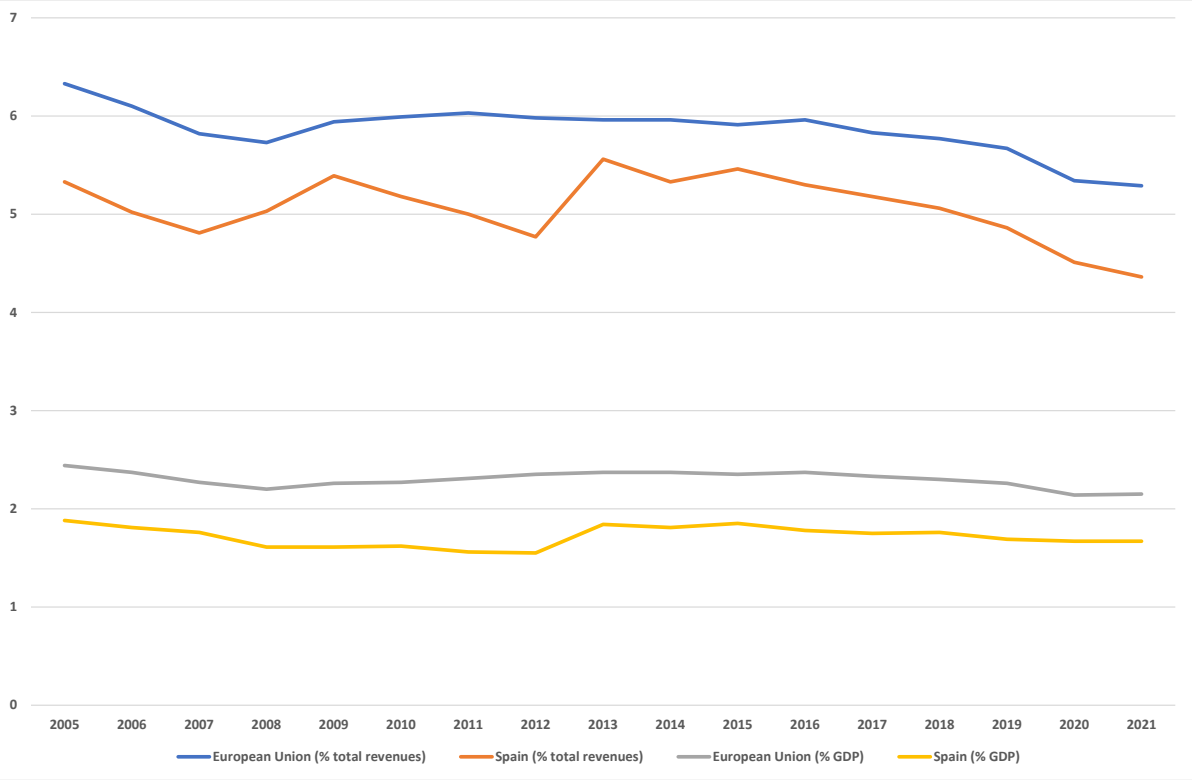

Figure 3. Weight of energy-environmental taxation in Spain and the European Union. 2005-20219

Source: Eurostat (2023a)

[9] Revenue from environmental taxes on energy and transport.

The main Spanish energy-environmental taxes, established by both the central government and the Autonomous Regions, are presented and analysed below.

3.1.1.2 Central government

Special tax on certain means of transport (IEDMT)

This tax is levied on the first registration in Spain of cars, boats and aircraft and was created in 1993 (Law 38/1992, 28 December 1992) as a revenue compensation measure, since VAT harmonisation at EU level had eliminated the increased VAT rate (28%) on vehicles. Its taxable base is the price of the vehicle, but whereas in 2005 tax rates varied according to the vehicle's cylinder capacity and fuel type, from 2008 tax rates are determined according to the vehicle's official CO2 emissions. Its collection is entirely devolved to the Autonomous Regions, which can increase tax rates by up to 15%. The revenue has been decreasing since 2005, especially since the 2008 reform, so that, despite small increases from 2015 onwards, in 2021 its collection in real terms represented only 19.7% of the collection in 2005 (see Table 3).

Vehicle purchase taxes are a key tool to facilitate the decarbonisation of transport, as the environmental impacts over the lifetime of the vehicle ultimately depend on purchasing decisions. In this context, if vehicle purchase taxes are of the right design and intensity, they will incentivise the purchase of low-emission vehicles (Gerlagh et al., 2018; Yan & Eskeland, 2018) and thus the supply of these vehicles. However, the Spanish tax has a tiered tax rate, which does not incentivise continuous environmental improvement, but only up to a certain threshold. Moreover, vehicles whose official CO2 emissions do not exceed 120 g/km are taxed at a 0 tax rate, which means that a large proportion of vehicles (61% in 2021, AEAT, 2023a) are not taxed at all.

Excise tax on hydrocarbons

A tax introduced in 1993 (Law 38/1992 of 28 December 1992) to adapt the taxation of hydrocarbons to EU rules, which is levied on the consumption of products used as fuel and hydrocarbons used as fuel. Its tax base is the volume, weight or energy content of the product subject to the tax and, since 2005, the tax rate on diesel was increased in 2007 and 2009 and the tax rate on petrol in 2009. In addition, in 2013 the exemptions that had existed until then for biofuels and natural gas not used as fuel were abolished, and the tax on retail sales of certain hydrocarbons, which had been levied on retail sales of certain hydrocarbons since 2002, was integrated into the tax. Thus, from 2013 until 2019 it had a tax rate made up of the sum of a state tax rate (in turn made up of a general rate and a special rate) and a regional tax rate, over which the Autonomous Regions had regulatory capacity. However, as of 2019, the regional rate was integrated into the special state rate at the maximum level allowed to the Autonomous Regions, thus eliminating their regulatory capacity. 58% of the collection of the general rate, as well as the totality of the collection of the special rate, is ceded to the Autonomous Regions. This collection was progressively reduced from 2005 to 2014, increasing subsequently in the period

2015-2019, although in 2021 its collection in real terms accounted for 79.3% of the collection in 2005 (see Table 3).

This tax has a primarily revenue-raising purpose, although by taxing consumption it encourages energy saving and efficiency. However, given that its tax rates are unitary, are not indexed to inflation and have not been updated since 2009, in real terms they have been reduced over the years, thus reducing incentives for energy saving and efficiency. Moreover, the environmental impact of the tax is limited, as it does not discriminate on the basis of the environmental effects of fuels and therefore does not promote substitution.

Excise duty on electricity

An indirect tax levied on the supply of electricity for consumption, as well as on the consumption by producers of electricity generated by them. The tax was introduced in 1998 (Law 66/1997 of 30 December 1997) as a special manufacturing tax on the production and import of electricity, with the basic objective of obtaining the necessary revenue to compensate for the abolition of the surcharge that had been applied until then on electricity invoiced as aid to coal mining. In 2015, the object of the tax was changed from production to the supply of electricity for consumption. The tax base of the tax is the same as that of VAT (excluding the tax liability) on which an ad-valorem tax rate is applied. The collection of the tax is fully devolved to the Autonomous Regions, albeit without regulatory capacity, and increased in the period 2005-2012 and then decreased, so that in real terms the collection in 2021 is very similar to that of 2005 (see Table 3).

Since the tax is levied on electricity expenditure, it incentivises energy savings and efficiency, although not as directly as if it were levied on the amount of electricity consumed. However, it does not incorporate environmental arguments, as it does not take into account the origin of the electricity consumed and its associated environmental impact. Moreover, as a consequence of the origin of the tax, its tax rate is well above the minimum level set by the Energy Taxation Directive, which does not favour the electrification necessary to achieve the decarbonisation of the economy.

Excise duty on coal

This tax was introduced in 2005 (Law 22/2005 of 18 November) as a consequence of the transposition of the Energy Taxation Directive (Directive 2003/96/EC) into Spanish law, and is levied on the consumption of coal (first sale or delivery of coal after production or extraction, import or intra-Community acquisition and self-consumption). However, its regulations contemplated almost all possible exemptions allowed by European legislation, so it did not start to generate revenue until 2013, when the exemption for coal used to generate electricity was eliminated. Since then, its revenue has increased in the first few years, only to fall significantly in recent years as a result of the reduction in coal-fired electricity generation, so that its revenue in 2021 in real terms represented only 18.4% of its revenue in 2013 (see Table 3).

Since the tax is levied on an energy product whose consumption generates significant impacts, it has an environmental character. However, existing exemptions mean that its effective taxation is

almost zero, except for coal used to generate electricity. Moreover, the calculation of its tax rates does not seem to take into account the environmental damage caused.

Special tax on the value of electricity production (IVPEE)

This direct tax was introduced in 2013 (Law 15/2012 of 27 December) and is levied on electricity production activities and incorporation into the electricity system. The creation of this tax, together with the two taxes on nuclear fuel, responded to the need to reduce the electricity sector's tariff deficit and its collection is used to finance the costs of the electricity system provided for in the Electricity Sector law, referring to the promotion of renewable energies. Its collection remained relatively stable during the first years of application, reducing in recent years (see Table 3), as in October 2018 the government suspended its application for six months and in June 2021 suspended it again for three months, a suspension that has been extended until the present day.

