EU Energy Plans between Energy Justice and Ethical Dilemmas. Expectations and Future Education

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Abstract

Globally, the EU energy system has gradually emerged as an educational science research agenda which is required for the unpredictable environment of energy consumption. Our research extends beyond ethical dimensions of the affordable and renewable energy systems but through balanced energy making decisions. The authors deftly explain the energy justice and energy consumption nexus by using an econometric model. The results emphasize the value of the investments in renewable energy generation systems and extended research in energy education.

Key words: energy system, climate change, sustainability, energy justice, affordable energy.
J.E.L. classification: A2, K10, E01

1. Introduction

The realm of energy transition to a decarbonized and digital energy system implies multiple risks of injustice (Calver & Simcock, 2021). The extensive academic literature attest that by offering some policy recommendations or by identifying the inherent risks of domestic consumers of the energy system may be bordered in a changing climate.

Becoming an interdisciplinary energy research subject till nowadays, energy justice appears to solve some of the current energy transition by settling some inherent disputes between different parties, stakeholders and the common consumer (Heffron, 2022). In the current research paper, we will focus on how energy justice is an indissoluble part of the energy transition taking into consideration the accelerated climate change and the future sustainable world. Energy justice seeks to accumulate the ethical mixture of some energy systems, such as climate change (Bickerstaff et al. 2013), energy economics (Sovacool et al. 2013) and the EU energy policy (McCauley et al. 2013). Energy justice, also energy equity, states the goal of obtaining equilibrium in the energy system by identifying two concepts as environmental justice and climate justice.

The increased number of academics who developed a personal implication of the energy concept seeks to find the core of the following issues: i) the root of injustice concerning the energy system, ii) which are the limits of the injustice, iii) the ignored part of the energy dilemmas, iv) the theoretical plan of reducing the current injustices, and vi) implementing an energy justice concept into the policy field.

Summarizing all the above, it is observable that after some decades of time, even it is entitled the concept of energy justice and there were already implemented some plans concerning the energy dilemmas, the society still is waiting for a sustainable plan which will be able for some results which decrease considerable and gradually the emergent energy choices. In the same vein, each energy decision should be defined and taking into consideration each national regulatory system and mostly for the EU countries.

Going further, each national energy system has created its own defense against the emergent and direct attack of the reality challenges. In this sense, we review the most significant issues which constitutes, at the same time, actual energy dilemmas for several EU countries, as the following: i) the increasingly need for larger-scale storage capacity, ii) the building of the radioactive waste, iii) the cost of decreasing the renewable energy, iv) the gradual transition to the low-carbon production. Concluding all the above, the connection of the energy justice and ethical dilemmas led to the emergence of the rich of specialized literature characterized by an increased number of UE plans developing their own energy system.

In this context, our research captures and reflects the energy values of the investments in renewable energy generation systems which can't be created without the existence of the ethical and strategic goals at the same time.

2. Literature review

On a general level, we can assess the economic viability of a country by sustainable development. Unemployment and inflation rates are benchmarks on the macroeconomic map of a country, in what concerns sustainable development. The main economic indicator is inflation in a macro context of the economy of one state. Nowadays, there are different types of inflation when comparing to the past, but the root causes and the repercussions are the same (Girdzijauskas et al., 2022).

Modern inflation affects all countries across the globe in different forms. In the past two decades, more developed economies have experienced decreased inflation rates, after periods of time when the inflation rate was on an ascending trend of inflation.

This has been highlighted also by the literature and inflation varies depending on each country's particularities and that includes the inflation measures as well used (Ha et al., 2021)

What contributes to the welfare of a country is the unemployment rate. There is a direct link between the environment and unemployment, but this aspect has been scarcely described by the literature. Climate change plays a very important role and policymakers together with the authorities have this climate change issue under their close attention (Jiang et al., 2022).

Pre-pandemic, employment was progressively increasing but not for all countries and industries. As per the World Employment and Social Outlook, employment is very diversified depending on the sectors and countries, the labor market being very volatile. When crises strike, such as the pandemic, it is very abrupt the employment scenery, since it changes from total employment to temporary employment, and people find it difficult to adapt.

According to a study carried out by the OECD, the share of foreign assets on total assets for the sample of companies that is the basis of the study carried out in the period 1995-2008, together with the evolution of energy prices on the domestic market of these companies, resulted. Thus, it could be seen that both FDI and energy prices have both increased since the early 2000s, suggesting that some of the increase in FDI may have been associated with offshoring in the face of higher energy prices.

