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# FINANCING THE GREEN TRANSITION IN THE MEDITERRANEAN: ASSESSING THE IMPACT AND DIVERSITY OF GREEN FINANCE TOOLS

## Akdeniz'de Yeşil Dönüşümün Finansmanı: Yeşil Finansman Araçlarının Etki ve Çeşitliliğinin Değerlendirilmesi

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**Abstract**

This study examines the effects of environmentally related taxes and feed-in tariffs (FiTs) on greenhouse gas (GHG) emissions in Mediterranean countries, while also exploring the role of broader green finance instruments in the region. The study highlights several key findings. First, environmentally related taxes and climate taxes, while not significantly reducing per capita GHG emissions when applied alone, appear to become more effective when combined with stringent environmental policies. Specifically, a 1 percentage point increase in these taxes leads to a 0.01-0.02% decrease in GHG emissions per capita, with more stringent policies amplifying their impact. Similarly, the presence of FiTs does not consistently reduce emissions unless tariffs are increased for specific energy sources such as hydro, waste, or marine energy, leading to a more pronounced decline in emissions. Green finance mechanisms are necessary but not sufficient on their own; their success depends on alignment with complementary fiscal and regulatory policies. A comprehensive policy mix—phasing out fossil fuel subsidies, implementing carbon pricing, and reinforcing environmental regulation—is crucial for enabling a credible transition to a low-carbon economy in the Mediterranean.

**Keywords:**
Climate Change,
Climate Finance,
Environmental Taxes,
Feed-In Tariffs,
GHG Emissions,
Green Finance.

**JEL Codes:**
H23, G23,
Q38, Q54.

**Öz**

Bu çalışma, çevresel nitelikli vergilerin ve yenilenebilir enerji alım garantilerinin (Feed-in Tariff, FiT) Akdeniz ülkelerinde sera gazı (GHG) emisyonları üzerindeki etkilerini incelemekte ve aynı zamanda bölgedeki daha geniş kapsamlı yeşil finansman araçlarının rolünü değerlendirmektedir. Çalışma, birkaç temel bulgu ortaya koymaktadır. İlk olarak, çevresel nitelikli vergiler ve iklim vergileri tek başlarına uygulandıklarında kişi başına düşen sera gazı emisyonlarını anlamlı ölçüde azaltmasa da sıkı çevre politikaları ile birlikte uygulandıklarında daha etkili hale gelmektedir. Nitekim bu vergilerdeki 1 yüzde puanlık artışın, kişi başına düşen sera gazı emisyonlarında %0,01–0,02 oranında bir azalma ile ilişkili olduğu ve daha sıkı düzenlemelerin bu etkiyi güçlendirdiği tespit edilmektedir. Benzer şekilde, alım garantilerinin (FiT'lerin) varlığı, hidroelektrik, atık ya da deniz enerjisi gibi belirli enerji kaynaklarına yönelik FiT fiyatları artırılmadıkça emisyonları tutarlı biçimde azaltmamaktadır; ancak bu kaynaklara yönelik tarife artışları emisyonlarda daha belirgin bir düşüş sağlamaktadır. Bulgular, yeşil finansman mekanizmalarının gerekli olmakla birlikte tek başına yeterli olmadığını göstermektedir; bu araçların başarısı, tamamlayıcı mali ve düzenleyici politikalarla uyum içinde uygulanmasına bağlıdır. Sonuç olarak, fosil yakıt sübvansiyonlarının kademeli olarak kaldırılmasını, karbon fiyatlandırma mekanizmalarının uygulanmasını ve çevre mevzuatının güçlendirilmesini içeren kapsamlı bir politika bileşimi, Akdeniz bölgesinde düşük karbonlu bir ekonomiye geçişin güvenilir bir şekilde sağlanması için kritik öneme sahiptir.

**Anahtar Kelimeler:**
Iklim Değişikliği,
Iklim Finansı,
Çevre Vergileri,
Alım Garantileri,
GHG Salımları,
Yeşil Finans.

**JEL Kodları**:
H23, G23,
Q38, Q54.

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## 1. Introduction

The primary focus of economic policies worldwide remains sustaining economic growth, yet the adverse impacts of global warming and environmental degradation have already become widespread across many countries. Despite the concerns regarding the unsustainability of current production and consumption patterns, the global community has failed to provide a common and robust response to these concerns against strong economic growth goals. It is observed that resources are used unsustainably as a result of the desire for higher levels of production and consumption, as well as for rapid industrialization as part of countries' growth strategies.

Climate change is a pressing reality, scientifically proven and widely acknowledged. As stated by the Intergovernmental Panel on Climate Change (IPCC, 2013), "it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century." Global greenhouse gas (GHG) emissions from the combustion of fossil fuels have increased extraordinarily since the onset of the Industrial Revolution. In 2022, the majority of global GHG emissions stemmed from carbon dioxide ($CO_2$), largely produced by burning fossil fuels (71.6%). Methane ($CH_4$) accounted for 21% of total emissions, with nitrous oxide ($N_2O$) making up 4.8%, and fluorinated gases (F-gases) comprising the remaining 2.6% (IEA- EDGAR, 2023).

According to the world $CO_2$ emissions statistics (IEA- EDGAR, 2023), GHG emissions released in the whole Mediterranean region were almost at the same level as those emitted by the EU27 countries as of 2022. While global GHG emissions reached 54 billion tonnes of carbon dioxide equivalent ($CO_2e$), emissions in the EU27 and Mediterranean have recently stabilized at around 3.1-3.6 billion tonnes. In the European Union (EU), GHG emissions per capita have been on a downward trend, with countries like Spain, Italy, and France contributing significantly to this decline (IEA- EDGAR, 2023).

The EIA (2021) reports that world energy-related $CO_2$ emissions were at a level of 34 billion metric tons as of 2020 and are projected to increase considerably throughout the years from 2020 to 2050. Energy-related $CO_2$ emissions are expected to surpass 40 billion metric tons by the year 2050. Taking a glance at their composition reveals that emissions from coal dominate all other sources in 2020 and will continue to be the major contributor to global energy-related emissions up to 2050. Emissions from coal are closely followed by those from liquid fuels. Emissions from natural gas make less than a third of the energy-related emissions throughout the inspected horizon (EIA, 2021). In addition to the GHG emissions caused by fossil fuel combustion and gas- or coal-fired power plants, there are other external costs of fossil fuel use in terms of environmental and health problems. Fossil fuels bear significant external costs, such as creating water, air, and soil pollution and deteriorating public health.

Addressing environmental challenges requires considering the differing circumstances of countries at various stages of development, as they exhibit significant variation in their levels of environmental degradation. Historically, high income countries have had much higher per capita GHG emissions than those of low and middle income countries. The Southern and Eastern Mediterranean countries and the Balkan countries in the Mediterranean are mostly composed of middle-income countries, whereas the EU members in the Mediterranean as well as Israel are mostly high-income countries. From an economic standpoint, the current trajectory of emissions has been a result of a combination of various policy tools such as taxes, subsidies, grants, loans, tax exemptions or reductions, financial instruments, and regulations. Conversely, a shift towards sustainable practices is also achievable through a range of policies and strategies. Green finance represents one of these strategies aimed at facilitating the transition to a low-carbon economy.

This study[1] first aims to assess the economic policy implications of environmentally related taxes and feed-in tariffs (FiTs) utilized in Mediterranean countries concerning their impact on climate change. Second, it seeks to examine other green finance mechanisms employed and shed light on how they correlate with GHG emissions in the region. By doing so, the study seeks to evaluate the role and potential of green finance as a catalyst for advancing the transition to a low-carbon economy in the Mediterranean. This dual focus provides a comprehensive understanding of how economic tools and financial mechanisms can support sustainable development in the region.

The study offers several novel contributions. It is the first empirical analysis focusing specifically on the Mediterranean context that applies an econometric approach to assess the effectiveness of FiTs and climate-related taxes in reducing GHG emissions. It also accounts for the stringency of accompanying environmental policies, highlighting the conditions under which such tools become more effective. Through an evaluation of the broader landscape of green finance in the region, the paper sheds light on how different instruments interact to influence emission trends. This research is also particularly relevant given that the updated Mediterranean Strategy for Sustainable Development (MSSD 2026-2035)[2] led by UNEP/MAP, now places sustainable finance at the core of its approach. By providing evidence-based insights into how fiscal and financial instruments can support national and regional transitions, this paper directly contributes to advancing the MSSD’s goals for sustainable, low-carbon Mediterranean economies.

The structure of the study is as follows: Section 2 undertakes a literature review on the implications of environmental finance policies for climate change outcomes and low-carbon transitions at country level. Section 3 aims to scrutinize the link between the selected finance mechanisms and per capita GHG emissions in Mediterranean states. Section 4 sheds light on the other green finance tools utilized in the region. Finally, Section 5 discusses the results, concludes and provides policy suggestions for the region.

## 2. Literature Review

Environmental taxation and renewable energy subsidies are pivotal tools in financing the transition to a green economy. These mechanisms leverage economic incentives to discourage environmentally harmful practices and foster sustainable development.

### 2.1. Environmental Taxation and Its Role in Emissions Reduction

Environmental taxes, in particular, target activities that generate negative externalities, such as carbon emissions, waste generation, and resource depletion, creating financial disincentives for damaging behavior.

[1] Building on the Acar (2025), it expands the analysis and contributes to academic engagement.
[2] The MSSD 2026–2035 is scheduled to be finalized and adopted by the end of 2025. After its mid-term evaluation, a draft update was prepared and reviewed by the Mediterranean Commission on Sustainable Development (MCSD) in February 2025, with final recommendations in June 2025, followed by formal adoption at COP 24 of the Barcelona Convention in December 2025.

