Acta Universitatis Danubius
ŒCONOMICA

Implications of Public Finances Sustainability on the Consumption of Renewable Energy in EU Countries

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Abstract: The study analyses the implication of governments in providing financial support for the growth of the renewable energy sector, reveals some aspects of novelty, by analysing the relationship between the specific framework of sustainable public finances, the spectrum of fiscal measures capable of influencing renewable energy consumption and explore the fiscal-budgetary incentives to support the transition to renewable energy consumption. The paper generates awareness for policymakers and retrospective analysis the status of public grants and development funding as well as provides insights to improve financial support for renewable energy without increasing the number of public funds.

Keywords: renewable energy; public finances; sustenability; economic growth

JEL Classification: Z23

1. Introduction

Over the last decades, the problems related to human-induced global warming and climate change have increased and accelerated the importance of producing energy from renewable resources. The sources of renewable energy are as following: wind power, solar power (thermal, photovoltaic and concentrated), hydro power, tidal power, geothermal energy, ambient heat captured by heat pumps, biofuels and the renewable part of waste.

It is well known that over time, among the main barriers specific to the dissemination of renewable energy systems, we identify the design of financing systems and their specific limitations. The process of identifying funding initiatives and focusing specifically on the shortcomings of funding systems requires celerity and reveals the

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existing problems in the sustainability of public finances. When we talk about fiscal stimulus it is prior necessary to keep in mind the idea of responsibility and efficiency in spending. That's why the entire fiscal governance framework related to renewable energies mechanisms implies a common type of approach and sustained forms of implication from both politics and environmental conditions.

In this paper, we analyse the implication of governments in providing financial support for the growth of the renewable energy sector, reveals some aspects of novelty, by analysing the relationship between the specific framework of sustainable public finances, the spectrum of fiscal measures capable of influencing renewable energy consumption and explore the fiscal-budgetary incentives to support the transition to renewable energy consumption.

2. Literature and Legal Framework Background

In nowadays, renewable energy is a key part of the strategy to combat climate change (Toke, 2006). Europe has as main scope to become the world's first climate-neutral continent by 2050 and this main objective is established under the European Green Deal (European Commission, 2019), which represents the very ambitious package of measures that should enable European citizens and businesses to benefit from sustainable green transition.

According to the European Green Deal (European Commission, 2019), concrete aspects are specified regarding the involvement of the public financial dimension through elements of public budget management and public management of public authorities:

(i) *Firstly, it is specified that national budgets play a key role in the transition from conventional energy to renewable energy systems*. In this context, the document (the European Green Deal) specifies that a greater use of green budgeting tools will help to redirect public investment, consumption and taxation to green priorities and away from harmful subsidies, developing medium-term fiscal plans that take environmental considerations and risks into account, and, of course, learning from best practices. A review will be performed periodically on the European economic governance framework that will include references about green public investment in the context of the quality of public finance, which will determine the improvement of the EU fiscal governance based on possible future steps including how to treat green investments within EU fiscal rules, while preserving safeguards against risks to debt sustainability.

(ii)*According to the European Green Deal, well-designed tax reforms can boost economic growth and resilience to climate shocks and help contribute to a fairer society and to a just transition.* Tax reforms send the right price signals and provide

the right incentives for sustainable behaviour by producers, users and consumers based on the removing of subsidies for fossil fuels, the shifting of the tax burden from labour to pollution, and taking into account social considerations. One of the most important tax is value added tax (VAT) whose application can reflect increased environmental ambitions (e.g. to support organic fruit and vegetables).

(iii) *The European authorities are focused on developing State aid guidelines on the environment and energy* that will reflect the policy objectives of the European Green Deal, supporting a cost-effective transition to climate neutrality by 2050, and will facilitate the phasing out of fossil fuels, in particular those that are most polluting, ensuring a level-playing field in the internal market.

The use of renewable energy has many potential benefits, including: (i) a reduction in greenhouse gas emissions; (ii) the diversification of energy supplies and a reduced dependency on fossil fuel markets (in particular, oil and gas); (iii) may also stimulate employment in the EU, through the creation of jobs in new 'green' technologies (European Commission, 2022). Thus, strategies are being implemented in each state of Europe that involve the development of renewable energy systems. In this regard, national governments are developing public policies to address the fight against climate change. One of these public policies developed in our research used by the authorities is the fiscal-budgetary policy which is responsible for the sustainability of public finances in general. The most used mechanisms to support fiscal policy are feed-in-tariffs (a policy used as a support mechanism to accelerate investment in renewable energy technologies), tax incentives (including subsidies and tax deductions), and tradable green certificates. Generally, different kinds of economic instruments are used to finance renewable energy techonologies by governments, such as capital grants, grants to infrastructure, utility procurement, etc. (Abolhosseini & Heshmati, 2014).