Considering the low price elasticity of electricity demand (Labandeira et al., 2016), given that the tax uses the same tax rate for all generation technologies regardless of their environmental impacts (including marginal ones), it is foreseeable that it will be largely passed on to final consumers. Thus, its environmental impact is similar to that of the excise tax on electricity, encouraging energy savings and efficiency, but hindering decarbonisation by increasing the relative prices of electricity compared to other energy products and not encouraging technological change in electricity generation.

Tax on the production of spent nuclear fuel and radioactive waste resulting from nuclear power generation.

This tax is levied on the production of spent nuclear fuel resulting from each nuclear reactor, as well as on radioactive waste resulting from the generation of nuclear power. Like the IVPEE, it was introduced in 2013 (Law 15/1992) and its collection, which has remained relatively stable over the years (see Table 3), is used to finance the promotion of renewable energies.

The tax has a purely revenue-raising objective, since by taxing an infra-marginal technology it does not incentivise changes in the behaviour of producers, who will simply pay the tax, without it being passed on to the final price of electricity.

Tax on the storage of spent nuclear fuel and radioactive waste in centralised facilities

As its name suggests, this tax is levied on the storage of spent nuclear fuel and radioactive waste in a centralised facility. It was also introduced in 2013 (Law 15/2012) and its revenue is used to promote renewable energies. Its purpose is also purely revenue-raising, without causing changes in the behaviour of producers, although its revenue-raising capacity is very small (see Table 3).

Charge for the use of inland waters for the production of electricity.

The levy was created in 2013 (Law 15/2012 of 27 December) and taxed the use and exploitation of inland waters to produce electricity. Its tax base was the economic value of the hydroelectric energy produced, on which a tax rate of 22% was initially applied, which was increased to 25.5%

in mid-2017. The establishment of the levy was appealed by the electricity companies and, despite being declared in accordance with EU law (JCJEU of 7 November 2019), the Supreme Court, in a ruling of 15 April 2021 (confirmed by subsequent rulings of 16 and 29 April 2021), annulled part of its regulation, for not being foreseen in the concession clauses of the hydroelectric facilities, as well as for violating the principles of hierarchy of norms and prohibition of retroactivity to the maximum extent possible, among other reasons, which implied the return to the electricity companies of the revenue generated in the 2013-2021 period. In any case, in 2022 (Law 7/2022 of 8 April), with effect from 2023, Congress amended the levy legislation in order to be able to reapply it. At present, the levy is levied on the use and exploitation of public water assets for electricity production and its taxable base is still the value of the economic value of the hydroelectric energy produced, on which a tax rate of 25.5% is applied.

Initially, 2% of its collection was considered as revenue for the basin organisation, while the remaining 98% was paid into the Treasury and used for actions to protect and improve the public water domain. At present, 50% of its collection is considered as revenue of the basin organisation and is used to finance control activities, quality improvement, procedures and protection of the public water domain, while the remaining 50% is used to promote renewable energies. Its collection, in real terms, decreased until 2018, remaining stable in 2020 and 2021 (see Table 3), although, as indicated above, the State had to return this collection to the electricity companies.

Since its tax base is not directly related to the environmental damage caused, the levy is purely revenue-raising, with a similar structure to the IVPEE, but limited to hydropower plants. The justification for the establishment of the levy was to obtain resources for the protection of the public water domain, which should be contributed by those who obtain a benefit from its use for electricity production, but the destination of the collection does not influence the determination of a levy as environmental.

Tax on fluorinated greenhouse gases.

This tax came into force in 2014 (Law 16/2013 of 29 October) following EU recommendations and taxes the use of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, as well as mixtures containing any of these substances, depending on their global warming potential. The tax was phased in gradually, so that in 2014 the tax rates were 33% of the established rates and in 2015 and 2016 66%. In 2022, the regulation of the tax was modified to ensure effective control of these gases, as well as to simplify compliance with formal obligations and, therefore, the management of the tax. Its collection in real terms increased until 2017, as a result of the increase in the tax rates applied, and then decreased thereafter (see Table 3).

This tax does have a fundamentally environmental purpose, since it taxes very powerful GHGs, which are generally used as refrigerants or insulators, and uses tax rates linked to the global warming potential of each gas.

Tax on motor vehicles (IVTM)

This is a municipal tax, but regulated by a state law (Law 39/1988 of 28 December 1988), which is levied annually on the ownership of mechanical traction vehicles that can be driven on public roads. Its taxable base is the fiscal power (passenger cars and tractors), the number of seats (buses), the payload (lorries, trailers and semi-trailers), the cylinder capacity (motorbikes) or the vehicle (mopeds), and local councils may increase any of its tax rates up to double, as well as establish rebates of up to 75% depending on the environmental impact of the type of fuel used by the vehicle, as well as on the environmental impact of the characteristics of the vehicle's engines. The collection of the tax, in real terms, increased in the period 2005-2010, then decreased and has remained relatively stable in recent years (see Table 3).

The tax has a purely revenue-raising purpose, although municipalities have the regulatory capacity to introduce bonuses based on the environmental impact of the type of fuel and the characteristics of the vehicle's engine, although the legislation does not specify how these bonuses are to be applied, limiting their environmental 'drag effect'.

Table 3. Evolution of central government energy and environmental taxes revenue (2021 € value used)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
IEDMT	2380,1	2295,0	2329,0	1247,2	822,2	731,5	534,7	365,2	292,9	292,0	326,7	351,6	410,6	531,3	633,1	384,5	467,9
Hydrocarbons	14500,5	14401,1	14443,7	13195,0	12785,0	12633,3	11635,8	10825,1	10564,9	10357,7	10472,4	11323,4	11448,2	11599,9	12602,1	10645,6	11491,9
ED on electricity	1095,7	1205,2	1283,5	1374,3	1475,0	1554,6	1516,3	1624,8	1536,5	1472,8	1482,6	1384,1	1374,0	1398,9	1414,2	1275,5	1086,2
ED Coal	-	-	-	-	-	-	-	-	157,0	281,8	330,6	245,8	328,3	280,5	143,1	42,7	29,0
IVPEE	-	-	-	-	-	-	-	-	1341,0	1554,1	1718,5	1378,0	1589,1	1640,8	737,3	1181,4	1107,4
Production of nuclear fuel	-	-	-	-	-	-	-	-	322,7	170,0	267,6	304,8	301,9	287,0	300,3	295,1	282,4
Storage of nuclear fuel	-	-	-	-	-	-	-	-	6,0	6,7	9,2	6,2	9,8	9,0	9,9	9,5	8,0
Charge on water	-	-	-	-	-	-	-	-	-	-	485,4	217,1	207,2	114,3	325,4	159,2	151,9
Fluorinated gases	-	-	-	-	-	-	-	-	-	32,6	105,9	101,6	126,2	113,4	83,0	69,4	65,4
IVTM	2641,8	2689,8	2752,3	2776,5	2846,3	2805,0	2692,5	2642,9	2408,0	2372,3	2512,7	2566,0	2505,2	2481,3	2467,4	2469,7	n.a.
TOTAL	**20618,1**	**20591,1**	**20808,5**	**18592,9**	**17928,5**	**17724,4**	**16379,4**	**15457,9**	**16629,0**	**16539,8**	**17711,7**	**17878,5**	**18300,6**	**18456,5**	**18715,8**	**16532,6**	**14690,1**

Source: Prepared by the authors with data from AEAT (2023a), AEAT (2023b) and Ministry of Finance (2022b)

In summary, there are currently ten energy-environmental taxes in Spain established by the central government, which were introduced mainly for tax collection purposes and incorporate few environmental elements, in some cases even encouraging negative environmental behaviour (see CERSTE, 2014; OECD, 2015b). These taxes have, in general, low environmental effectiveness and a very uneven revenue-raising capacity (see Table 4). Their combined collection in the period 2005-2020, in real terms, began to decline in 2008, reaching its minimum level in 2012, and then increased again with the creation of new taxes, although the actual collection in 2020 was only 80% of the collection in 2005 (see Table 3).

Table 4. Revenue generating capacity and environmental effectivity of the central government taxes**.**

	Taxable event	Revenue generation capacity	Environmental effectiveness
IEDMT	First registration of motor vehicles in Spain	Low	Medium
Hydrocarbons	Manufacture and importation of products used as motor fuels and of mineral oils used as fuels	High	Medium
ED on electricity	Electricity supply for consumption	High	Medium
ED Coal	Coal consumption	Low	Medium
IVPEE	Electricity production and grid integration	High	Medium
Production of nuclear fuel	Production of spent nuclear fuel and radioactive waste in nuclear power generation	Low	Low
Storage of nuclear fuelc	Storage of spent nuclear fuel and radioactive waste	Low	Low
Charge on water	Use of public water resources for electricity generation	Low	Low
Fluorinated gases	Sale, delivery, self-consumption or import of fluorinated greenhouse gases	Low	High
IVTM	Ownership of a motor vehicle	High	Low

Source: Adapted from Economics for Energy (2013)

3.1.1.3 Taxation from the autonomous regions

At present, the energy-environmental taxes established by the Autonomous Regions can be grouped into five categories: taxes on atmospheric emissions, taxes on installations and activities

that affect the environment, wind energy taxes, taxes on dammed water and taxes on hydrocarbons. These taxes have a significant revenue-raising weight in the taxation of several Autonomous Regions, but their role in regional tax revenues is marginal, except in the Canary Islands (Table 5).