Ma et al. (2018) use the environmental protection tax law in China as a case study to analyze how government tax oversight influences regional sustainable development, emphasizing the need for a robust green tax law system to achieve energy conservation and emission reduction goals while fostering green development. Similarly, Deng et al. (2022) argue that government tax policies play a critical role in shaping green development. Lv and Wu (2024) demonstrate that the reform of taxation systems has led to reduced carbon emissions in regions with stringent government environmental regulations as well as in regions with less stringent regulations in China. Furthermore, this transformation has facilitated regional green development overall. In the same vein, Chen et al. (2023) provide evidence that effective promotion of carbon emissions reduction hinges on leveraging the spatial effects of environmental taxes and carbon emissions in China. They advocate for establishing and enhancing a regional linkage mechanism for carbon emissions reduction, advocating for the inclusion of $CO_2$ within the taxation scope to bolster the positive impact of environmental taxes on reducing carbon emissions. Their research emphasizes the importance of addressing the diverse implementation approaches of environmental taxes to successfully achieve emission reduction objectives. Obobisa and Ahakwa (2024) find that renewable energy consumption, financial development, and environmental taxes contribute to the reduction of $CO_2$ emissions in 25 European countries, while Hao et al. (2021) and Xie and Jamaani (2022) detect a similar effect of environmental taxation on $CO_2$ emissions in G-7 countries (i.e. Canada, France, Germany, Italy, Japan, the United Kingdom and the United States). Khan et al. (2022), He et al. (2023), and Li et al. (2023) discover that environmental taxes and stringent environmental policies effectively decrease emissions in OECD countries. He et al. (2023) further demonstrate that an increase of one unit in environmental tax revenue per capita leads to a decrease of 0.02% in $CO_2$ emissions across OECD countries. Sarigul and Topcu (2021) as well as Akkaya and Hepsag (2021) detect that environmental taxes and fuel taxes have a negative impact on $CO_2$ emissions in Türkiye.

However, Zhu et al. (2023) critique overly optimistic assumptions, noting that regional disparities in regulations may lead to emissions shifting to jurisdictions with less stringent policies, thereby undermining the overall effectiveness of environmental taxes.

### 2.2. Renewable Energy Subsidies and Feed-in Tariffs

Renewable energy subsidies, such as feed-in tariffs (FiTs), represent another critical policy tool to accelerate the transition to a low-carbon economy. By facilitating the substitution of fossil fuels with renewable energy, they are expected to contribute to emissions reduction. One such measure is feed-in tariffs (FiT), which consists of fixed payments per kilowatt-hour (kWh) established by an administrative authority, typically offered to eligible energy producers. The FiT effectively subsidizes renewable energy generation by covering the difference between the market price of electricity and the tariff's value. Without such subsidies, renewable generators would sell their electricity on the wholesale market, where prices fluctuate based on market conditions at the time of generation. FiTs offer generators a predictable income through a fixed price for their entire output, which acts as a subsidy if this tariff exceeds the wholesale price. This subsidy is quantifiable by comparing FiTs with wholesale prices. Moreover, the certainty provided by the tariff reduces revenue risk associated with fluctuations in wholesale prices. FiTs help accelerate the adoption of renewable energy technologies by guaranteeing renewable energy producers a stable, long-term purchase price for the electricity they produce. This financial incentive provides a predictable revenue stream that reduces investment risks and encourages private sector participation in renewable energy projects. FiTs are expected to facilitate the financing of the green economy by attracting investments in renewable energy infrastructure, such as solar, wind and biomass systems, and encourage the growth of sustainable energy markets.

There are a range of subsidies granted to renewable energy in many countries. Qi et al. (2023) investigate the temporal alignment of an emissions trading system (ETS) and FiTs for solar and wind energy projects in China, emphasizing the impact of subsidy strategies. Their research indicates that continuous FiT subsidies have a more positive overall effect compared to phasing them out. They highlight that introducing FiT can ease the burden and cost of reducing emissions under the carbon ETS. During the FiT subsidy period, higher subsidy rates correspond to reduced pressure for emission reductions within the carbon ETS framework. Similarly, Lin and Xie (2024) discover that a one-unit increase in FiT subsidies correlates with a 3.4-unit rise in renewable energy investments, based on firm-level data from China. Mardones (2024) demonstrates in the case of Chile that integrating three climate policies—carbon taxes, coal-fired power plant phase-out, and renewable energy subsidies—leads to a significant decrease in GHG emissions, using a computable general equilibrium model and microsimulations.

The Mediterranean warrants distinct analytical attention for several reasons. First, it is recognized by the IPCC as a climate hotspot, warming faster than the global average and facing acute risks such as droughts, water scarcity, and sea-level rise. Second, the region combines high dependence on fossil fuel imports with abundant but underutilized renewable energy potential, making the design and financing of green finance policies especially consequential. Third, the Mediterranean spans a diverse set of economies—from EU member states like Italy and Spain to emerging economies in North Africa and the Balkans—creating a natural laboratory to examine how environmental taxes, subsidies, and policy stringency operate under heterogeneous institutional and financial conditions. Finally, the region's strategic role in EU climate and energy policy, including the European Green Deal and cross-Mediterranean renewable energy initiatives, further underscores the geopolitical importance of effective green finance mechanisms. Despite these distinctive features, systematic empirical assessments of green finance tools in the Mediterranean remain scarce, which justifies the regional focus of this study. Most analyses center on global, or national contexts, overlooking the region's specific economic and policy dynamics. Few studies combine environmental taxes, feed-in tariffs, and policy stringency within a single econometric framework. This paper fills that gap by providing one of the first empirical assessments of green finance tools and their impact on GHG emissions in Mediterranean countries, using a unique dataset and a consistent panel data approach. The findings offer practical insights for regional sustainability efforts.

## 3. Data, Method, and Analysis: The Link Between Environmentally Related Taxes, FiTs, and GHG Emissions in Mediterranean Countries

Making use of the relevant indicator definitions and data, the following research questions are answered in this section:

1. Which countries in the Mediterranean region tax the production or consumption of environmentally related goods and services more highly in the region?

2. Does environmental taxation make a significant difference in per capita GHG emissions in the region?

3. Which energy source is supported more by the FiT incentives in the region?

4. Does the type of renewable energy source subsidized make a significant difference in per capita GHG emissions in the region?

Section 3.1 undertakes a thorough review of environmentally related taxes and FiTs provided to renewable energy in the Mediterranean countries, whereas Section 3.2 explores the links between these policies and per capita GHG emissions in the region using an econometric approach.

### 3.1. Data: Environmentally Related Taxes and FiTs in the Mediterranean

Environmentally related taxes play a crucial role for governments in influencing the prices of goods and services. The OECD Environmentally Related Tax Revenue Database (ERTR) classifies taxes according to their environmental impact, using a structured method to compile revenue specifically from environmentally related taxes. This includes detailed categorization by tax-base types such as energy, transport, pollution, and resources, across 22 environmental domains. ERTR is constructed by 1) focusing on taxes on GHG emissions from different activities by splitting tax revenues into two subcategories: the energy-related part (recorded as an energy tax) and the non-energy-related part, such as certain GHG emissions from landfills or agriculture (recorded as a pollution tax), and 2) introducing four "memo items" to enhance the relevance of the accounts for policy work: (i) certain land taxes, (ii) taxes on oil and natural gas extraction, (iii) taxes on the resource rent (profit taxes only) and (iv) elevated VAT levied on environmentally related tax bases (OECD, 2023).[3]

As shown in Figure 1, in 2019, Croatia, Slovenia, and Greece led the Mediterranean region in the share of GDP allocated to environmental taxes, covering areas like carbon emissions, waste generation, and resource depletion. Conversely, countries from the South Mediterranean such as Morocco and Egypt appear to have allocated a smallest proportion of their GDP to environmental taxation. When considering tax revenue per capita (measured in 2015 USD PPP), Slovenia, Italy, Croatia, and Greece rank as the highest tax-collecting countries (OECD, 2023).

[3] For robustness checks, we employ the environmentally related tax revenue in the domain of climate change (% of GDP) as the main independent variable in two model specifications in Section 3.2.

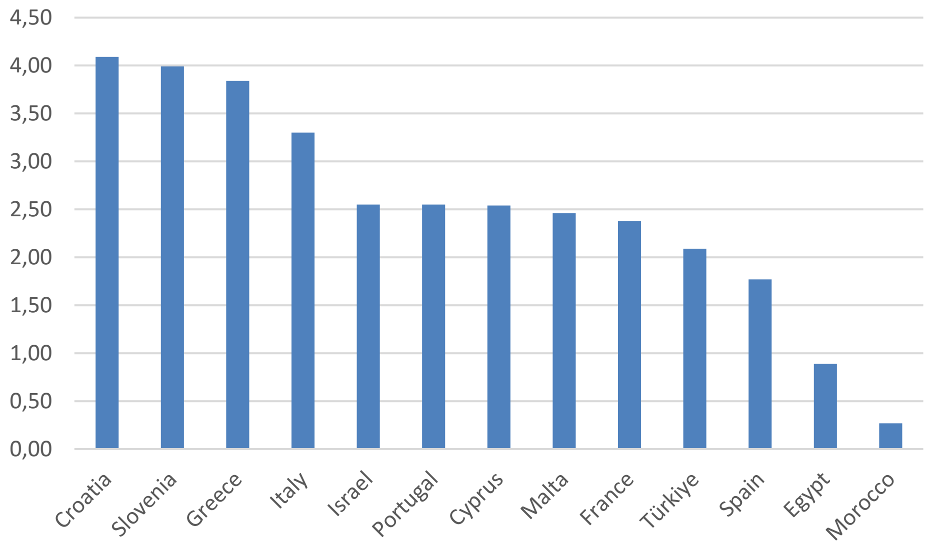


**Figure 1. Environmental Taxation (% of GDP) in the Region, 2019**
**Source:** Author's illustration using OECD (2023) data