The positive development of the energy systems from renewable sources in the European Union countries has been prompted by the legally binding targets for increasing the share of energy from renewable sources enacted by Directive 2009/28/EC on the promotion of the use of energy from renewable sources. In this context, the EU reached a 22.1 % share of its gross final energy consumption from renewable sources in 2020, around 2 percentage points above its target (European Commission, 2022).

However, World Bank (2022b) highlights that renewable energy technology projects implementation faces numerous barriers and risks, helping explain the low rate of take-up of these technologies in low-income countries (Table 1).

Table 1. Financing Instruments - Financing Barriers and Project Risks

Financing instruments	FINANCING BARRIERS						PROJECT RISKS			
	Lack of long-term financing	Lack of project financing	High and uncertain project	Lack of equity finance	Small scale of projects	High financial cost	High exposure to regulatory risk	Uncertainty over carbon financing	High costs of resource	Uncertainty over resource
Grants										
Capital grants	*	*		*		*				
Project preparation			*		*	*			*	*
Equity										
Venture capital		*	*	*						
Debt										
Senior debt	*	*				*				
Subordinated debt (mezzanine finance)	*	*	*	*						
Asset-backed securities										
Asset-backed securities	*	*		*						
Guarantees and insurance										
Individual guarantees	*	*		*		*	*		*	*
Liquidity guarantees	*	*								
Political risk insurance / Partial risk guarantee	*	*		*		*	*			
Resource insurance									*	*
Results-based financing										
Payment against outputs		*				*	*			
Contingent project development grants			*				*		*	
Carbon financing										
Carbon financing				*		*		*		

Small-scale project financing										
Microfinancing				*	*	*				
Portfolio guarantees and loss reserves	*	*		*	*	*	*			*
Aggregation					*	*				
Financial intermediaries										
CFIs	*				*					
Funds	*				*					

World Bank (2022b)

However, we can also identify countries (carefully analyzing the Renewable energy consumption index in Figure 1) with a high public financial capacity that are still in the beginning of implementation of renewable energy technology, such as United Kingdom, Germany, Belgium, and Switzerland.

3. Overview on the Status of Renewable Energy

The evolution of renewable energy systems is an accentuated one, in the implementation of these intervening multiple factors, such as geographical, political, social, financial factors. Thus, the category of geographical factors, such as the case of Iceland, the island very far from the mainland, determined the identification of methods of energy production based on its own resources, the orientation being towards geothermal energy and hydropower.

The states that are under the impact of political factors are characterized by a strong vulnerability regarding the maturity of political ideologies determining an immaturity of financial systems. Of course, these are also the states on which social and financial factors make their mark.

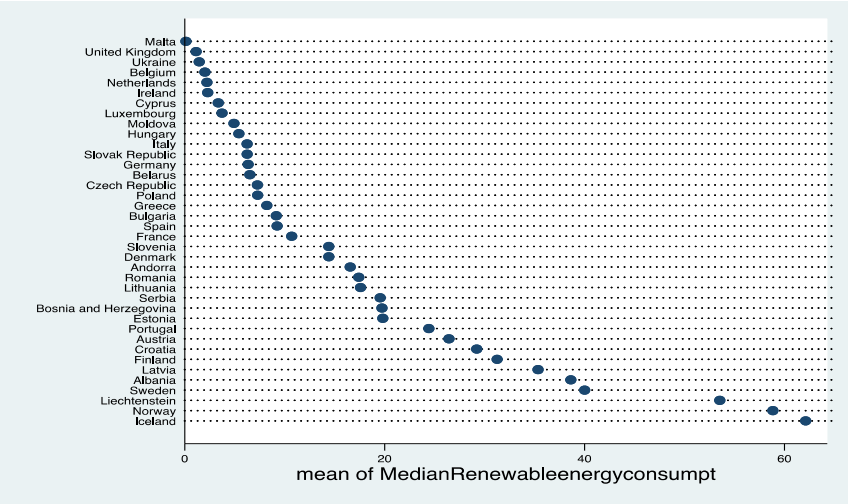


Figure 1. Median Renewable Energy Consumption (% of Total Final Energy Consumption)

Source: computed by authors using Stata 15.1 based on own calculation World Bank database (2022a)

Figure 1 highlights the status of each state in terms of capacity to produce and use renewable energy in the period 1990-2018. Iceland has the highest share of renewable energy in any national total energy budget, where nowadays about 80%-85% of the total primary energy supply in Iceland is derived from domestically produced renewable energy sources (Goverment of Iceland, 2022, World Bank, 2022a). In 2016, in Iceland, 65% of primary energy was provided by geothermal energy, 20% by hydropower systems, and 15% by the fossil fuels (mainly oil products for the transport sector) (Goverment of Iceland, 2022). Norway and Liechtenstein are the countries responsible for the use of renewable energy over 50%. At the beginning of the analysis period, Norway recorded the highest percentage of renewable energy (respectively 59.17% in 1990), but the evolution was slightly fluctuating and the highest percentage was recorded in 2017 with 61.11%. Sweden registers at the beginning of the period a percentage of 34.06% and registers at the end of the period in the analysis 52.48%.