Table 5. Revenue share of energy and environmental taxes over own taxes and overall tax revenue (including transferred taxes from the central government) in 202010

	% Own taxes	% Global tax revenue
Andalusia	1,35%	0,01%
Aragon	**24,14%**	**0,50%**
Asturias	1,68%	0,07%
Canary Islands	73,96%	9,57%
Castilla y León	85,53%	0,73%
Castilla LM	100,00%	0,19%
Catalonia	9,96%	0,23%
Extremadura	85,65%	4,67%
Galicia	46,02%	0,58%
Murcia	1,05%	0,02%
La Rioja	14,13%	0,27%
C. Valenciana	8,04%	0,15%

Source: Prepared by authors with data from REAF (2022).

These taxes were introduced mainly for revenue-raising rather than environmental reasons, so they generally do not define the externality properly, do not adequately estimate social costs, have jurisdictional allocation problems, have limited capacity to achieve behavioural change, and lack inter-jurisdictional coordination. Existing taxes are described below, grouped into the five categories listed above.

Taxes on atmospheric emissions

These taxes are the figure most used by the Autonomous Regions in the sphere of energy-environmental taxation, with nine taxes currently being levied in seven Autonomous Regions on emissions into the atmosphere of various pollutants (NOx, SOx, CO2, NH3, VOCs, particulates and/or total organic carbon). The first to apply them was Galicia (1996), followed by Castilla-La

[10] The collection of energy-environmental taxes in Asturias and Catalonia does not include the collection derived from the tax on the environmental effects of water use and the water canon, respectively, as there is no disaggregated information on the collection derived from taxing the use of water to generate electricity.

Mancha (2001), Andalusia (2004), Aragon and Murcia (2006), Valencia (2013) and Catalonia (2014). In general, its tax rate is structured in tiers with increasing rates (except Aragon and Catalonia, which use a single rate for each pollutant) and has a minimum exemption. In addition, Catalonia introduced another tax in 2014 that levies a single rate on NOx emissions from commercial aviation during take-off and landing, and in 2021 a tax on CO2 emissions from motor vehicles, which is levied annually on passenger cars, light commercial vehicles and motorbikes according to their official CO2 emissions/km, applying a zero tax rate to the least polluting vehicles and using increasing tax rates by tiers.

The combined collection of these taxes over the period 2005-2021, in absolute terms, began to decline from 2007, increasing progressively from 2011 to 2016, and then declining again (see Table 6). However, in 2021, the introduction of the Catalan tax on vehicle emissions allowed it to increase substantially, as the collection of this tax is higher than the combined collection of the other taxes on emissions. The revenues derived from these figures are used to finance environmental protection actions, except in the case of the Catalan tax on aviation emissions, the collection of which is not affected.

The environmental assessment of these figures, in general, is not very positive. The use of minimum exemptions and increasing rates by tiers limits the number of taxpayers and as well as the incentive to improve if there is not the possibility to access the next bracket. Thus the possibilities of achieving cost-effective results are also hindered. Moreover, their tax rates are low in relation to the environmental damage caused, making their technological and behavioural change effects small, and they also have problems of jurisdictional assignment, since, in most cases, the environmental damage exceeds the territorial scope in which they are applied, especially in the case of CO2. The Catalan tax on vehicle emissions is closer to the environmental damage caused than the state registration tax, as it uses the official emissions of the vehicle as the taxable base, rather than the value of the vehicle. However, it does not take into account the actual emissions of the vehicles in each year, so it only incentivizes emission reductions at the time of purchase.

Taxes on installations and activities that have an impact on the environment

The Balearic Islands (1991) was the first autonomous community to introduce a tax of this type, taxing the ownership of assets associated with activities with an environmental impact, such as the production, storage, transformation, transport and supply of electricity and fuels. However, its taxable base was related to gross operating income, which led to its annulment in 2000 by the Constitutional Court (Ruling 289/2000), on the grounds that it taxed the same taxable matter as the municipal property tax. Subsequently, Extremadura (1997) began to apply a very similar tax which was also annulled by the Constitutional Court in 2006 (Ruling 179/2006) for the same reason, although the government of Extremadura modified the tax in 2005 by changing the taxable base to the level of production, which allowed it to continue, even though it was also appealed by the electricity companies, considering that it taxed the same concept as the municipal Business Activity Tax. Currently, this tax is levied on both electricity production and transmission networks.

In 2001 Castilla-La Mancha established the Tax on certain activities affecting the environment, which initially taxed thermonuclear electricity production and radioactive waste storage, as well as NOx and SOx emissions. However, the Constitutional Court (Ruling 196/2012) declared it unconstitutional in relation to the taxation of thermonuclear production and the storage of radioactive waste. The tax had been modified in 2006, but in 2013 the Constitutional Court (Ruling 60/2013) again declared it unconstitutional in relation to the aforementioned taxable events. These jurisdiction conflict issues between the central government and the regional governments are an illustrative example of the lack of a common coordinated strategy in terms of environmental taxation.

Subsequently, Asturias (2011), Castilla y León (2012), the Canary Islands (2013), La Rioja (2013) and Aragón (2016) established taxes similar to that of Extremadura, although only taxing transport networks, although the Canary Islands tax was never applied. The Valencian Community (2013) also introduced a similar tax, but taxing only electricity production, although in 2021 its tax was also extended to transmission grids. Finally, Catalonia (2020) also introduced a similar tax, taxing both electricity production and transmission networks.

The collection of these taxes, in real terms, has generally had a growing trend, so that in 2021 it was more than five times higher than in 2005 (see Table 6), and is affected (partially in the case of Catalonia) to finance measures and programmes of an environmental nature.

With respect to their environmental valuation, it is not positive either, as they use gross electricity production or the number of assets as the tax base, assuming that they are correlated with environmental damage, but in no case is an estimate of the environmental damage to be corrected carried out, nor do they have the capacity to change the behaviour of agents. Therefore, they are basically of a revenue-raising nature, in some cases even using higher tax rates to tax a basic technology such as nuclear power.

Wind energy charges

There are three Autonomous Regions that apply these charges: Galicia (2010), Castilla y León (2012) and Castilla-La Mancha (2012). Their taxable event is the generation of negative visual and environmental effects and impacts as a result of the installation of wind farms, and their tax base is the number of wind turbines.

Its combined collection, in real terms, increased in the first years of application, then stabilised, experiencing a reduction in recent years (see Table 6). This revenue is used to finance environmental programmes, as well as environmental and territorial compensation and rebalancing actions.

The environmental effects of these taxes are debatable, as their tax base is not well related to the environmental damage they seek to correct and they do not calculate the social costs of environmental impact, nor do they refer to them in the tax rates. Even the Castilla y Leon wind tax uses increasing tax rates depending on the power of the wind turbine, thus encouraging the

creation of wind farms with many low-power wind turbines and, consequently, greater visual and environmental impacts. Likewise, the fees are taxing a technology that provides environmental and energy security benefits, and which is promoted by other administrations.

Reservoir water taxes

These taxes are levied on the use of water to produce electricity in hydroelectric power plants. Catalonia (2003) was the first autonomous community to apply them, as part of a levy on different water uses, including electricity generation. Subsequently, Galicia (2009), Castilla y León (2012) and Aragón (2016) introduced specific taxes to tax water use, while Asturias (2014) established a tax similar to the Catalan one. Its taxable event is the use or exploitation of dammed water and its tax base is the volume of water used or estimated (Catalonia and Asturias), the capacity of the reservoir (Galicia) or the capacity of the reservoir and the height of the dam (Aragón and Castilla y León).

Their combined collection, in real terms, has increased over the years and then stabilised (see Table 6), and is used to finance environmental programmes, generally related to water.

Its environmental assessment is not positive either. On the one hand, these taxes present notable differences, both quantitative and qualitative, when choosing tax bases and rates, which shows that there are no reliable estimates of the social costs caused by the use of dammed water. Moreover, they tax existing reservoirs according to their capacity, height and installed power, with indirect reference to hypothetical environmental damage, and have no capacity to generate changes in behaviour and technologies. Therefore, their environmental definition is dubious and could implicitly respond to the search to capture rents associated with the resource.

Taxes on hydrocarbons

This category only includes the Canary Islands tax on petroleum-derived fuels, a special tax on wholesale deliveries of these products, as the special tax on hydrocarbons does not apply in this Autonomous Community. Given that this tax is similar to the State tax on hydrocarbons but with lower tax rates, its impact is similar, although of a lesser magnitude. Its collection, in real terms, decreased from 2005 to 2011, and then increased until 2019 (see Table 6).

In summary, the energy-environmental taxes of the Autonomous Regions were introduced mainly for revenue-raising reasons and are linked to two facts. On the one hand, the important limitations that the Autonomous Regions have to create their own taxes, with few exceptions among which is the environmental field. On the other hand, the low social cost of their introduction for political decision-makers, due to the greater social acceptance of this type of tax (Economics for Energy, 2013).