According to the "Environmental Policy: Renewable energy feed-in tariffs" database of the OECD (Edition 2021), FiTs are widely used policies designed to promote the expansion of renewable electricity capacity. These market-driven economic tools generally provide long-term agreements that ensure a fixed price per kilowatt-hour (kWh) for electricity supplied to the grid from a specified energy source. OECD (2022) reports both the mean FiT prices (in USD) and the length of power purchase agreements (in years) for each renewable source supported. The length of agreements ranges between 10 and 25 years. In the Mediterranean region, almost every country has implemented a FiT policy, except for Malta and Morocco. As a small island nation, Malta has limited land and natural resources, making large-scale renewable energy deployment difficult. Solar and wind are the most viable options, but land scarcity and high population density restrict the deployment of large solar farms or wind projects. This explains why it may not be preferred to implement a FiT policy in Malta. While Morocco has abundant solar and wind resources, its focus has historically been on large-scale centralized renewable projects such as Noor Ouarzazate (one of the world's largest solar power plants)[4]. The government may view FiT policies as less compatible with its central development strategy. Besides, FiT policies often require long-term subsidies or guaranteed purchase agreements, which can be a burden on national budgets or lead to higher energy prices for consumers. For countries like Morocco, where affordability and energy access are priorities, FiTs might not be the optimal choice. Also, competitive bidding or auctions for renewable energy projects, which allow investors to control costs better compared to FiTs, can attract large-scale investors by providing a predictable framework in countries like Morocco.

Based on Figure 2, the number of countries adopting FiTs in the Mediterranean region reached a total of 13 in year 2012 and afterwards started to decline. As of 2019, there were only three countries (France, Italy, and Türkiye) in the region that provided FiT support to one or more renewable resources. Among them, FiTs in France were the highest, with 0.094 USD/kWh to small hydro, 0.16 USD/kWh to waste, and 0.14 USD/kWh to marine power in 2019. Historically,

[4] https://ouarzazate.city/noor-ouarzazate-solar-power-station/

some countries provided higher FiT prices to solar power per kWh of electricity (e.g. Cyprus and Greece) while countries such as Türkiye provided the lowest prices (OECD, 2022). Feed-in tariffs in Türkiye also benefit from local content premiums depending on the renewable energy technology.[5]

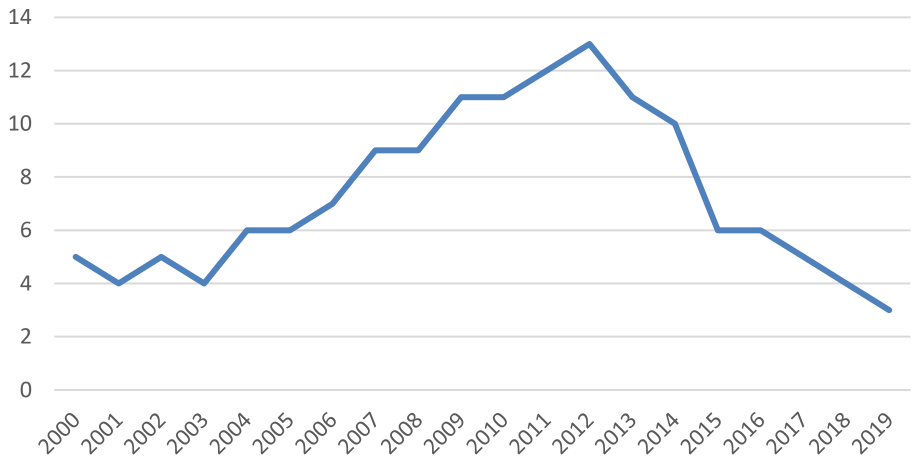


**Figure 2. Number of Countries Adopting FiTs in the Region**
**Source:** Author's illustration using OECD (2022) data

Figure 3 shows the decline in countries offering FiT support for renewable energy sources from 2012 to 2019. In 2012, the peak year, 10 countries supported solar, 11 wind, and 10 small hydro, among other resources.

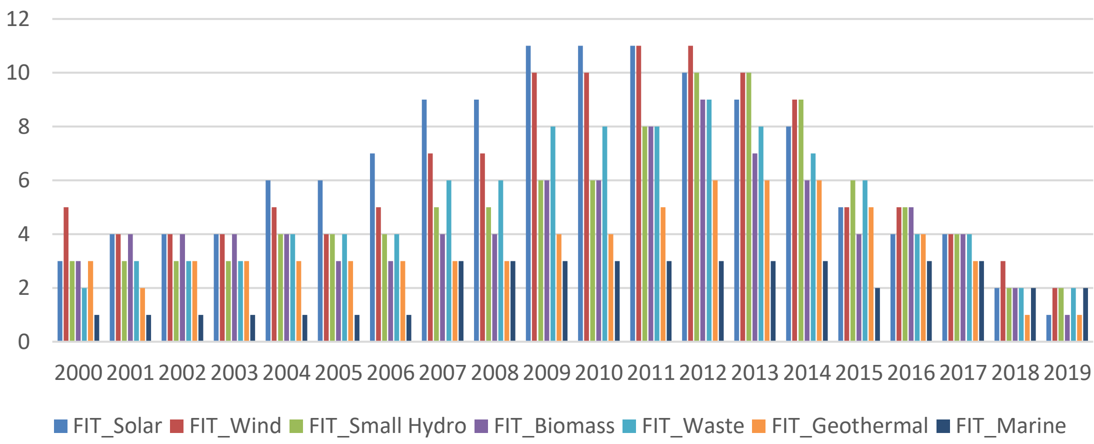


**Figure 3. Number of Countries with FiTs with Respect to Source**
**Source:** Author's illustration using OECD (2022) data

By 2019, this had dropped to just 1 for solar, 2 for wind, 2 for small hydro, and 1-2 for other resources. This decline can be attributed to several factors: As solar and wind technologies

[5] Türkiye also advances renewable energy through YEKAs (Renewable Energy Resource Areas), which are legally designated zones aimed at fostering substantial renewable electricity capacity and promoting localization in renewable energy technologies.

became more cost-competitive (IRENA, 2024), the need for FiTs decreased. Many countries also shifted from FiT schemes to competitive auctions, which reduce costs through competition (Mathieu and Valenzuela, 2024). Additionally, governments increasingly favored alternative support mechanisms like tax credits, subsidies, and green certificates, which offer more flexibility and lower costs (Del Rio and Linares, 2014). Countries like Italy, Spain, France, Greece, Morocco, Tunisia, and Egypt have adopted such market-based approaches to encourage renewable investment while reducing financial burdens on public budgets and consumers.

### 3.2. Methodology and Results

This section examines the causal relationship between GHG emissions per capita and two key environmental policy tools in the Mediterranean region. Specifically, it analyzes:

- The effect of environmentally related taxes on GHG emissions from 1994 to 2021.
- The effect of Feed-in Tariffs (FiTs) on GHG emissions from 2000 to 2019.

The analysis uses panel data methods to explore these relationships.

The data for environmentally related tax revenue (% of GDP) for the period 1994-2021 and FiTs (USD) for the period 2000 – 2019 are extracted from the OECD database, whereas per capita GHG emissions (*GHGPC)* data (tonnes $CO_2$e/year) is extracted from the IEA and Emissions Database for Global Atmospheric Research (EDGAR) constructed by Crippa et al. (2023). GHG emissions in the IEA-EDGAR database include $CO_2$ (fossil only), $CH_4$, $N_2O$ and F-gases and are aggregated using Global Warming Potential (GWP) values from IPCC AR5 (GWP-100 AR5). GDP per capita (purchasing power parity-adjusted, constant 2021 international USD), renewable electricity output (% of electricity production) and fossil fuel energy consumption (% of total) are used as control variables in explaining per capita emissions in each country. Economic expansion is positively correlated with increased energy consumption, which, in turn, elevates GHG emissions, particularly in countries that predominantly depend on fossil fuel-based energy infrastructures. The generation of renewable electricity (*REO*) is anticipated to mitigate per capita GHG emissions, whereas fossil fuel energy consumption (*FOSSIL*) is projected to have the opposite effect, contributing to increased emissions. A higher proportion of renewable energy sources in electricity generation directly diminishes emissions attributed to fossil fuel combustion. Renewable energy technologies, including solar, wind, and hydroelectric power, do not produce carbon emissions during their energy conversion processes, thereby reducing overall emission intensity. Concurrently, the declining levelized cost of electricity (LCOE) for renewable energy technologies promotes their broader adoption, further enhancing their potential to mitigate emissions.