Since countries with lax environmental policies are predicted to gain a competitive advantage in heavily polluting industries (Pethig, 1976; Siebert, 1977; Yohe, 1979), stricter environmental policies should provide incentives for firms to relocate. parts of their production processes to countries with looser regulations (Siebert, 1977; McGuire, 1982; Merrifield, 1988). Assuming that capital is sufficiently mobile between countries and transportation costs are not too high, this relocation effect is a particular concern for polluting industries when implementing new environmental regulations. The study's conclusion shows that relative energy prices (that is, the difference between domestic energy prices and foreign energy prices) matter as a driver of FDI, but the magnitude of the effect is small. The effect is found only for firms experiencing an increase in the price of energy at home, while a reduction in domestic energy prices is not correlated with a lower amount of international assets.

According to the study carried out by Majewski et al, it shows that there is a negative relationship between the production of renewable energy, the amount emitted in agriculture and the values of CO2 per capita. If determined, a 1% increase in renewable energy production leads to a 0.18% decrease in CO2 emissions. Our results remain robust when including additional control variables. The results of our study suggest that policy instruments such as subsidies or low-interest loans can be used to promote renewable energy consumption in middle-income countries.

3. Research methodology

The research focuses on analyzing the main drivers of economic and electrical and indicators. Our panel dataset contains data for the period 2010-2021, for all the EU-27 countries. The following data sources were used:

Eurostat database, for the following indicators: *GDP per capita and Inflation rate*

Our World in Data for: *Electricity generation, Annual change in primary energy consumption, Annual change in renewable energy generation, CO2 emissions per capita, Renewables electricity*

According to the data sources mentioned above, the indicators used for the purpose of this paper are*:*

- *Foreign direct investment (FDI)*.
- *GDP per capita*.
- *Renewable energy* is energy derived from natural sources that are replenished at a higher rate than they are consumed. Sunlight and wind, for example, are such sources that are constantly being replenished (United Nations, Climate action, 2022).
- *Electricity price for household* - the price of energy in the EU for household depends on a range of different supply and demand conditions, including the geopolitical situation, the national energy mix, import diversification, network costs, environmental protection costs, severe weather conditions, or levels of excise and taxation (Eurostat, 2022).
- *Electricity generation* is defined as electricity generated from fossil fuels, nuclear power plants, hydro power plants (excluding pumped storage), geothermal systems, solar panels, biofuels, wind, etc. It includes electricity produced in electricity-only plants and in combined heat and power plants. Both main activity producer and auto producer plants are included, where data are available. Main activity producers generate electricity for sale to third parties as their primary activity (OECD, 2019).
- *Annual change in renewable energy generation* represent the change in renewable energy generation relative to the previous year, measured in terawatt-hours. This is the sum of energy from hydropower, solar, wind, geothermal, wave and tidal, and bioenergy (Our World in Data, 2021).
- *CO2 emissions per capita* are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring (World Bank).
- *Inflation rate* is an increase in the general price level of goods and services. When there is inflation in an economy, the value of money decreases because a given amount will buy fewer goods and services than before (Eurostat, 2018).

To analyze the level of correlation between the previously defined indicators, we have constructed the following research hypotheses:

Hypotheses

H1. Do companies redirect their FDI to countries that have lower energy distribution prices and weaker environmental policies?

H2. Do investments in renewable energy generation systems lead to a decrease in carbon dioxide emissions and an increase in GDP per capita?

H3. Does the low energy price lead to an increase in the consumption of renewable energy and a decrease in carbon dioxide emissions per capita?

H4. If the price of energy and the inflation rate are low, does the consumption of primary energy and GDP per capita increase?

We have used panel regression models and the software used for all the analysis is R (R Core Team, 2021). In table no. 1 the dependent and independent variables used in the econometric models were listed.

Table no. 1 Dependent and independent variables

Dependent variables	Independent variables
1. FDI current prices 2. GDP per capita current prices 3. Renewables electricity 4. Electricity price for household	Electricity generation Annual change in primary energy consumption Annual change in renewable energy generation CO2 emissions per capita Inflation rate

Source: Authors' contribution

As can be seen in Table no. 2. Correlation matrix, there is a very strong relationship between the price of household electricity and carbon emissions per capita (0.907404), between the price of household electricity and GDP per capita (0.858427), carbon dioxide emissions and GDP per capita (0.882262), household electricity price and renewable energy (0.795693), household electricity price and inflation rate (0.669616). And there is a moderate relationship between GDP per capita and electricity production (0.515299), carbon dioxide emissions and electricity production (0.512901), inflation rate and GDP per capita and a weak and very weak relationship between foreign direct investment and electricity generation (0.365329), GDP per capita (0.338199), annual change in primary energy consumption (0.032745), annual change in renewable energy generation (0.18854), inflation rate (0.217196).