Table 6. Evolution of the revenue from energy and environmental taxes in the autonomous regions11. (2021 € level)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Emmissions	33,73	47,90	46,92	24,79	14,10	12,02	13,07	17,76	33,73	23,76	26,86	28,12	24,86	23,14	24,69	20,20	47,21
Installations and activities having an impact on the environment	55,90	39,93	31,22	99,48	57,92	95,38	99,34	88,36	55,90	140,45	141,24	82,44	114,24	138,60	146,06	187,35	287,32
Wind power levy	-	-	-	-	-	25,82	25,42	50,16	-	58,48	60,74	61,51	60,00	59,54	62,99	46,70	55,48
Dammed water	-	-	-	-	9,23	12,12	11,74	26,74	-	32,68	35,78	52,54	51,60	51,93	56,08	46,57	48,32
Hydrocarbons	329,63	322,11	316,71	291,83	263,36	250,73	238,69	258,49	329,63	302,42	315,01	350,88	347,76	341,89	374,54	300,83	327,00
TOTAL	**419,26**	**409,94**	**394,85**	**416,10**	**344,60**	**396,08**	**388,26**	**441,51**	**419,26**	**557,79**	**579,63**	**575,49**	**598,46**	**615,10**	**664,36**	**601,65**	**765,33**

Source: Prepared by the authors with data from Ministry of Finance (2022a, 2023)

[11] The tax in Castilla y León is levied on three different taxable events (installations, wind farms and dammed water), so its revenue is distributed evenly between the three taxed items. The Valencia tax is levied on two different taxable events (emissions and installations) and its revenue is therefore distributed evenly between the two taxed items. The tax on certain activities affecting the environment in Castilla-La Mancha levied two different taxable events (emissions and installations) until 2013, so that until that year 88.7% of its revenue was allocated to installations and the remaining 11.3% to emissions, following the distribution of 2011, the year for which disaggregated information is available on the revenue from each taxed concept.

Therefore, Spanish energy-environmental taxation is characterised by its low revenue-raising capacity in relation to neighbouring countries (Labandeira, 2022), as well as by the dubious environmental nature of most of its figures. In this context, it is not surprising that both different international organisations (IEA, 2015; OECD, 2015b, 2018; EC, 2017; IMF, 2018) and expert commissions created by the Spanish government (CERSTE, 2014; CERMFA, 2017; CETE, 2018; CPEELBRT, 2022) have insistently recommended a substantial increase and reform of these taxes.

3.1.1.4 Reform proposals by expert commissions

In the last decade, the Spanish government created five expert commissions whose reports included proposals for energy-environmental tax reform. Two of these commissions (CERSTE, 2014; CPEELBRT, 2022) studied the reform of the Spanish tax system as a whole, while CERMFA (2017) and CERSFL (2017) focused on the revision of the regional and local financing model, respectively. CETE (2018) made proposals to define a strategy for the energy transition to a low-carbon economy. The proposals made in these commissions included:

d. The abolition of the tax on the value of electricity production (CERSTE, 2014; CPEELBRT, 2022) as it does not respond to environmental criteria, as it does not differentiate according to the environmental impact of different technologies, and hinders the electrification of the economy.

e. Modification of the excise tax on electricity (CERSTE, 2014; CPEELBRT, 2022) to promote electrification and energy efficiency, changing its tax base so that it directly taxes the amount consumed and not the VAT base.

f. Unification of the two taxes on nuclear fuel (CERSTE, 2014), transforming them into one tax to cover the cost of waste management and storage.

g. Increase in the taxation of automotive diesel (CERSTE, 2014; CETE, 2018; CPEELBRT, 2022), eliminating the favourable treatment of this fuel in relation to petrol, which does not correspond to the environmental impacts of both.

h. General increase in taxation on hydrocarbons (CERSTE, 2014; CPEELBRT, 2022), to achieve significant reductions in pollutant emissions.

i. Removal of exemptions from the special carbon tax (CERSTE, 2014) that prevent more extensive application of the tax.

j. Replacing existing energy taxes with taxes that internalise the environmental damages associated with energy generation and consumption (CETE, 2018). To this end, it is proposed to create two new taxes on both CO2 and other pollutant emissions, which would be levied on electricity generation facilities, as well as on final consumers of coal, natural gas and oil derivatives.

k. Introduction of taxes on aviation and marine fuels and increased taxation of agricultural fuels (CPEELBRT, 2022), to reduce the favourable tax treatment of these sectors compared to other activities, which is not commensurate with the external costs generated.

l. Introduction of environmental taxes on emissions produced by ships in ports and on air transport (CETE, 2018). In this regard, CPEELBRT (2022) proposes the introduction of a tax on airline tickets, with the aim of moderating demand.

m. Consideration of taxation mechanisms for payment for the use of certain road infrastructures (CERSTE, 2014; CETE, 2018; CPEELBRT, 2022), through a surcharge on fuel consumption, a vignette system obliging vehicle owners to pay for the right to use the infrastructure, or a combination of both. It is also proposed (CERSTE, 2014; CPEELBRT, 2022) to create municipal congestion charges in selected cities.

n. With regard to registration and circulation taxes, two different proposals are made. On the one hand, CERSTE (2014) and CERMFA (2017) propose abolishing the registration tax and integrating it into the circulation tax, leaving the management of the new tax in the hands of local councils. This new tax could have two tax rates, one regional and the other municipal, so that both administrations would share the collection, and its regulation would correspond to the state, being the same for all municipalities and Autonomous Regions. Thus, in the case of registration tax, in order to favour a sustainable vehicle fleet, it suggests extending the number of tiers and increasing its tax rates, as well as modifying its ad-valorem levy on the price of the vehicle for a unitary tax on the expected emissions of the vehicle. With regard to road tax, it proposes to modify it to penalise the most polluting technologies, replacing taxation based on taxable power with representative indicators of environmental damage, a proposal also shared by CETE (2018) and CERMFL (2017).

o. Introduction of measures to improve the design and effectiveness of regional taxes (CERSTE, 2014; CERMFA, 2017; CETE, 2018; CPEELBRT, 2022). In this sense, CERMFA (2017) propose the creation of a framework law on environmental taxation that would attribute the different tax figures or relevant taxable events to the different levels of government, taking into account the spatial scope of the taxable events. In the cases attributed to the Autonomous Regions, the framework law would establish the elements of each tax, its optional or compulsory nature and a range for the establishment of rates and deductions. For its part, CERSTE (2014) proposes abolishing regional CO2 taxes, due to the impossibility of them being able to efficiently meet their environmental objectives, as well as wind energy taxes and regional taxes on dammed water, given their insufficient environmental approach and justification, without prejudice to the possibility of replacing them with other taxes of a truly environmental nature.

p. With regard to the distributional and competitiveness impacts of the reforms, it is proposed that the additional revenue generated be used to compensate households through lump-sum transfers to reduce their possible regressive distributional impacts (CPEELBRT, 2022), as well as to reduce state burdens on the labour factor (CERSTE, 2014). It is also proposed to consider compensation mechanisms for industries most exposed to international competition and exemptions to mitigate the impact on certain sensitive user groups (CETE, 2018).

3.1.1.5 Distributional effects

One of the risks of environmental taxation, as in other taxes, is the existence the distributional effects when they are regressive. That is when they end up having a stronger impact on lower income households. The distributional impacts of energy-environmental taxation on households depend on their share of expenditure on the taxed products (direct effects), as well as on other products and services whose prices increase when energy prices rise (indirect effects) (Ari et al., 2022). In general, direct effects represent the main source of additional costs, while indirect effects are comparatively small (Steckel et al., 2022). In principle, their impact is regressive, as richer households consume more energy in absolute terms, but the share of energy expenditure tends to be higher for low-income households (Combet et al., 2010). In the case of Spain, using micro-data from the 2021 Household Budget Survey (INE, 2022), Figure 4 shows that the share of energy expenditure has a decreasing trend with the level of equivalised income, being 9.5% in the first two income deciles but only 5.8% in the richest decile, so that energy taxes have a regressive impact.

However, energy consumption varies significantly depending on the geographical location of the household (Carl & Fedor, 2016), so that, in general, rural households are particularly affected (Flues & Thomas, 2015) due to their demand for transport fuels and electricity, a consequence of the lower availability of public transport and alternative energy products. In the case of Spain, INE data (2022) show that while urban households spend, on average, 7.8% of their income on energy, in rural households this percentage rises to 10.1%.

Another important factor is the energy product taxed. In this sense, in Spain, if we consider the main energy products (Figure 5), we see that the share of electricity expenditure decreases with the equivalent income level, so that electricity taxes will have a regressive impact. In the case of motor fuels (petrol and diesel), the share of expenditure is increasing in the lower income deciles and decreasing in the higher income deciles, so that taxes will have a progressive impact on poorer households and a regressive impact on richer households. The share of expenditure on natural gas is quite similar across all income-equivalent deciles, although households in the two richest deciles are the least affected by taxes on this energy product. Distinguishing between rural and urban households, rural households have a higher average share of expenditure on electricity and fuels (3.7% vs. 3.2% and 4.6% vs. 3.3%, respectively), due to the fact that, as mentioned above, they are more dependent on private transport and have fewer energy alternatives to

electricity, In the case of natural gas, the expenditure share of urban households (0.9%) is three times higher than that of rural households (0.3%), as they have greater access to this energy product, so taxes on natural gas will affect these households more.