In order to test whether policy stringency plays a role and affects the effectiveness of environmental taxation, the OECD Environmental Policy Stringency Index (EPS) is used in several equations as well (Kruse et al., 2022). The EPS index is a country-specific and internationally comparable measure of the stringency of environmental policy ranging from zero (least stringent) to six (most stringent). The index covers the years from 1990 to 2020, across 40 countries and 13 policy instruments, focusing on climate change and air pollution mitigation policies.[6]

The econometric analysis uses panel data, which tracks the same countries over multiple years. This allows for the analysis of both cross-country variations and time-series trends. Panel data analysis helps control for individual differences between countries, ensuring that the relationship between environmental policies and emissions is not obscured by other factors. The panel structure of the data used in this study enables to examine the effects of environmentally related policies on GHG emissions per capita both on a country level and over a time span (1994-2021). Panel data analysis facilitates the control of individual heterogeneity by allowing for the examination of variation and involving less linear correlation between variables. Besides, a fixed effects specification is selected in order to control for variables that are constant within each entity (such as a country), but vary between entities.[7] It allows us to estimate the impact of variables that change over time (e.g., tax revenues) while accounting for unobserved characteristics that could differ between countries but do not change over time (such as institutional frameworks). In simpler terms, it helps isolate the effects of changes in specific variables by controlling for other factors that might influence the results. The model can be expressed as follows:

$$y_{it} = \alpha + X_i'\beta + u_{it} \tag{1}$$

In Equation (1), for $i = 1,..., N$ and $t = 1,..., T$, where $y_{it}$ is the dependent variable, $X_i'$ is the vector of independent variables, $\beta$ is the coefficient vector of independent variables, and $u_{it}$ is the composite error. In the current analysis, heteroskedasticity-corrected standard errors are estimated using the robust estimator of the covariance matrix proposed by Arellano, which take into account both heteroskedasticity and autocorrelation. By incorporating country-fixed effects (to control for time-invariant unobserved heterogeneity) and time-fixed effects (to capture global shocks like economic crises or climate agreements), our methodology helps mitigate confounding. Furthermore, the inclusion of fixed effects helps mitigate omitted variable bias. Additionally, our regressions might suffer from reverse causality, which implies that higher GHG emissions per capita might drive policy responses, rather than environment/climate policies influencing emissions. This issue can be handled by using lagged independent variables to ensure that the explanatory variables precede the outcome (GHG per capita), reducing simultaneity bias. Models 1a.i to 2b.ii in the Appendix present the results of the regressions with lagged values of renewable electricity output, fossil fuel consumption, and environment/climate policies, which provide similar results to those presented in Table 1. To maintain a broader dataset without omitting data for any given year, we base our interpretations on the results presented in Table 1.

Table 1 presents the fixed effects estimation results in four separate models that include two environmental tax categories as explanatory variables. Model 1a and 1b integrates the effects of total environmental tax revenue (*ENVTAX*) (at all tax bases as a % of GDP) on the natural logarithm of *GHGPC*, whereas Models 2a and 2b integrate the effects of environmental tax revenue in the domain of climate change (*CLIMTAX*) (as a % of GDP). Models 1a and 2a include *REO*, renewable electricity output (% of electricity production), whereas Models 1b and 2b

[6] The structure of the EPS, its components and the index construction can be accessed in the related 2022 OECD working paper: https://doi.org/10.1787/90ab82e8-en

[7] The fixed effects specification is chosen for the analysis because the Hausman (1978) test results indicate that the null hypothesis (which asserts that GLS estimates are consistent) is rejected. This rejection implies that the random effects estimator is inconsistent, making fixed effects the appropriate approach.

include *FOSSIL*, fossil fuel energy consumption (% of total) as well as *EPS* in interaction with the tax variables.

**Table 1. Fixed Effects Estimation Results for Environmental and Climate Taxation**

| | Model 1a LNGHGPC | Model 1b LNGHGPC | Model 2a LNGHGPC | Model 2b LNGHGPC |
|---|---|---|---|---|
| **Variable** | **Coefficient (Standard Error)** | **Coefficient (Standard Error)** | **Coefficient (Standard Error)** | **Coefficient (Standard Error)** |
| LNGDPPC | 0.60*** (0.09) | 0.51*** (0.05) | 0.61*** (0.09) | 0.50*** (0.05) |
| REO | -0.005*** (0.001) | | -0.005*** (0.001) | |
| FOSSIL | | 0.02*** (0.002) | | 0.02*** (0.002) |
| ENVTAX | -0.004 (0.012) | -0.03** (0.012) | | |
| CLIMTAX | | | 0.0009 (0.011) | -0.03** (0.01) |
| EPS | | -0.03*** (0.012) | | -0.04*** (0.009) |
| EPS*ENVTAX | | 0.01*** (0.003) | | |
| EPS*CLIMTAX | | | | 0.02*** (0.002) |
| constant | -4.06 (0.91) | -4.65*** (0.38) | -4.15*** (0.91) | -4.60*** (0.43) |
| time dummies | yes | yes | yes | yes |
| observations | 350 | 175 | 352 | 176 |
| LSDV R-squared | 0.96 | 0.98 | 0.96 | 0.98 |

**Note:** Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Models 1a and 2a reveal that an increase in the share of country-level environmental tax revenue or climate-related tax revenue in GDP does not significantly affect GHG emissions per capita in the region. Once these two tax variables enter the equation in interaction with environmental policy stringency (*EPS*), taxation decreases GHG emissions significantly (Models 1b and 2b). A 1 percentage point increase in *ENVTAX* or *CLIMTAX* leads to a net decline of 0.01-0.02% in *GHGPC*. This implies that environmental taxes alone may not be set at levels high enough to significantly change behavior, especially if the cost of compliance is lower than the economic benefits of continuing high-emitting activities. However, strict environmental policies increase the effectiveness of taxes by creating additional pressure to adopt cleaner technologies and practices. Besides, taxes often work best when paired with complementary policies, such as emissions standards, renewable energy mandates, or energy efficiency incentives. Policy stringency likely reflects the existence of such measures that enhance the impact of taxation by providing multiple, reinforcing mechanisms to reduce emissions. In the absence of strict enforcement, tax policies may be missed or fail to achieve their intended effect. Strict policies are more likely to include robust enforcement measures that ensure that taxes are effectively implemented and their behavioral objectives are achieved (see the country examples such as

France and Italy, where EPS has risen during the investigated time period and per capita GHG emissions are on a considerable decline).

To sum up, environmental taxation, alone, while an effective tool for internalizing the environmental costs of economic activities, may fail to significantly accelerate the low-carbon transition due to several limitations such as insufficient tax rates, policy design flaws, economic and political resistance, regressive impacts on low-income populations, and the risk of carbon leakage. Additionally, taxation alone cannot fully address the structural and behavioral changes needed for a low-carbon economy without complementary measures like subsidies, infrastructure investments, and stringent regulations. When combined with strict environmental policies, taxation becomes more effective and leads to measurable emissions reductions. This suggests that strict regulations increase the impact of taxes by encouraging cleaner technologies and discouraging high-emitting activities. To maximize its impact, environmental taxation should be integrated into a broader policy framework that addresses these challenges holistically by including renewable energy subsidies, infrastructure investments, and regulatory enforcement. In addition, earmarking tax revenues for climate action (such as financing renewable energy projects and energy efficiency programs) can increase their effectiveness. Targeting high-emitting sectors specifically rather than broad-based taxes can also lead to more significant reductions.

In the same analysis above (Table 1), GDP per capita makes a significant contribution to emissions per capita; i.e. being a wealthier country in average per capita terms implies an increase in the GHG each person emits on average. To be more precise, a 1% increase in *GDPPC* leads to a 0.5-0.6% increase in emissions per capita. On the other hand, renewable energy output, *REO*, contributes to the low-carbon transition significantly as it decreases emissions by 0.005% as *REO* increases by 1 percentage point. Higher shares of fossil fuel consumption, *FOSSIL*, contributes to increasing per capita emissions, as expected.

Table 2 presents the results of fixed effects analyses examining the factors influencing emissions across four different models. Each model focuses on how different types of Feed-in Tariffs (FiTs) affect emissions.

Models 3a and 3b analyze whether simply having a FiT policy (*FIT_DUMMY*) in place in a given country and year impacts emissions.

Models 4a and 4b go a step further by examining the specific *FiT prices* offered for different renewable energy sources, including solar, wind, hydro, biomass, waste, geothermal, and marine energy.

Additionally, these models differ in the control variables they include:

Models 3a and 4a control for economic activity (log of GDP per capita, *LNGDPPC*) and renewable electricity output (*REO*).

Models 3b and 4b instead control for economic activity (*LNGDPPC*) and fossil fuel consumption (*FOSSIL*).

This approach allows us to compare the effects of having FiT policies versus the specific price incentives they provide, while also accounting for key economic and energy-related factors.

**Table 2. Fixed Effects Estimation Results for FiTs**

| | Model 3a LNGHGPC | Model 3b LNGHGPC | Model 4a LNGHGPC | Model 4b LNGHGPC |
|---|---|---|---|---|
| **Variable** | **Coefficient (Standard Error)** | **Coefficient (Standard Error)** | **Coefficient (Standard Error)** | **Coefficient (Standard Error)** |
| LNGDPPC | 0.64*** (0.10) | 0.78*** (0.05) | 0.62*** (0.11) | 0.79*** (0.05) |
| REO | -0.005*** (0.001) | | -0.005*** (0.001) | |
| FOSSIL | | 0.01*** (0.003) | | 0.01*** (0.003) |
| FIT_DUMMY | -0.0007 (0.003) | 0.0009 (0.003) | | |
| FIT_SOLAR | | | -0.01 (0.03) | -0.004 (0.014) |
| FIT_WIND | | | 0.02 (0.04) | 0.005 (0.024) |
| FIT_HYDRO | | | -0.11** (0.05) | -0.07* (0.04) |
| FIT_BIOMASS | | | 0.27* (0.15) | 0.20 (0.13) |
| FIT_WASTE | | | -0.09*** (0.03) | -0.04** (0.02) |
| FIT_GEOTHERMAL | | | -0.02 (0.09) | -0.07 (0.08) |
| FIT_MARINE | | | -0.08** (0.04) | -0.0006 (0.04) |
| constant | -4.71*** (1.07) | -7.26*** (0.38) | -4.45*** (1.19) | -7.14*** (0.37) |
| time dummies | yes | yes | yes | yes |
| observations | 280 | 231 | 280 | 231 |
| LSDV R-squared | 0.96 | 0.99 | 0.96 | 0.99 |

**Note:** Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Models 3a and 3b reveal that providing feed-in-tariffs (i.e. the presence of a FiT scheme to any renewable source) alone does not significantly affect GHG emissions per capita in the region. It is a well-known fact that FiTs might be effective in promoting renewable energy but face limitations such as high financial burdens, inefficiencies in targeting emerging technologies, market distortions, and grid integration challenges. By guaranteeing fixed prices, FiTs can potentially distort energy markets, discouraging competition and innovation. Over-reliance on FiTs may also slow the transition to market-based mechanisms like auctions or competitive pricing, which can drive cost efficiencies in renewable energy deployment. Policy instability and regional disparities can further hinder their effectiveness, while their focus on electricity generation often neglects other critical sectors like transportation or industry. Additionally, the long timeframes for renewable infrastructure development may delay significant emission reductions. To enhance their impact, FiTs need to be part of a broader strategy that includes grid modernization, energy storage, carbon pricing, and measures to ensure equity and regional inclusivity.