Table no. 2 The matrix of correlations

Variables	**Electricity generation**	**GDP per capita current prices**	**Annual change in primary energy**	**Annual change in renewable energy generation**	**CO2 emissions per capita**	**Renewables electricity**	**Inflation rate**	**Electricity price for household**	**FDI current prices**
Electricity generation	1								
GDP per capita current prices	0.515299	1							

Annual change in primary energy consumption	0.076192	0.057601	1						
Annual change in renewable energy generation	0.503338	0.278178	0.015772	1					
CO2 emissions per capita	0.512901	0.882262	0.088868	0.266238	1				
Renewables electricity	0.446644	0.73133	0.078856	0.257717	0.689685	1			
Inflation rate	0.378232	0.543226	0.031669	0.015772	0.088868	0.078856	1		
Electricity price for household	0.577637	0.858427	0.102287	0.297521	0.907404	0.795693	0.669616	1	
FDI current prices	0.365329	0.338199	0.032745	0.18854	0.340069	0.180779	0.217196	0.35355	1

Source: Authors' calculation performed in R

The correlation analysis revealed significant relationships between most of the factors (table no. 2). Consequently, they were successively introduced in the models.

Model 1:

FDI. Current. prices ~ Electricity. Generation + Annual. Change. In. primary. Energy. consumption + Annual. Change. In. renewable. Energy. generation + Renewables. electricity + Electricity. Price. For. household (1)

Model 2:

Renewables. electricity ~ GDP. Per. Capita. Current. prices + Electricity. generation + Electricity. Price. For. household + CO2 emissions per capita (2)

Model 3:

Electricity price for household ~ Renewables. electricity + CO2. Emissions. Per. capita + Inflation. rate (3)

Model 4:

Electricity price for household ~ Annual change in primary energy consumption + CO2 emissions per capita + GDP. Per. Capita + Inflation rate + Renewables. electricity (4)

4. Results and discussion

The econometric model used for testing the hypotheses is a panel regression (table no.3). In all four models the country has been considered as a factor.

Table no 3. The interpretation of models

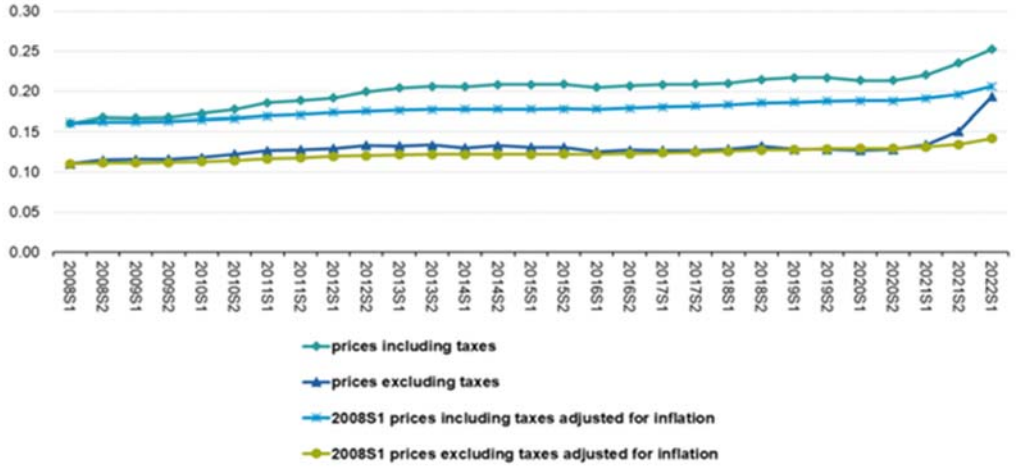
Models	**Model 1**		**Model 2**		**Model 3**		**Model 4**	
Independent Variables	**Estimate**	**Pr(>|t|)**	**Estimate**	**Pr(>|t|)**	**Estimate**	**Pr(>|t|)**	**Estimate**	**Pr(>|t|)**
Electricity generation	8.893e-09	0.135	2.235e-05	0.0101 *				
GDP per capita current prices	-6.084e-09	0.377	3.940e-06	0.6942				
Annual change in primary energy consumption	4.674e-06	0.075.	4.603e-03	0.2276	2.755e+02	< 2e-16 ***	4.393e-06	8.72e-06 ***
Annual change in renewable energy generation	-9.611e-01	2.76e-07 ***	-1.357e+03	5.93e-07 ***				
CO2 emissions per capita					-7.348e+01	0.411310		
Renewables electricity					6.575e+01	0.379775		
Inflation rate					6.133e+01	0.679531		
Electricity price for household							4.450e-02	0.0129 *