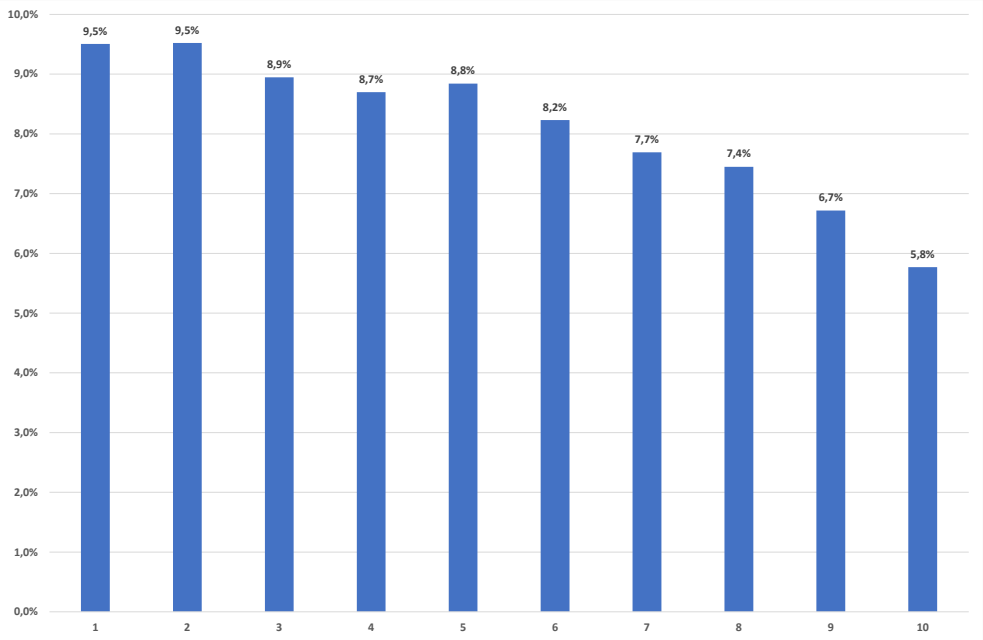

Figure 4. Share of energy expenditure of Spanish households by equivalent income deciles. 202112

Source: Prepared by the authors with data from INE (2022)

[12] Household expenditure on electricity, natural gas, LPG, liquid fuels, coal, other solid fuels, petrol and diesel is considered. As an income variable, total household expenditure is considered.

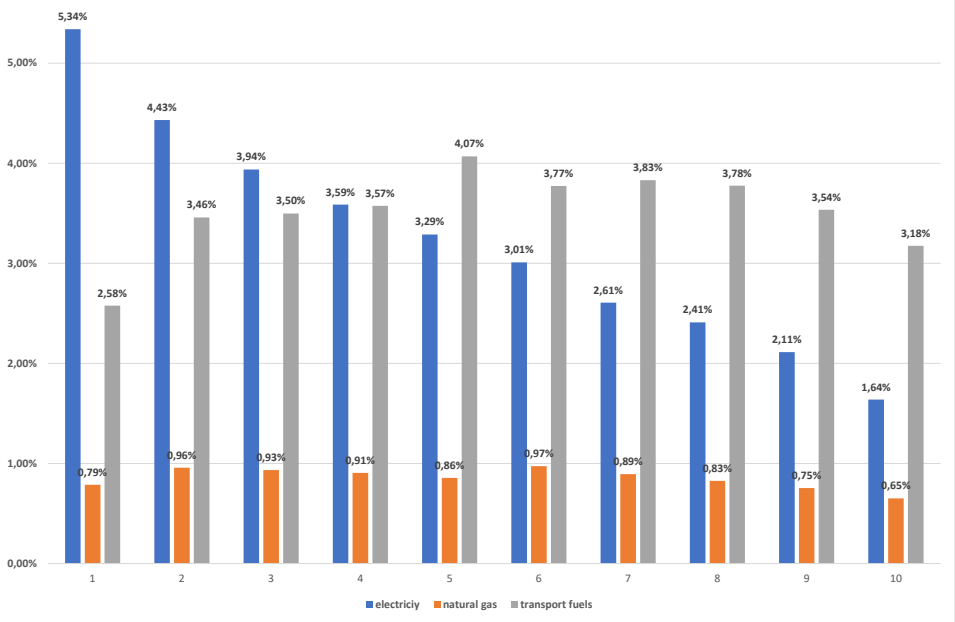

Figure 5. Share of expenditure on the main energy products of Spanish households by equivalent income deciles. 2021

Source: Prepared by the authors with data from INE (2022)

With respect to vehicle taxes (registration and circulation), Table 7 shows that both the percentage of households that bought a car in 2021 and the percentage of households with a car in that year is, in general, increasing with income level, so that these taxes will mainly affect wealthier households. In turn, the percentage of households with a car is higher in rural households than in urban households, but the percentage of households that bought a car is higher in urban households.

Table 7. % of households that bought a car and of households with a car by equivalised income deciles. 202113

Decile	% of households that bought a car	% of household owning a car
1	0,00%	39,41%
2	0,13%	50,25%
3	0,41%	49,85%
4	0,24%	49,54%

[13] Households with car: Households with positive expenditure on fuels (petrol, diesel and/or other fuels). Households that bought a car: Households with positive expenditure on "new cars".

5	0,78%	53,53%
6	1,89%	54,56%
7	1,73%	55,27%
8	3,99%	55,61%
9	7,92%	55,70%
10	13,99%	57,70%
Urban	3,23%	51,87%
Rural	2,46%	54,70%

Source: Prepared by the authors with data from INE (2022)

Compensatory alternatives for the distributional impacts of energy-environmental taxation

As seen above, raising energy-environmental taxation can cause an increase in energy prices that can have regressive distributional impacts on households, so it will be essential to estimate and compensate for these impacts in order to make the increase in taxation fair and socially acceptable. Given that energy-environmental taxes generate significant public revenues, their distributional impacts in practice will depend on how these revenues are used to compensate the most affected households.

A first option would be to use offsets that reduce energy prices, as most European countries did in the face of the increase in energy prices (unrelated to energy-environmental taxation) that occurred in recent years (see Sgaravatti et al., 2022). However, while these measures would reduce the cost of energy for households, they would remove the effective price signal for pollution, which is the main policy objective (Carl & Fedor, 2016), thus removing incentives for energy savings and efficiency. Alternatively, temporary monetary transfers, independent of energy consumption, can be used in a way that does not distort relative prices (Amaglobeli et al., 2022). These transfers have relatively low administrative costs, as they can be carried out in cash or using existing social security systems (IMF, 2022). Finally, the tax burden on households could also be reduced (CLPC, 2016), without changing energy-environmental taxes, although the possible distributional effects of such measures need to be considered. In this sense, reductions in personal income tax, which tends to be progressive, or in corporate income tax, which mainly taxes wealthy households, will have a regressive impact, while reductions in VAT, being a regressive tax, will mainly benefit lower-income households (Pomerleau & Asen, 2019; World Bank, 2019).

With respect to the households to be compensated, ideally these should only target vulnerable households (Kalkuhl et al., 2022), as generalised compensations imply helping also the richest households, which implies a significant loss of revenue (Steckel et al., 2022). However, there may be difficulties in designing programmes that target particular groups (World Bank, 2019). A certain income threshold can be used as a criterion for deciding which households will receive

compensation, but this requires reliable data on household income (Ari et al., 2022), and income is not the only factor that determines the most vulnerable households. In addition, households with an income level close to the threshold may want to reduce it in order to receive compensation. To avoid these problems, criteria in addition to income can be included to determine the households to be compensated, as well as using variable compensation with income level, although this would increase the complexity of the system, which could make it difficult for poorer households to participate (Zachmann et al., 2018). If vulnerable households cannot be identified, or are not disproportionately affected, universal offsets can be used. These offsets, while also benefiting richer households, are progressive, as they imply a higher share of income for poor households relative to rich households (Zachmann et al., 2018).

Finally, while the above measures would reduce impacts on households in the short term, in the medium term it will be necessary to incentivise energy efficiency and the deployment of renewable energy to reduce dependence on fossil fuels (Seckel et al., 2022). To achieve this, subsidies for energy efficiency improvements could be used to reduce energy use and thus household costs (CPLC, 2016). However, it is crucial that only lower-income or particularly affected households receive these subsidies, as widespread subsidies are likely to have a regressive impact, as wealthy households are much more likely to have the resources to undertake energy-efficient investments. Alternatively, subsidies could be targeted at options, such as public transport or social housing renovation, mainly used by low-income households (Carattini et al., 2018).

3.1.1.6 The role of harmful subsidies in the Spanish energy and environmental tax system

Table 8 shows the evolution of fossil fuel subsidies in Spain in recent years. These subsidies are mainly centred on petroleum products and have been reduced over time, so that in 2010 they represented 0.44% of GDP, while in 2021 they had fallen to 0.14%.