Once the FiT prices (USD per kWh) to each renewable source are accounted for (Models 4a and 4b), 1 USD increase in FiT prices provided to hydro, waste and marine power decreases GHG emissions per capita significantly (Model 4a). The coefficients of FiTs to waste and hydro appear to be significant in Model 4b as well, once *FOSSIL* is used as a control variable. On the other hand, a 1-USD increase in *FIT_BIOMASS* increases *GHGPC* by around 0.3%.

The difference in the impacts of FiT prices on GHG emissions reductions among renewable energy sources in Mediterranean countries can be attributed to several factors: The first one is related to the baseline energy mix. Hydro, waste, and marine power often displace high-emission, base-load energy sources like coal or oil-fired plants, leading to more substantial reductions in GHG emissions. On the other hand, solar, wind, and geothermal may replace less carbon-intensive energy sources, such as natural gas, or contribute to intermittent generation that doesn't fully offset fossil fuel dependency. Second, hydro, waste-to-energy, and marine power typically have higher capacity factors (i.e., they generate electricity more consistently) compared to solar and wind, which are intermittent and dependent on weather conditions. Consistent generation ensures a more stable replacement of fossil fuel-based energy, resulting in greater GHG reductions. Geothermal energy has high reliability but may have limited implementation due to geological constraints in Mediterranean countries (for example, in countries like Algeria, Egypt, and Morocco, geothermal has limited implementation due to the absence of significant tectonic activity). Third, in regards to infrastructure needs, hydro, waste, and marine power are often integrated into existing grid systems more effectively, leading to immediate and sustained reductions in emissions; whereas solar and wind power may face challenges like curtailment due to grid constraints or a lack of storage solutions, reducing their net impact on emissions. Fourth, hydro, waste, and marine projects often involve large-scale installations that can significantly impact national energy mixes. On the contrary, solar and wind installations in Mediterranean countries may be smaller-scale (Türkiye being an exception in this regard), distributed systems that individually contribute less to GHG reductions.

FiT prices provided to biomass energy might inadvertently trigger an increase in GHG emissions per capita in Mediterranean countries due to several factors: To begin with, if biomass feedstocks (e.g., wood, agricultural residues, or organic waste) are sourced unsustainably, such as through deforestation or overharvesting, the carbon released during combustion may exceed the carbon sequestered during the biomass's growth cycle, leading to a net increase in GHG emissions. Besides, transportation and processing of biomass can also generate significant emissions, particularly if local supply chains are not well-developed. Furthermore, older or poorly maintained biomass power plants may operate with low energy conversion efficiencies, resulting in higher emissions per unit of energy produced (for instance, the biomass power plants in Greece (Alatzas et al., 2019), Türkiye (Ocak and Acar, 2021), and Italy (Moliner et al., 2021) still use older combustion technologies or are not optimized for efficiency). Incomplete combustion of biomass can release methane, carbon monoxide, and black carbon, all of which are potent contributors to global warming.

In the same analysis (Table 2), GDP per capita makes a significant contribution to emissions per capita by leading to a 0.6-0.8% increase in *GHGPC* as a result of 1% increase in *GDPPC*. A 1 percentage point increase in *FOSSIL* triggers *GHGPC* by 0.01%. On the other hand, as in Models 1a and 2a, renewable energy output, *REO*, contributes to the low-carbon transition significantly as it decreases emissions by 0.005% as *REO* increases by 1 percentage point.

Alternative methods such as system GMM, instrumental variables, or quasi-experimental approaches (e.g., difference-in-differences, event studies) can strengthen causal identification under the right conditions. Yet, given our dataset—a moderate number of Mediterranean countries observed over a long time horizon—fixed effects estimation offers the most reliable framework. IV approaches are constrained by the scarcity of strong exogenous instruments in cross-country green finance research, while DID methods face difficulties in this context due to heterogeneous policy adoption and the challenge of satisfying parallel trend assumptions. Therefore, the fixed effects framework represents a rigorous and widely accepted methodology for our research question.

## 4. How to Finance the Low-Carbon Transition Through Other Types of Green Finance?

Carbon pricing—through emissions trading schemes (ETS) or carbon taxes—is one of the most widely used policy instruments to reduce greenhouse gas emissions by internalizing their social cost (Nordhaus, 2014; Tietenberg and Lewis, 2018). Yet, in practice, carbon markets often fail to reflect the true marginal cost of emissions reductions, with prices remaining volatile and frequently too low to drive long-term investment shifts (ERCST, 2021). The EU Emissions Trading System (EU ETS), which applies to Mediterranean EU member states, illustrates this tension (Figure 4).

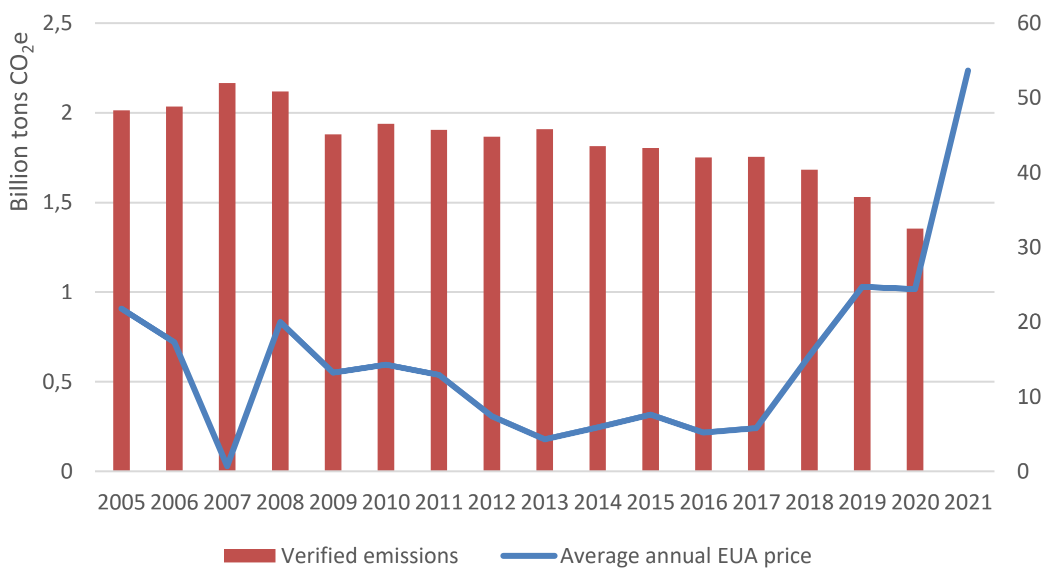


**Figure 4. Average Annual EUA Prices (Euro/ton) and Verified Emissions (billion tons $CO_2e$)**
**Source:** EEA (n.d.) EU Emissions Trading System Data Viewer & Ember (n.d.) Climate Carbon Price Viewer

While verified emissions have declined—most notably in the electricity sector, where reductions reached nearly 28% between 2013 and 2019—evidence suggests more limited abatement in other covered sectors (Martin et al., 2016; Pellerin-Carlin and Vangenechten, 2022). The performance of the EU ETS in Mediterranean countries therefore remains mixed and difficult to assess at the macro level, as sectoral and firm-level impacts are uneven. One tangible benefit, however, has been the revenue generated through allowance auctions, much of which is earmarked for climate and energy investments. In 2022, for example, most Mediterranean EU member states allocated nearly all of their auction revenues to such purposes, though Italy notably directed only half (EEA, 2023). These variations underscore why it is important to empirically assess whether carbon pricing mechanisms have delivered measurable emission reductions across Mediterranean economies—something that remains underexplored in the literature. While carbon pricing seeks to influence emissions through market-based incentives, complementary green finance instruments—such as green bonds, loans, and central bank initiatives—directly channel investment toward low-carbon projects, addressing gaps that carbon pricing alone may not resolve. Globally, the green bond market has expanded rapidly since 2007, with proceeds primarily allocated to energy, buildings, and transport (CBI, 2022; also see Figure 5 below). Yet concerns about "greenwashing" persist, as some issuances finance projects with limited or even negative climate benefits (Rajwanshi, 2019). Green loans face similar criticisms, while their distribution remains heavily skewed toward developed markets, leaving developing countries with only a marginal share of issuances (IFC, 2021). These challenges highlight the need for robust transparency and reporting standards if such instruments are to genuinely accelerate the green transition.