At the other end of the scale, the states that use conventional energy (respectively over 90%) are Malta, United Kingdom, Ukraine, Belgium, Netherlands, Ireland, Cyprus, Luxembourg, Moldova, Hungary, Italy, Slovakia, and Germany. Positive developments in the use of renewable energy are recorded in each state of Europe, but progress is different from one state to another, as the diagram (Figure 1) suggests.

According to European Commission (2022), wind and water provide most renewable electricity and solar is the fastest-growing energy source. In 2020, renewable energy sources made up 37.5 % of gross electricity consumption in the EU, up from 34.1 %

in 2019, where wind and hydro power accounted for more than two-thirds of the total electricity (36 and 33 %, respectively).

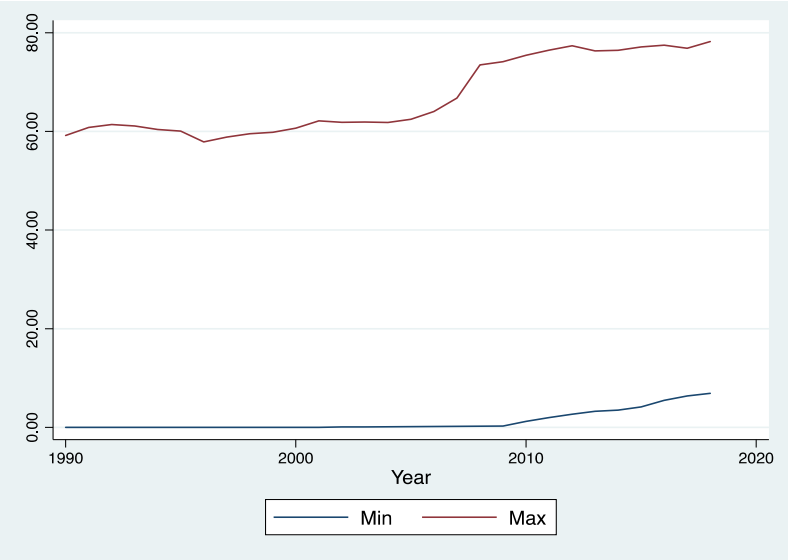


Figure 2. Minimum (Maximum) of Renewable Energy Consumption (% of Total Final Energy Consumption) Over the Period 1990-2020

Source: computed by authors using Stata 15.1 based on own calculation World Bank database (2022a)

Own calculations presented in Figure 2 reflects the minimum (maximum) of Renewable energy consumption (% of total final energy consumption). Minimum (maximum) measure a relative size of horizontal disparities/gap between European countries regarding the capacity of European states to use renewable energy. In accordance with Figure 2, we can see that this gap is deepening, reflecting a different position of the states in terms of speed and degree of implementation of renewable energy systems.

Until 2001, there are countries (e.g. Malta) without systems of renewable energy and all energy was produced by classical systems, respectively conventional energy systems. Some countries have made significant progress in implementing various renewable energy systems, such as Cyprus, and others have developed these systems so that they have become energy independent, such as Iceland. The major gap between states is justified by multiple factors, but what is certain is that in recent years the governments of many low-income countries have embarked on the path to low-carbon development, such as Romania and Bulgaria. Romania started from 3.36% and until 2019 has reached the level of almost 23.05%, and Bulgaria started from 1.92% and until 2019 has reached the level of almost 20%. It is recognized by

authors that the use of public funding for renewable energy technologies projects also creates inevitable market distortions (World Bank, 2022b).

As authors observe (Abolhosseini and Heshmati, 2014) there is a gap between the actual share and optimal level of renewable energy consumptions in the world because many countries over the world are still investing in traditional/conventional energy sources compared to renewable energy sources.