Table 8. Fossil fuel subsidies in Spain. % GDP.

	Coal	End-use electricity	Natural gas	Petroleum
2010	0,16%	0,04%	0,00%	0,44%
2011	0,10%	0,07%	0,00%	0,33%
2012	0,07%	0,06%	0,00%	0,29%
2013	0,06%	0,07%	0,00%	0,26%
2014	0,06%	0,07%	0,00%	0,23%
2015	0,04%	0,07%	0,00%	0,20%
2016	0,04%	0,05%	0,00%	0,18%
2017	0,03%	0,05%	0,00%	0,16%

2018	0,03%	0,05%	0,00%	0,17%
2019	0,03%	0,04%	0,00%	0,15%
2020	0,03%	0,04%	0,00%	0,44%
2021	0,02%	0,01%	0,00%	0,33%

Source: Prepared by the authors with data from OECD/IISD (2023), OECD (2023b)

Spain applies certain subsidies to fuel uses of energy products. Energy products are subject to VAT at the normal rate[14] and exemptions apply to certain uses, such as commercial aviation and international shipping. In addition, mineral oil tax paid on the use of diesel fuel in agriculture and animal husbandry is partially refunded, as well as that paid on business use in goods transport, passenger transport and taxis, subject to certain limits[15]. Reduced tax rates are also applied for gas oil used as fuel in stationary engines, special vehicles and agricultural vehicles and, in general, for those used as heating fuel; for LPG and natural gas used for non-fuel purposes; for natural gas used as fuel in stationary engines or for professional purposes (except electricity generation and cogeneration); and for paraffin used for non-fuel purposes (Government of Spain, 2020).

The main source of support for fossil fuel production was financial aid to the coal mining industry. Thus, the government compensated coal companies by covering the difference between their high operating costs and the prices at which coal was sold to local power plants, with mandatory purchase volumes set by the government. In the wake of the 2008-09 economic crisis the Spanish government sought to cut support to mining companies by 63% and eliminate state aid in 2019. The Spanish government announced its compliance with EU regulations (Decision 2010/787/EU) on coal mines in late 2018 and reached an agreement in October 2018 with mining unions to invest €250 million in the period 2019-2027 for the alternative development of mining regions and to fund environmental restoration, social benefit programmes and economic packages aimed at transitioning affected regions towards environmentally sustainable industries (OECD, 2019b).

3.2 Transformative character of the studied case

In this section the transformative character and limitations of environmental taxation is assessed through the lens of the two selected I: Innovation and Integration.

[14] De todos modos, dentro de las medidas para hacer frente al fuerte incremento experimentado por los precios de la energía, el Gobierno español redujo el IVA sobre la electricidad del 21% al 5% a mediados de 2021, así como el IVA sobre el gas natural a mediados de 2022, también al 5%.

[15] Además, desde abril de 2022 y hasta el final de ese año, el Gobierno español introdujo un subsidio de 20 céntimos de € por litro de carburante, para hacer frente a la escala de los precios de los carburantes.

3.2.1 Innovation

In section 2.3 the different types of innovation and how environmental taxation could contribute to it was presented. In this section we move from the theoretical to the applied context. The impact of environmental taxes on technology innovation has been studied in the literature (Hashmi & Alam, 2019; Karydas & Zhang, 2019)Although there are diverging opinions on the efficiency of this type of instrument there are some interesting studies that have empirically quantified this impact. In this regard Karmaker et al. (2021) have conducted a study at country level in 42 high and middle income countries, including Spain, which uses data on patents on environment-related technologies as a proxy of technological innovation. Their analysis concludes that a 1% increase in environmental taxes can result in an increase in technological innovation of 0,57 to 1,52 depending on the methods used.

Centred in Spain, we find a study by Tchorzewska et al. (2022) that analyses the effectiveness of environmental taxation in Spain to promote technological innovation. In this case, however, the definition of environmental taxes used leaves out general taxes on electricity and fuel because, in line with our initial methodological note, the authors consider these not to have a genuine environmental ambition. The study assesses the impact at firm level of environmental taxes in terms incentivizing technological innovations. The study provides interesting insights for our case. Firstly, it shows how different levels of taxation have different impact on the spending on technological innovation. Thus, low tax pressure has barely influenced innovation whereas where the pressure increased so did the expenditure in green innovation. This confirms how by having few instruments and, in general, low rates as we have shown above the potential impact of decarbonization through green innovation is missed.

Secondly, within technological innovation, the study differentiates among investment in the adoption of clean technologies and end-of-pipe solutions. Current environmental taxes in Spain stimulate both types of innovation in similar ways. This is relevant in the perspective of achieving the increasingly ambitious decarbonization goals. While end-of-pipe innovations tend to be cheaper and effective short-solutions they are less desirable than the transition towards new technologies that do not focus on mitigating the impact but on preventing it.

We carried out our own analysis for the period 2005-2021 in which we explored whether there has been correlation between the evolution of the revenue from environmental taxes and the green innovation related expenses at the autonomous regions level. By focusing on the regional level we tried to observe whether different environmental taxation instrument combinations lead to different results in terms of technology innovation stimulation. The data from the INE allowed us, as in the study mentioned above, to differentiate between different types of technological innovation investment: investment new technologies representing upstream interventions and end-of-pipe investments which aim more at correcting rather than preventing emissions or pollution. Compared to previous studies like the one by (Tchorzewska et al., 2022) which also considered other environmental taxes such as waste taxes, we focused the analysis of taxes related to emissions and energy.

Through a graphical observation at the evolution of energy-environmental tax collection and company investments in cleaner technologies in the twelve regions that have specific instruments out of the total seventeen, there only seems to be a relationship in Aragon between environmental tax collection and investments in cleaner production (see Figure 6).

By using the Pearson correlation coefficient, which measures the degree of covariation between two linearly related variables, we found that in the case of the relationship between energy-environmental tax revenue and firms' investments in end-of-pipe solutions, it is only significant for Andalusia (also for the Canary Islands and Extremadura, but indicating a negative correlation). In the case of the relationship between energy-environmental tax revenues and companies' investments in cleaner production, it is not significant in any of the studied cases (see Table 9).

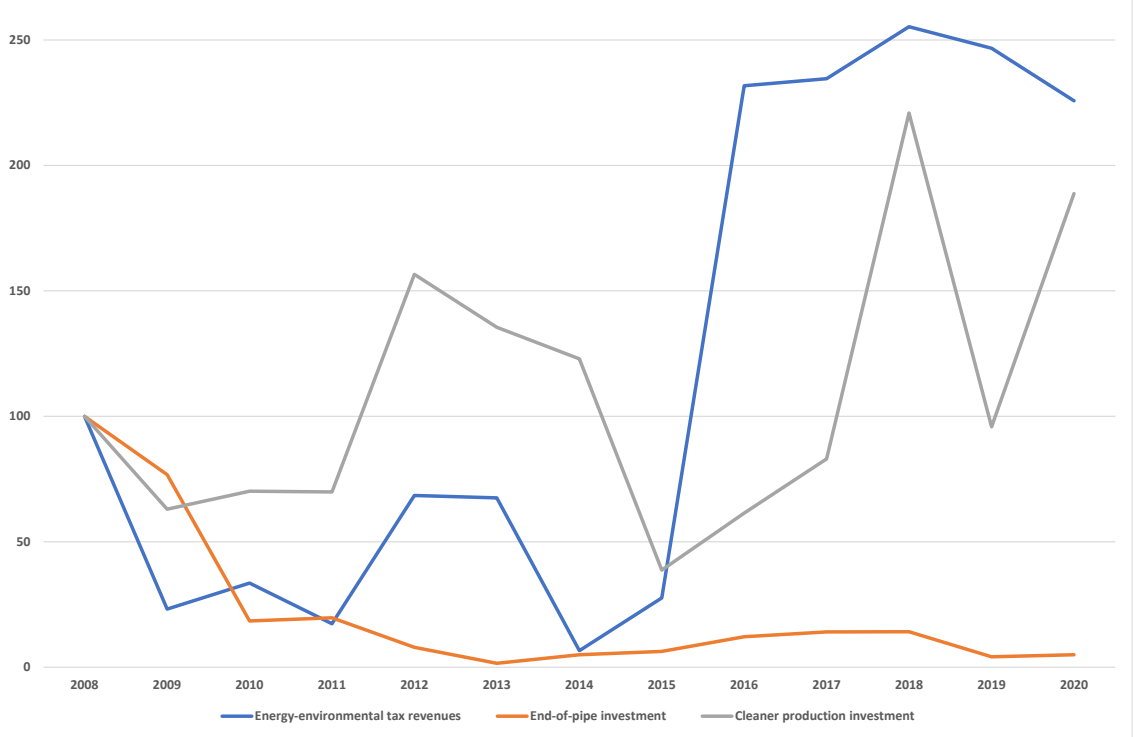

Figure 6. Environmental tax revenue and green innovation investment in the Autonomous region of Aragon16.