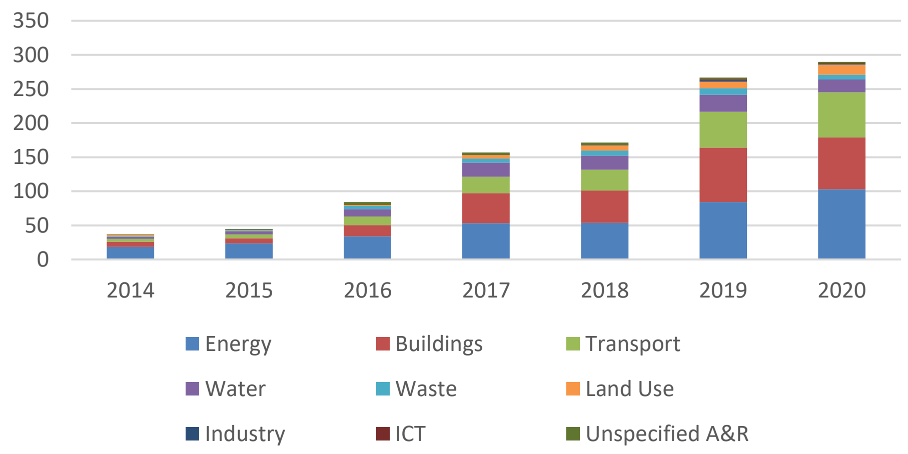


**Figure 5. Sectoral Use of Proceeds from Climate Bonds (issued billion USD)**
**Source:** Climate Bonds Initiative (CBI, 2022)

In the Mediterranean, the development of green finance markets is uneven. Northern Mediterranean countries, particularly France and Italy, are among Europe's leading issuers, while Southern and Eastern Mediterranean countries have only recently entered the market. Notable milestones include Turkey's first green bond issuance in 2016 and Egypt's launch of the MENA region's first sovereign green bond in 2020 (TSKB, 2017; Hussain, 2022). Central banks in the region are also beginning to integrate sustainability into their mandates, with the Central Bank of Egypt issuing guidelines for sustainable finance in 2021 (American Chamber of Commerce in Egypt, 2023). These steps suggest growing momentum, but the scale remains modest compared to Northern peers.

The banking sector plays a pivotal role in this landscape, serving as the primary channel for financing the real economy. While green loans are growing globally—reaching $56.8 billion in the US and $1.4 billion in Italy in 2021 (World Bank, 2021)—their uptake across much of the Mediterranean remains limited. This divergence underscores a critical gap: while the region faces urgent climate risks, its financial capacity to support the green transition varies widely across national contexts. For this reason, in future studies, it is essential to empirically evaluate whether and how these green finance instruments have contributed to emission reductions across Mediterranean economies, rather than assuming global trends translate automatically to regional outcomes.

While green bonds, loans, and central bank initiatives mobilize domestic and regional capital for low-carbon projects, multilateral development banks (MDBs) and climate funds play a complementary role by providing large-scale financing and technical support, particularly in Mediterranean countries where private and public resources for the green transition remain limited. In the Mediterranean, initiatives such as the Clean Technology Fund and the World Bank have supported renewable energy and efficiency projects—for example, in Türkiye, where financing has contributed to the installation of nearly 1 GW of renewable capacity and significant emission reductions (Fosse et al., 2017). Among MDBs, the European Bank for Reconstruction and Development (EBRD) is especially influential: in 2023, half of its portfolio (€6.5 billion) was allocated to green finance, with Türkiye consistently among its major recipients (Bitsadze, 2024). Other European institutions, including the Council of Europe Development Bank and the French Development Agency, have also provided important funding streams.

The distribution of multilateral climate finance, however, is highly uneven across Mediterranean countries. While France and Italy have historically attracted the largest shares of MDB outflows, other EU members such as Greece, Portugal, and Spain have received minimal inflows (Bos and Thwaites, 2021; also see Figure 6 below). This divergence suggests that access to multilateral finance depends not only on need, but also on institutional capacity, creditworthiness, and alignment with donor priorities. Such disparities are particularly important for the Mediterranean, where domestic fiscal space and capital markets are often insufficient to meet investment needs for the green transition.

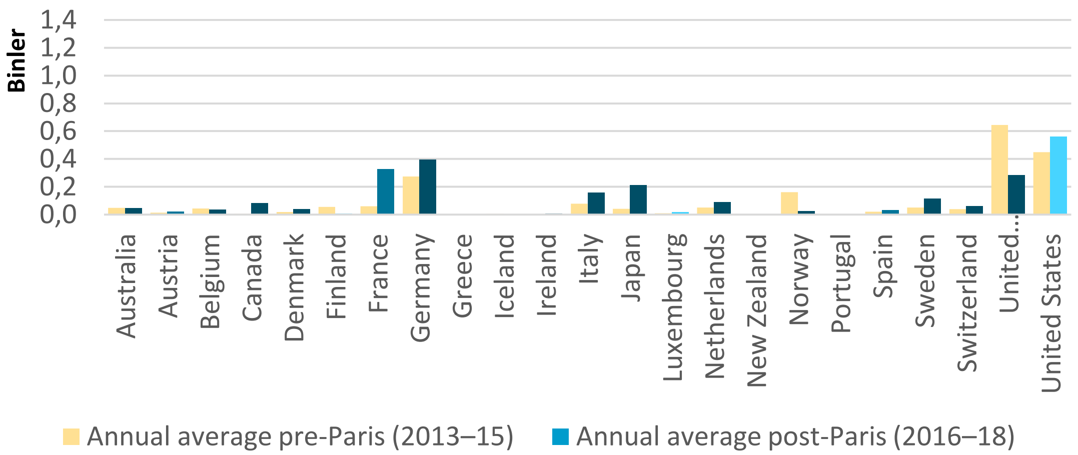


**Figure 6. Multilateral Climate Finance Inflows (excluding MDBs) by Country, Annual Average Pre– and Post–Paris Agreement**
**Source:** Bos and Thwaites (2021), World Resources Institute.

These observations highlight the importance of considering multilateral finance as part of the broader green finance landscape in the region. Yet the lack of consistent long-term data makes it difficult to evaluate systematically whether MDB funding has translated into measurable reductions in greenhouse gas emissions—reinforcing the need for empirical assessments such as the one undertaken in this study.

In sum, carbon pricing, green finance instruments, and multilateral funding initiatives represent three complementary avenues for advancing the green transition in the Mediterranean. Yet, each faces challenges: carbon markets remain volatile and uneven in their sectoral impact; green bonds and loans are expanding but subject to risks of greenwashing and unequal distribution; and multilateral finance flows, while critical for countries with limited fiscal space, are highly concentrated in a few recipients. What unites these mechanisms is both their potential to reshape investment patterns and their uneven performance across the region's diverse institutional, financial, and economic contexts. Despite their growing prominence, there is little systematic evidence on how these tools have translated into measurable emission reductions at the regional level. This gap highlights the importance of future research pathways, which could offer empirical assessments of green finance tools and their effectiveness in reducing GHG emissions across Mediterranean economies.

## 5. Conclusion and Policy Recommendations

Leaning upon our empirical findings, green taxation significantly matters, on condition that policies are stringent enough to enforce measures that ensure that taxes are effectively implemented. For instance, in countries such as France and Italy, rising EPS values during the period of analysis coincided with a measurable decline in per capita emissions, illustrating how policy stringency amplifies the effect of taxation. By contrast, in Southern and Eastern Mediterranean countries, where tax revenues as a share of GDP remain below 1% and EPS scores are low, the impact of such taxes has been negligible.

Besides, revenues from environmental taxes can be strategically allocated to finance renewable energy projects, energy efficiency programs, sustainable infrastructure, and research and development in green technologies. In addition, such taxes can support subsidies or grants for clean energy adoption, offsetting transition costs for businesses and households. By internalizing environmental costs into market prices, environmental taxation may not only promote resource efficiency, but also encourage innovation and investment in sustainable industries, thereby accelerating the transition to a low-carbon economy.

Sectoral targeting in environmental taxation also matters. Taxes should focus on the Mediterranean's most emissions-intensive sectors—transport fuels, cement, and shipping—rather than being applied in a diffuse, economy-wide manner. Revenues could be earmarked for investments in public transport electrification (relevant for North African cities) or for retrofitting energy-intensive industries (relevant for Southern Europe). Environmental taxes need to be designed in a way to target the most emissions-intensive sectors effectively instead of being broadly applied. When combined with stringent policies that focus on high-impact areas (e.g., heavy industry, transportation), the interaction may drive more substantial emissions reductions.

FiTs are a policy mechanism designed to accelerate the adoption of renewable energy technologies by guaranteeing renewable energy producers a stable, long-term purchase price for the electricity they produce. This financial incentive provides a predictable revenue stream that reduces investment risks and encourages private sector participation in renewable energy projects. However, as observed through the econometric analysis, the implementation of FiTs does not always guarantee the acceleration of a low-carbon transition. Our econometric results indicate that FiTs are most effective when directed at hydro, waste-to-energy, and marine power, while FiTs for biomass correlate with higher emissions. This is consistent with evidence from the literature, where inefficient biomass combustion technologies have increased net emissions. Moreover, France stands out as a country with relatively high FiTs for hydro, waste, and marine energy, illustrating the potential for well-targeted tariffs to drive emission reductions.

FiTs can promote renewable energy production in an economic environment which also prioritizes a reduction in dependence on fossil fuels and reducing GHG emissions. When there are contradictory energy policies in place, FiTs may not end up with the desired outcomes they are meant to lead to. On the one hand, subsidies to renewable energy can be justified as they support infant renewable energy industries in the early stages of their development and spread. On the other hand, continuing to subsidize fossil fuels anchors them to the economic structure, hinders the development of renewable energy, and reduces the fiscal space available to support green technologies and mitigation actions. Besides, the FiT policy needs to be designed to include provisions that prioritize smaller producers or community-based projects, and democratize energy production and distribution. If planned appropriately and coherently, FiTs can contribute to creating green jobs, thereby promoting economic growth that is compatible with environmental sustainability.

Experience so far highlights the necessity for both the public and private sectors to actively engage in fostering and advancing green finance. Central banks and regulatory authorities hold the influence to steer market dynamics towards greener practices and ensure their consistent implementation. Development banks and financial institutions play a crucial role in broadening the scope of green financial activities. State support is indispensable during the early stages of green finance, primarily through incentives and regulations. Public efforts to promote transparency and consistency in green reporting are essential; without them, monitoring green finance becomes challenging, leaving the system more susceptible to misuse. Reporting on the 'use of proceeds' is a critical component of green finance. Achieving this requires transparent disclosures from the private sector, aligned with environmental, social, and economic sustainability standards.