Range *(R)* is a measure characterizing the empirical area of variation of the examined feature (Cowell, 2011; Kowalic, 2015), based on following formula:

$R=y_{max}-y_{min}$

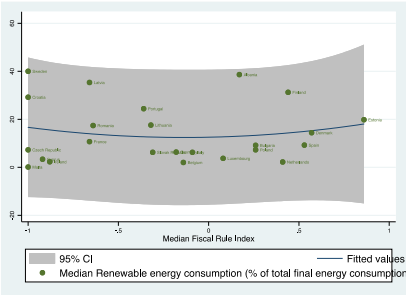
Figure 3. Range of Renewable Energy Consumption (% of Total Final Energy Consumption) Over the Period of Time

Source: computed by authors using Stata 15.1 based on own calculation using World Bank database (2022a)

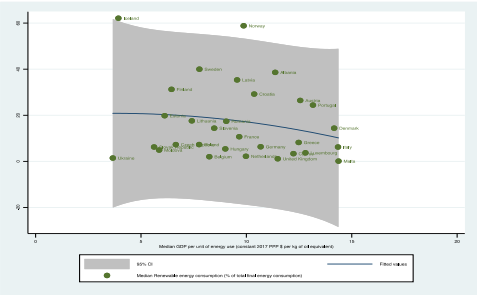
Figure 3 shows that the estimated search range is unstable among the European Countries, respectively that the gap between the implementation of renewable energy systems and use is accentuated, being justified by the fact that some states demonstrate a public policy orientation towards the use of financial resources to support the implementation of renewable energy systems and its use, while other states invest very little in renewable energy. Thus, among the states with low renewable energy consumption are Ukraine, Netherland, and Malta (under 10% of total final energy consumption) and among the states with renewable energy systems and with a representative consumption are Sweden, Liechtenstein, Norway, and

Iceland (over 50% of total final energy consumption).

a. Median Renewable energy consumption (% of total final energy consumption) and Median Fiscal Rule Index over the period of time 1995-2020



b. Median Renewable energy consumption (% of total final energy consumption) and Median GDP per unit of energy use (constant 2017 PPP $ per kg of oil equivalent) over the period of time 1995-2020



c. Median Renewable energy consumption (% of total final energy consumption) and Median Fiscal Pressure

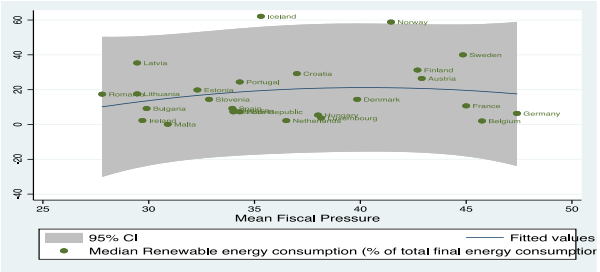


Figure 4. Figure Plots the Prediction from a Quadratic Regression

Source: computed by the authors based on World Bank database (2022a) using Stata 15.1.

Figure 4 plots the prediction from a quadratic regression, and it adds a confidence interval for Europe countries. According to the figure above (Figure 4), we can identify the fact that there is an inverse relationship between Renewable energy consumption (% of total final energy consumption) and GDP per unit of energy use (constant 2017 PPP $ per kg of oil equivalent) variables over the period 1995-2020, respectively that states that are geared towards investing in renewable energy will invest substantially less in conventional energy. Thus, Iceland and Norway are recognized as economically stable and strongly oriented towards public spending on renewable energy. The correlation between the level of Renewable energy consumption (% of total final energy consumption) and fiscal pressure is a positive one, many of the states bearing the expenses for renewable energy from the public budgets. States such as Iceland and Norway use both public resources to finance renewable energy and private resources. Thus, in the two states, the intervention of the private sector for the financing of renewable energy is also evident. In the case of Germany, we notice a high degree of taxation, so an increased fiscal pressure, but

renewable energy is not a priority for the public sector, as evidenced by its low level of use.

4. Conclusions

A first important issue that the analysis conducted within this study is for the Europe countries over the period of time 1990-2020 and descriptive analysis was used as a methodology. The analysis was conditioned by a number of limitations because the official databases do not include indicators or the possibility to calculate certain indicators that would help us for a more detailed analysis, such as the level of public spending on renewable energy, the level of tax deductions for implementing renewable energy, which would greatly support the theme addressed in this paper.

However, our analysis highlights the orientation of the European states towards the use of renewable energy over conventional energy as a result of the internal governmental strategies of states as a result of their compliance with the international strategies to which they have adhered. Our analysis also shows that there are significant differences between states in terms of the level of use of renewable energy due to multiple factors, but still significant is the involvement of central and local authorities in substantiating spending in this area or supporting the private sector in implementing renewable energy systems, either by subsidizing it, by making deductions from the payment of taxes and fees, or by creating a favorable infrastructure from an administrative point of view. Through this, we can deduce the importance of public authorities for the development of fiscal and budgetary policies that have a positive impact on the development of renewable energy systems.

This paper is intended to be just the beginning of advanced studies on the correlation between renewable energy and sustainable public finances.

Acknowledgments*:* *This work was supported by a grant of the "Alexandru Ioan Cuza" University of Iasi, within the Research Grants program, Grant UAIC, code GI-UAIC-2021-08".*

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