Thus, we see that at current levels of taxation there does not seem to be a direct relation between the fiscal pressure and the degree of technological innovation. This would seem to be consistent with the situation presented where the levels of taxation are lower than average at the EU level and with the fact that the instruments have not necessarily been designed with an environmental perspective in mind. These findings, however, need to be contextualized taking into account the whole policy mix that includes different policies that might also play a role in stimulating or

[16] 2008=100

disincentivizing innovation. For example, the role of the EU ETS for sectors affected or other national level interventions. This could be an interesting subject for further research if the challenge of obtaining necessary data can be overcome.

In terms of business model innovation, we see how current instruments are not necessarily conducive to promote it. In general terms, the low-price signal provided by the energy and environmental taxation as a whole limits the incentives to change behaviours both in the stimulation of entrepreneurship linked to greener business models and also in changing demand habits of end users.

Additionally, as most instruments related specifically to energy production do not make a distinction among different production technologies, they do not contribute to provide new business ideas based on cleaner energies a competitive advantage to be able to compete with incumbent more established technologies. Although it can be argued that other more targeted instruments exist for this matter, not using environmental taxes to contribute to that aim seems like a missed opportunity. Linked to the idea above, an additional barrier to business model innovation is the existence subsidies to fossil fuels that also hinder the emergence of innovative models based on greener technologies. Although the phasing-out of such subsidies seems to be in the political agenda, the linked social impacts referred to before, creates the need to find alternative measures that manage to both protect vulnerable economic sectors while also promoting a green transition.

Table 9. Pearson correlation coefficient17

	E. tax revenue /Investment end-of-pipe	E. tax revenue/ cleaner production investment
Andalucía	0.5582**	0.3958
Aragón	-0.2215	0.4005
Asturias	0.2863	-0.3541
Canarias	-0.7219***	-0.2655
Castilla y León	0.2545	0.3028
Castilla - La Mancha	0.1610	0.1728
Cataluña	-0.2040	-0.0267

[17] ***significant at the 1% level; **significant at the 5% level, *significant at the 10% level. In the Autonomous Regions where there is no collection of energy-environmental taxes in some years, only the years in which there is collection are considered.

C. Valenciana	0.0660	-0.0461
Extremadura	-0.5358*	-0.3910
Galicia	-0.4026	-0.2850
Murcia	-0.3834	0.1896
La Rioja	0.5174	-0.4192

From a policy innovation perspective, it is important to consider in the design of future instruments, what are the characteristics that taxes need to have to promote investment in clean technologies rather than on end-of-pipe solutions. This of course is something that a single instrument may not achieve and that may need to be assessed at the policy mix level.

With a broader perspective, the different reform proposals presented in section 3.1, make clear and provide well-argued suggestions on how to reform the environmental taxation system in Spain to improve its environmental impact.

3.2.2 Integration

Regarding integration, in section 2.3 we presented the two aspects the 4I-Traction project considers. On the one hand integration as policy mainstreaming and on the other as sector coupling. We also established how from a theoretical perspective that environmental taxes can be an instrument that contribute to achieve both types of integration. The analysis of the Spanish environmental taxation in the studied period of 2005-2020, however, shows that there has been little in the way of strategic policy design and coordination to promote this integration.

The policy mainstreaming approach includes the idea of coordination and coherence to achieve the desired goal in an efficient way. In this regard, when the policy mix lacks coherence, and different policy instruments pursue different goals and are not well coordinated, as is the case of Spain, the policy mix results in uncertainty for firms (Christiansen & Smith, 2015) thus making it more difficult to achieve meaningful changes in behaviour. In this line, regarding the introduction of new environmental taxation instruments, CPEELBRT (2022) emphasizes the need to integrate them in the current regulatory framework, minimizing negative interactions and enabling synergies with other public policy instruments.

A first issue in this regard is the lack of sufficient and specific environmental ambition. That is, the fiscal instruments implemented from the central government level as described in section 3.1 are, for the most part, not properly designed to internalize emissions-related externalities with a coordinated climate goal and as part of a broader policy mix. In this regard, we also see a reluctance to use this type of instruments. The tax on coal, for example, was only established in 2005 when the ETD made it compulsory and then every possible exemption was used to delay its effective implementation as much as possible. Taxes on electricity have also been designed with the balance of costs of the network versus revenue in mind more than any environmental effect. Thus we see how although these taxes by pricing the use of a resource that pollutes do have an

environmental effect albeit more limited than they could have if they were specifically design with this purpose.

A second aspect is the lack of coordination among different jurisdictions. As presented above, in the case of Spain the jurisdiction is shared among the central government, regions and, for a small part, municipalities. This distribution of competences is quite common and although it is not bad per se, but it does add complexity and requires having effective coordination mechanisms that provide coherence to the overall policy.

In the case of Spain, in relation to taxation, there has not been a deliberate effort to devise the distribution from an environmental perspective but instead it has been the result of the different participants pursuing their own interests through the existing rules. The creation of their own taxes by the Autonomous Regions is subject to a series of limitations, such as the prohibition on taxing taxable events already levied by the State or local corporations. Given that the Autonomous Regions were created relatively recently, most of the taxable events and matters were already in the hands of other administrations, so the Autonomous Regions opted to introduce taxes of a mainly extra-fiscal nature, whose main objective is, in theory, to serve as a tool for regulating and intervening in the economy to achieve various objectives (social, economic, environmental, etc.), and not to obtain financial resources. This fact, however, implies that when designed these taxes do not necessarily the environmental effectiveness as the primary goal and that they are often, as portrayed in the examples in the section above, more focused on generating revenue. The result is a disparity of uncoordinated instruments in different regions that do not follow any preestablished strategy and have no specific common targets across regions and across sectors. In this sense, having identified this problem, several of the commissioned studies on the reform of the taxation system in Spain have suggested creating a coordination mechanism.

A third aspect identified is related to both coordination issues and sector coupling. When we observe the different environmental taxes in use in Spain, especially at the regional level, we see how they target the mitigation of different externalities. In this regard we see how some of the taxes target emissions, some other the environmental impact of the use of water or the visual impact of wind power generators. Although when well defined all these instruments may pursue legitimate environmental goals, from a climate change mitigation perspective this can create some undesired effects. A clear example are the taxes on wind generators as the tax on this clean energy source hinders a wider development of this cleaner technology and puts it in a competitively worse position compared to incumbent more polluting power generating technologies.

We also find a similar example related to solar energy. For the 2015-2018 period there was a specific tax at national level on energy generation for self-consumption. The rationale of the tax was that those producers were still attached to the energy network as a backup and should therefore contribute to the system costs. The tax had several exemptions especially for low volume infrastructure. Thus, we see how a tax that did not have a specific environmental purpose

could end up having a negative effect by taxing the production of decentralized clean energy which is currently seen as one of the ways to proceed to contribute to achieve climate neutrality.

Thus we see how indeed integration issues are very relevant in the design and implementation of a coordinated environmental tax policy. As mentioned, increased jurisdictional coordination is required. In terms of sectoral integration it is especially important to coordinate the path towards electrification of the transportation and heating sectors. There is an undeniable complexity in trying to make compatible the advancement towards a decarbonized economy while at the same time considering other environmental concerns and social aspects that enable not only a green but also a just transition.

Beyond the ex-post perspective it is worth having a glimpse at the immediate future. In this regard, in the current Spanish NECP (Government of Spain, 2020) from 2020 and covering the period from 2021 and 2030, we can observe a clear ambition to mainstream climate policy. In this regard, beyond defining the different strategies and actions there is a specific section dedicated to the interrelation between different policies, it's climate ambition and the sectors and policy areas that each of them aims to have an influence on. The information is disaggregated by sector (services, industry, transport, residential and agriculture) but also by other dimensions of the climate transition such as energy security or energy dependency as well as social aspects such as energy poverty and also the role of R&D. In this context it is important to highlight that taxation is seen as a cross-cutting instrument that can influence all the climate policy goals defined. Thus, this suggests that within the mainstreaming of climate policy in Spain taxes are set to play an important role.

However, the NECP does not provide much in terms of details of how taxes will be used in this direction. There is mention to a "future green reform" applied to the residential and to the transport sectors. In relation to the residential sector there is a vague reference to analyse the fiscality to introduce the positive effects of energy efficiency improvements. As for the transport sector the reference is made in the context of the renovation of automobile fleets and the introduction of electric cars. In this sense the Plan identifies the need to reformulate some of the transport taxes such as the IVTM and IEDMT to better correct the environmental externalities and, in the case of the electric car, to effectively induce its adoption. Beyond these specific examples the references to environmental taxes are limited to the current instruments.

A last note regarding the provisions of the NECP, we see how although the idea of removing harmful subsidies is included in the plan, some subsidies to vulnerable sectors such agriculture and measures to ensure the competitiveness of energy intensive industries are still foreseen. In this regard the support measures should step away from the form of fossil fuel subsidies and advance towards alternative measures that targeted the social impacts without damaging the environmental goals.