Environmental taxes, FiTs, and other mechanisms discussed in Section 4 play a critical role in supporting the Mediterranean region’s transition to a low-carbon economy. While the EU taxonomy on sustainable finance offers a valuable reference, the region’s diversity, spanning both EU and non-EU countries, calls for alignment with shared sustainability principles and taxonomies adapted to the Mediterranean context, as promoted by the updated Mediterranean Strategy for Sustainable Development (MSSD 2026-2035). Harmonization of standards would also facilitate cross-border renewable energy projects, such as exporting North African solar and wind power to Southern Europe, which remains an underexploited opportunity for the region.

These frameworks should reflect regional priorities in climate mitigation, pollution control, and ecosystem protection. Furthermore, there are social implications of any green finance measure that are discussed in the current study. These social impacts include, but are not limited to, job creation (or unemployment), energy access and affordability, social equity, public health benefits, education and awareness. The necessity of a holistic program in financing the solutions to combat the climate crisis is clearly seen. Therefore, a macro perspective, which is not content with monetary policy and finance alone, but evaluates all the policy tools of the macro economy together, is a prerequisite for the fight against the climate crisis. In this context, it is desirable to support green finance policies and monetary tools with green fiscal policies such as fossil fuel subsidy removal, carbon tax, energy efficiency investments and incentives, tax incentives for green investments, and renewable energy investments and incentives. It is necessary to channel financial flows in a way that supports a just transition. For instance, there will be groups who will be negatively affected by subsidy removal. The finances that will be freed upon the removal of wasteful subsidies can be earmarked in order to support these disadvantaged groups.

Future research could build on these findings by expanding the scope of analysis to include the distributional and equity impacts of green finance measures, particularly in lower-income and fossil-dependent Mediterranean countries. A key area for further investigation is the extent to which environmentally harmful subsidies, such as fossil fuel subsidies, may offset or neutralize the effectiveness of green taxation and renewable energy incentives (Acar, 2024). Exploring such policy incoherencies is critical to understanding net outcomes. Additionally, empirical work could assess the dynamic effects of combining instruments (e.g., carbon pricing with green bonds or public procurement strategies), and evaluate long-term impacts on innovation, employment, and social equity. More granular, sector-specific data would also enable better targeting of green finance tools across the region. Besides, while our fixed effects framework represents a rigorous and widely accepted approach for addressing unobserved heterogeneity and common shocks in panel data, we recognize its limitations in establishing strong causal identification. In particular, fixed effects cannot fully resolve potential endogeneity concerns that might arise from policy endogeneity or reverse causality. As such, our findings should be interpreted as robust associations rather than definitive causal effects. Future research could build on this work by employing complementary strategies—such as system GMM, instrumental variables, or quasi-experimental approaches like difference-in-differences—when suitable exogenous variation becomes available.

To sum up, in Mediterranean countries, green finance tools alone may lack the necessary scope, enforcement, or complementary measures to drive significant GHG reductions. However, when coupled with stringent environmental policies and paired with coherent energy policies that do not favor fossil fuels, these tools are more likely to be applied effectively, target key sectors, and trigger systemic changes, thereby significantly decreasing emissions. Concrete regional lessons suggest: (i) increasing environmental tax revenues and strengthening the stringency of environmental policies (as reflected in higher EPS index values) in Southern and Eastern Mediterranean countries; (ii) prioritizing hydro, waste, and marine FiTs while phasing out biomass support; (iii) accelerating fossil fuel subsidy removal, especially in North Africa; and (iv) fostering cross-Mediterranean cooperation on renewable integration and sustainable finance taxonomies. This interplay underscores the importance of integrating green finance instruments within a comprehensive and coherent environmental policy framework.

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**Declaration of Research and Publication Ethics**

This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

**Researchers' Contribution Rate Statement**

The authors declare that they have contributed equally to the article.

**Declaration of Researchers' Conflict of Interest**

There are no potential conflicts of interest in this study.

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## APPENDIX

**Table A1. Results with Lagged Independent Variables to Control for Reverse Causality**

Model 1a.i: Fixed-effects, using 340 observations
Included 14 cross-sectional units
Time-series length: minimum 7, maximum 27
Dependent variable: LNGHGPC
Driscoll-Kraay standard errors, bandwidth 2

| | Coefficient | Std. Error | z | p-value | |
|---|---|---|---|---|---|
| const | −4.85016 | 1.03627 | −4.680 | <0.0001 | *** |
| LNGDPPC_1 | 0.648141 | 0.0973863 | 6.655 | <0.0001 | *** |
| REO_1 | −0.00312508 | 0.00132005 | −2.367 | 0.0179 | ** |
| ENVTAX_1 | 0.000995021 | 0.0138419 | 0.07188 | 0.9427 | |
| dt_2 | 0.308512 | 0.0498327 | 6.191 | <0.0001 | *** |
| dt_3 | 0.309750 | 0.0514360 | 6.022 | <0.0001 | *** |
| dt_4 | 0.329389 | 0.0445898 | 7.387 | <0.0001 | *** |
| dt_5 | 0.309596 | 0.0447315 | 6.921 | <0.0001 | *** |
| dt_6 | 0.299474 | 0.0438286 | 6.833 | <0.0001 | *** |
| dt_7 | 0.286325 | 0.0439159 | 6.520 | <0.0001 | *** |
| dt_8 | 0.252781 | 0.0409915 | 6.167 | <0.0001 | *** |
| dt_9 | 0.255511 | 0.0391831 | 6.521 | <0.0001 | *** |
| dt_10 | 0.245582 | 0.0405402 | 6.058 | <0.0001 | *** |
| dt_11 | 0.248853 | 0.0364703 | 6.823 | <0.0001 | *** |
| dt_12 | 0.239021 | 0.0323418 | 7.390 | <0.0001 | *** |
| dt_13 | 0.217568 | 0.0324023 | 6.715 | <0.0001 | *** |
| dt_14 | 0.211417 | 0.0267609 | 7.900 | <0.0001 | *** |
| dt_15 | 0.171484 | 0.0275122 | 6.233 | <0.0001 | *** |
| dt_16 | 0.119722 | 0.0245236 | 4.882 | <0.0001 | *** |
| dt_17 | 0.149510 | 0.0238144 | 6.278 | <0.0001 | *** |
| dt_18 | 0.141956 | 0.0184980 | 7.674 | <0.0001 | *** |
| dt_19 | 0.119385 | 0.0221821 | 5.382 | <0.0001 | *** |
| dt_20 | 0.0807659 | 0.0220443 | 3.664 | 0.0002 | *** |
| dt_21 | 0.0797566 | 0.0154613 | 5.158 | <0.0001 | *** |
| dt_22 | 0.0676104 | 0.0134597 | 5.023 | <0.0001 | *** |
| dt_23 | 0.0407659 | 0.0120879 | 3.372 | 0.0007 | *** |
| dt_24 | 0.0614797 | 0.00873743 | 7.036 | <0.0001 | *** |
| dt_25 | 0.00841535 | 0.0101187 | 0.8317 | 0.4056 | |
| dt_26 | −0.0145169 | 0.00341372 | −4.253 | <0.0001 | *** |
| dt_27 | −0.0900089 | 0.00435822 | −20.65 | <0.0001 | *** |

| | | | |
|---|---|---|---|
| Mean dependent var | 1.905796 | S.D. dependent var | 0.388619 |
| Sum squared resid | 2.202401 | S.E. of regression | 0.086113 |
| LSDV R-squared | 0.956982 | Within R-squared | 0.574618 |
| Log-likelihood | 374.2585 | Akaike criterion | −662.5170 |
| Schwarz criterion | −497.8723 | Hannan-Quinn | −596.9131 |
| rho | 0.878862 | Durbin-Watson | 0.269723 |

Robust test for differing group intercepts -
Null hypothesis: The groups have a common intercept
est statistic: Welch F(13, 105.5) = 78.1684
with p-value = P(F(13, 105.5) > 78.1684) = 5.91961e-48

**Table A2. Results with Lagged Independent Variables to Control for Reverse Causality**

Model 1b.ii: Fixed-effects, using 175 observations
Included 8 cross-sectional units
Time-series length: minimum 21, maximum 22
Dependent variable: LNGHGPC
Driscoll-Kraay standard errors, bandwidth 2

| | Coefficient | Std. Error | z | p-value | |
|---|---|---|---|---|---|
| const | −5.61298 | 0.507608 | −11.06 | <0.0001 | *** |
| LNGDPPC_1 | 0.611586 | 0.0582633 | 10.50 | <0.0001 | *** |
| FOSSIL_1 | 0.0153694 | 0.00227852 | 6.745 | <0.0001 | *** |
| ENVTAX_1 | −0.0116666 | 0.00800425 | −1.458 | 0.1450 | |
| EPS | −0.0127776 | 0.0183685 | −0.6956 | 0.4867 | |
| EPSxENVTAX | 0.00736324 | 0.00368507 | 1.998 | 0.0457 | ** |
| dt_2 | 0.185632 | 0.0333864 | 5.560 | <0.0001 | *** |
| dt_3 | 0.173573 | 0.0325016 | 5.340 | <0.0001 | *** |
| dt_4 | 0.184289 | 0.0306581 | 6.011 | <0.0001 | *** |
| dt_5 | 0.174832 | 0.0292114 | 5.985 | <0.0001 | *** |
| dt_6 | 0.165875 | 0.0285438 | 5.811 | <0.0001 | *** |
| dt_7 | 0.166540 | 0.0268465 | 6.203 | <0.0001 | *** |
| dt_8 | 0.140782 | 0.0239959 | 5.867 | <0.0001 | *** |
| dt_9 | 0.156881 | 0.0231603 | 6.774 | <0.0001 | *** |
| dt_10 | 0.148283 | 0.0217435 | 6.820 | <0.0001 | *** |
| dt_11 | 0.154110 | 0.0189991 | 8.111 | <0.0001 | *** |
| dt_12 | 0.134345 | 0.0164992 | 8.142 | <0.0001 | *** |
| dt_13 | 0.108286 | 0.0156208 | 6.932 | <0.0001 | *** |
| dt_14 | 0.102083 | 0.0137630 | 7.417 | <0.0001 | *** |
| dt_15 | 0.0574731 | 0.0130517 | 4.404 | <0.0001 | *** |
| dt_16 | 0.00358196 | 0.0127176 | 0.2817 | 0.7782 | |
| dt_17 | 0.0369049 | 0.0118537 | 3.113 | 0.0018 | *** |
| dt_18 | 0.0345650 | 0.00904975 | 3.819 | 0.0001 | *** |
| dt_19 | 0.0260393 | 0.00795416 | 3.274 | 0.0011 | *** |
| dt_20 | −0.00581244 | 0.00701280 | −0.8288 | 0.4072 | |
| dt_21 | −0.0118427 | 0.00327409 | −3.617 | 0.0003 | *** |
| dt_22 | 0.0273996 | 0.00173608 | 15.78 | <0.0001 | *** |

| | | | |
|---|---|---|---|
| Mean dependent var | 2.100198 | S.D. dependent var | 0.228692 |
| Sum squared resid | 0.272226 | S.E. of regression | 0.043940 |
| LSDV R-squared | 0.970086 | Within R-squared | 0.849982 |
| Log-likelihood | 317.4526 | Akaike criterion | −566.9053 |
| Schwarz criterion | −459.3025 | Hannan-Quinn | −523.2585 |
| rho | 0.516854 | Durbin-Watson | 0.911586 |

Robust test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: Welch F(7, 71.1) = 192.715
with p-value = P(F(7, 71.1) > 192.715) = 1.38018e-43

**Table A3. Results with Lagged Independent Variables to Control for Reverse Causality**

Model 2a.i: Fixed-effects, using 340 observations
Included 14 cross-sectional units
Time-series length: minimum 7, maximum 27
Dependent variable: LNGHGPC
Driscoll-Kraay standard errors, bandwidth 2

| | Coefficient | Std. Error | z | p-value | |
|---|---|---|---|---|---|
| const | −4.96675 | 1.06796 | −4.651 | <0.0001 | *** |
| LNGDPPC_1 | 0.655059 | 0.0996257 | 6.575 | <0.0001 | *** |
| REO_1 | −0.00289276 | 0.00140209 | −2.063 | 0.0391 | ** |
| CLIMTAX_1 | 0.00898503 | 0.0121977 | 0.7366 | 0.4614 | |
| dt_2 | 0.340095 | 0.0517530 | 6.572 | <0.0001 | *** |
| dt_3 | 0.336426 | 0.0536665 | 6.269 | <0.0001 | *** |
| dt_4 | 0.354648 | 0.0461467 | 7.685 | <0.0001 | *** |
| dt_5 | 0.334964 | 0.0466739 | 7.177 | <0.0001 | *** |
| dt_6 | 0.324429 | 0.0452864 | 7.164 | <0.0001 | *** |
| dt_7 | 0.311989 | 0.0453846 | 6.874 | <0.0001 | *** |
| dt_8 | 0.280419 | 0.0430449 | 6.515 | <0.0001 | *** |
| dt_9 | 0.282260 | 0.0411084 | 6.866 | <0.0001 | *** |
| dt_10 | 0.271945 | 0.0424603 | 6.405 | <0.0001 | *** |
| dt_11 | 0.274160 | 0.0380182 | 7.211 | <0.0001 | *** |
| dt_12 | 0.264302 | 0.0338740 | 7.802 | <0.0001 | *** |
| dt_13 | 0.243354 | 0.0340628 | 7.144 | <0.0001 | *** |
| dt_14 | 0.237355 | 0.0284398 | 8.346 | <0.0001 | *** |
| dt_15 | 0.197036 | 0.0293492 | 6.714 | <0.0001 | *** |
| dt_16 | 0.145663 | 0.0263946 | 5.519 | <0.0001 | *** |
| dt_17 | 0.173862 | 0.0255069 | 6.816 | <0.0001 | *** |
| dt_18 | 0.163767 | 0.0201271 | 8.137 | <0.0001 | *** |
| dt_19 | 0.142489 | 0.0237905 | 5.989 | <0.0001 | *** |
| dt_20 | 0.103497 | 0.0236779 | 4.371 | <0.0001 | *** |
| dt_21 | 0.100245 | 0.0163711 | 6.123 | <0.0001 | *** |
| dt_22 | 0.0876516 | 0.0140966 | 6.218 | <0.0001 | *** |
| dt_23 | 0.0603985 | 0.0135044 | 4.472 | <0.0001 | *** |
| dt_24 | 0.0802961 | 0.00985703 | 8.146 | <0.0001 | *** |
| dt_25 | 0.0279384 | 0.0112848 | 2.476 | 0.0133 | ** |
| dt_26 | 0.00450957 | 0.00424428 | 1.063 | 0.2880 | |
| dt_27 | −0.0706289 | 0.00408288 | −17.30 | <0.0001 | *** |

| | | | |
|---|---|---|---|
| Mean dependent var | 1.908262 | S.D. dependent var | 0.386402 |
| Sum squared resid | 2.138419 | S.E. of regression | 0.084853 |
| LSDV R-squared | 0.957751 | Within R-squared | 0.584511 |
| Log-likelihood | 379.2703 | Akaike criterion | −672.5406 |
| Schwarz criterion | −507.8960 | Hannan-Quinn | −606.9367 |
| rho | 0.875734 | Durbin-Watson | 0.274043 |

Joint test on named regressors -
Test statistic: F(3, 26) = 74.3967
with p-value = P(F(3, 26) > 74.3967) = 6.90656e-13
Robust test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: Welch F(13, 106.0) = 78.1179
with p-value = P(F(13, 106.0) > 78.1179) = 4.30059e-48

**Table A4. Results with Lagged Independent Variables to Control for Reverse Causality**

Model 2b.ii: Fixed-effects, using 176 observations
Included 8 cross-sectional units
Time-series length = 22
Dependent variable: LNGHGPC
Driscoll-Kraay standard errors, bandwidth 2

| | Coefficient | Std. Error | z | p-value | |
|---|---|---|---|---|---|
| const | −5.66794 | 0.558416 | −10.15 | <0.0001 | *** |
| LNGDPPC_1 | 0.617714 | 0.0629746 | 9.809 | <0.0001 | *** |
| FOSSIL_1 | 0.0150990 | 0.00225822 | 6.686 | <0.0001 | *** |
| CLIMTAX_1 | −0.0109749 | 0.00911326 | −1.204 | 0.2285 | |
| EPS | −0.0238152 | 0.0119267 | −1.997 | 0.0458 | ** |
| EPSxCLIMTAX | 0.0125143 | 0.00247545 | 5.055 | <0.0001 | *** |
| dt_2 | 0.196854 | 0.0305365 | 6.447 | <0.0001 | *** |
| dt_3 | 0.181696 | 0.0299400 | 6.069 | <0.0001 | *** |
| dt_4 | 0.191491 | 0.0280176 | 6.835 | <0.0001 | *** |
| dt_5 | 0.182390 | 0.0265565 | 6.868 | <0.0001 | *** |
| dt_6 | 0.172934 | 0.0257355 | 6.720 | <0.0001 | *** |
| dt_7 | 0.175079 | 0.0249926 | 7.005 | <0.0001 | *** |
| dt_8 | 0.148849 | 0.0222588 | 6.687 | <0.0001 | *** |
| dt_9 | 0.164925 | 0.0213978 | 7.708 | <0.0001 | *** |
| dt_10 | 0.156461 | 0.0203336 | 7.695 | <0.0001 | *** |
| dt_11 | 0.164021 | 0.0181497 | 9.037 | <0.0001 | *** |
| dt_12 | 0.145041 | 0.0164344 | 8.825 | <0.0001 | *** |
| dt_13 | 0.119217 | 0.0161645 | 7.375 | <0.0001 | *** |
| dt_14 | 0.110780 | 0.0143901 | 7.698 | <0.0001 | *** |
| dt_15 | 0.0677945 | 0.0132385 | 5.121 | <0.0001 | *** |
| dt_16 | 0.0127151 | 0.0129515 | 0.9817 | 0.3262 | |
| dt_17 | 0.0433177 | 0.0124104 | 3.490 | 0.0005 | *** |
| dt_18 | 0.0404892 | 0.00898774 | 4.505 | <0.0001 | *** |
| dt_19 | 0.0311951 | 0.00817294 | 3.817 | 0.0001 | *** |
| dt_20 | −0.00236661 | 0.00739222 | −0.3201 | 0.7489 | |
| dt_21 | −0.00972173 | 0.00353763 | −2.748 | 0.0060 | *** |
| dt_22 | 0.0278587 | 0.00158301 | 17.60 | <0.0001 | *** |

| | | | |
|---|---|---|---|
| Mean dependent var | 2.099509 | S.D. dependent var | 0.228221 |
| Sum squared resid | 0.259400 | S.E. of regression | 0.042741 |
| LSDV R-squared | 0.971541 | Within R-squared | 0.857064 |
| Log-likelihood | 324.0152 | Akaike criterion | −580.0305 |
| Schwarz criterion | −472.2340 | Hannan-Quinn | −536.3088 |
| rho | 0.489893 | Durbin-Watson | 0.964457 |

Joint test on named regressors -
Test statistic: F(5, 21) = 194.601
with p-value = P(F(5, 21) > 194.601) = 7.57204e-17
Robust test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: Welch F(7, 71.5) = 154.961
with p-value = P(F(7, 71.5) > 154.961) = 1.36125e-40