3.1. Validity of findings

The methodology used does not present significant validity issues. Our research has mainly been carried out via primary and secondary sources published sources. The validity of the findings based on the use of primary sources as data or legal documents has been granted by the debate and discussion among the report authors. The validity of the findings based on secondary sources is based primarily on the selection of eligible sources and, also, the discussion among authors. In this regard in terms of academic literature review only indexed journals in the main databases such as Web of Science and Scopus have been considered. In terms of grey literature, only sources with trusted reputation have been used. The findings and conclusions expressed are based on and supported by the literature and when not, they are based on the analysis by the researchers of the sources and data. The previous experience of the authors as well as the consensus among them provide them with the necessary robustness. Additionally, the report has been peer reviewed internally by a member of the consortium of the 4I-Traction project and externally by an academic with experience in the area of study.

4. Conclusions and future work

4.1 Conclusions on the methodology

The use of desk research has proven adequate to conduct the case study. We have been able to build the background of the case study based on the existing literature on the several topics dealt with. From a more theoretical approach to the role of environmental taxes in climate policy, to the EU approach and experience and then going more specific into the Spanish case.

Then, through the use of data and legal documents, as well as previous studies we have been able to build the analysis about the impact of environmental taxes in Spain and its characteristics. Regarding the role of the Is (Innovation and Integration) we have found certain limitations. There is only limited literature on the specific issue of the role of innovation and integration as defined in the 4I project. In this we have tried to contribute by providing our own analysis from primary data and sources. However, the availability of relevant data has been somewhat limited. For integration a more qualitative approach has been used. For innovation, some data on investment in innovation has been used. As presented above, the data allowed us to make some relevant comparisons among regions with different environmental taxation instruments and the level of investment on innovation. However, we have found some limitations in the availability of data for relevant periods and specially microdata of some of the surveys. The INE was contacted to further understand the availability of specific data items however, despite their willingness to help, the data limitations specifically for the earlier period somehow limited our capacity of analysis of some of the issues on innovation.

4.2 Conclusions and recommendations for transformative climate policies

The research conducted in the case study leads as to the following main conclusions.

From the EU perspective, the use of environmental taxation is considered important as part of the policy mix to achieve climate neutrality and that its increased use is encouraged. However, the decision-making processes in certain aspects such as taxation, which require a unanimous vote, have limited the actual capacity of the EU in regulating and influencing Member States' policies in that area. As we have seen, the scope of the ETD is reduced to energy taxes and the environmental goal only has a secondary role leaving much of its implementation to the will of each Member State. Also, the only mechanism allowing to enhance its environmental potential was through the use of exemptions to specific sectors or technologies, but exemptions were also available to address competitivity issues which could lead to inconsistencies within the policy. Additionally, the lack of review of the taxation rates since its implementation in 2003 further limited its environmental capacity. However, the ongoing review of the ETD although still limited in scope, fixes some of the main shortcomings identified by first, linking the rates to the environmental impact of each of the products and establishing an automatic mechanism to update rates to match inflation.

The issue remains, however, in the lack of further harmonization of environmental taxes that fall out of the scope of the ETD. This is, as shown in the study, the case in Spain where only a handful of instruments on fuels and electricity are harmonized. Although there are other policies that do coordinate and regulate at the Member State level with a more general approach such as for example the ESR which establishes national emissions targets, the way of complying with these targets is left for each state to decide. Thus, we see how the political discourse at the EU level encourages the use of environmental taxes as an instrument to achieve national emissions targets, however the harmonization or regulation of these has been as, presented above, very limited both in scope and ambition.

Focusing on the case of Spain, we have seen how the levels of environmental taxation during the 2005-2021 period have remained among the lowest of the EU MS. Although there are instruments that by definition are considered environmental taxes, their environmental effectivity remains quite low. In the study we have identified how there are challenges regarding both the ambition and the design of the instruments. In general, most taxes although they might have a modest capacity to influence behaviours towards more environmentally responsible ones, the main focus has remained the revenue generating one. In regards of design problems, we have a clear example in the car registration tax which although setting a tier system to increase taxation according to emissions, in reality the lack of update in rates left the instrument with a very limited impact. Thus, the general conclusion at the national level is of a missed opportunity to take advantage of the potential of environmental taxes to contribute to achieve decarbonization goals.

The study has also analysed the case of the taxes implemented at the regional level. We have identified that the motivation to use of such instruments at the autonomous region level often responds to the need to find complementary revenue sources by seizing the opportunity to regulate in areas where the central government had not and thus were available. We have also seen limited impact due to design flaws that do not adequately deal with the externality in a way to minimize its impact. For example in the case of the taxes on wind turbines in one of the regions, the tax rate is associated to the power generated, thus incentivizing the installation of a higher number of less powerful turbines which worsen the visual and ecological impact that the tax was supposed to mitigate in the first place.

The undesired negative social effects, specifically on most vulnerable sectors of the population, related to the implementation of environmental taxation have also been assessed. We studied how the different energy and environmental taxes in Spain affect different population sectors. Using the revenue generated by energy-environmental taxation to establish distributive compensations is key to achieving a fair and successful transition to a decarbonised economy. To this end, it is first necessary to carry out a rigorous analysis to identify losers and winners, as well as the impacts of existing alternatives to compensate households. These compensations cannot be linked to energy consumption, in order to incentivise energy savings and efficiency, and should be targeted, whenever possible, to particularly affected households. Furthermore, over time, offsets should be progressively reduced, thereby incentivising households to adapt to a low-carbon economy. Still from a social perspective, we observe that certain subsidies to fossil fuel remain for some vulnerable economic sectors. Alternative ways to support these collectives in the just transition need to be found as not to create incoherences that lead to less efficient results.

Lastly, the case study has looked at the transformative potential of environmental taxation as a policy instrument from the lenses of innovation and integration. In terms of innovation we have seen that although the academic literature supports that one of the ways in which environmental taxation contributes to decarbonization is by incentivizing technological innovation, the impact in the case of Spain can be considered modest at best. The lack of availability of specific data make it hard to quantify with precision the extent of this impact, but what seems clear is that its full potential is missed. This is coherent with the conclusions presented above on the shortcomings of the existing instruments in particular and of the system as a whole.

Related to integration, we have seen how one of the main challenges is related to the coordination and coherence among jurisdictions. This lack of coherence seems to be partly due to the intrinsic complexity of coordinating a large number of institutions with particular political and social agendas. But also, as mentioned above, during the reviewed period, there did not seem to be a clear ambition from the central government to use this type of instruments and to search for coordinated action with the regional governments, not from the regional governments to seek for coordination amongst themselves.

Another important aspect that the analysis has revealed is the potential conflict among instruments targeting to mitigate different externalities. We have cited the example of taxes

targeting the visual impact of wind energy infrastructure which can put this technology in a disadvantaged position compared to more polluting ones from an emissions perspective. In this case, again, better coordination and better policy design are needed to try to mitigate these undesired effects.

4.3 Future work

From an EU perspective, as the main pieces in the EU climate policy mix are being reviewed (EU ETS, ESR, ETD etc.), and some new instruments like the "EU ETS2" are included, it will be interesting to see what is the role of environmental taxes. With an increased scope of carbon pricing instruments at the EU level, and with sectors like road transportation and shipping entering in the emissions trading scope, one of the challenges at the national level will be the coordination of this supranational regulations with the efficient use of instruments like environmental taxes to make them complementary and thus strengthen the decarbonization path.

In terms of the Spanish environmental taxation, it will be interesting to follow-up the evolution of these instruments. On the one hand, monitor if reforms aligned with the proposals from the different expert commissions are implemented. If that were the case, the implementation process, its impacts and the role of the different stakeholders would be a worth studying subject. On the other hand, the impact on the efficiency of environmental taxation by circumstantial measures implemented linked to external factors such as, for example, the energy crisis generated by the Russian invasion of Ukraine are also a relevant subject. A clear case in this sense is the subsidy on road transportation fuels implemented in 2022 which partially counters the environmental effect existing taxes. As this type of events disrupting the economy are likely to periodically occur, it is worth studying which mitigating measures can be implemented that manage to better target the undesired social impact and at the same time interfere as little as possible with other long term strategic policies such as the decarbonization of the economy.

Finally, in terms of innovation and integration, further research can provide deeper insights on how the different aspects related to them will enable or hinder decarbonisation. In terms of innovation, if new data sets with information on different types of innovation investment at the firm level, and also data disaggregated at the sector and geographical levels were to be published, further research would be possible to better determine the role of environmental taxation on innovation.

As per integration one key aspect to keep track of is the role of energy taxation in the context of the electrification of economies as a strategy to decarbonization. As we have seen in the case study, the coordination among policy goals and the different instruments used to achieve them is necessary to avoid inconsistent outputs. In this regard, further research on how energy taxes impact electrification and how the instruments can be better designed to contribute to the overall goal of decarbonization is relevant.

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About the project

4i-TRACTION – innovation, investment, infrastructure and sector integration:
TRAnsformative policies for a ClimaTe-neutral European UnION

To achieve climate neutrality by 2050, EU policy will have to be reoriented – from incremental towards structural change. As expressed in the European Green Deal, the challenge is to initiate the necessary transformation to climate neutrality in the coming years, while enhancing competitiveness, productivity, employment.

To mobilise the creative, financial and political resources, the EU also needs a governance framework that facilitates cross-sectoral policy integration and that allows citizens, public and private stakeholders to participate in the process and to own the results. The 4i-TRACTION project analyses how this can be done.

Project partners

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