Notes: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Authors' calculation performed in R

The First Hypothesis is not confirmed by the first model that shows us that the volume of foreign direct investment is strongly correlated with the generation of electricity and with the annual change in primary energy consumption, while the negative coefficient of GDP per capita and the annual change in generation of renewable energy shows that the increase in foreign direct investment does not directly cause an increase in GDP per capita and the annual change in renewable energy generation.

Figure no. 1. Development of electricity prices for household consumers, EU, 2008-2022 (EUR per kWh)

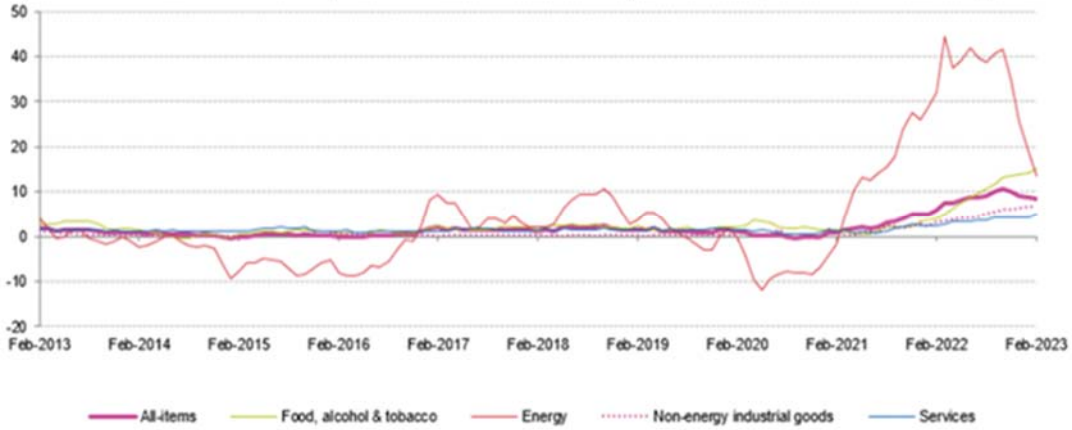


Source: (Eurostat, 2022)

As can be seen in Figure 1. Development of electricity prices for household consumers, EU, 2008-2022, prices have experienced a gradual increase in recent years, but at the European level according to Eurostat data, the highest distribution prices (including all taxes) for consumers are in the following: Denmark, Belgium, Germany, Italy, Spain, Czech Republic, Romania, while the lowest rates are in Bulgaria, Hungary, Netherlands, Albania, Serbia, Bosnia and Herzegovina. This shows us that the fact that some countries have lower energy distribution prices does not determine a greater attraction of foreign direct investments.

The model 3 confirm that the price of electricity for households is closely related to the increase in the consumption of renewable energy by the population of European countries, which does not lead to the confirmation of hypothesis number 3 that the reduced price of energy leads to an increase in the consumption of renewable energy and a decrease in carbon dioxide emissions per capita.

Figure no 2. Euro area annual inflation was 8.5 % in February 2023, down from 8.6 % in January 2023



Source: (Eurostat, 2023)

Model 4 shows us that the price of electricity for the household is closely related to the annual change in primary energy consumption and confirms the first part of hypothesis 4 in which if the price of energy and the inflation rate are low, primary energy consumption increases but not also confirms the increase in GDP per capita.

5. Conclusions

Over the years at the EU level, several countries have faced several energy dilemmas such as the need for greater storage capacity, the construction of spaces for radioactive waste and all this leading to a decrease in the cost of renewable energy as well as the transition to low-carbon production.

In order to be able to discuss a sustainable development from an energy point of view, we considered in our analysis, the main landmarks on the macroeconomic map of each EU member country, namely: inflation rate, GDP per capita, foreign direct investments correlated with those more relevant energy indicators, electricity price for household, renewable energy, annual change in renewable energy generation, CO2 emissions per capita, and research has shown us that there is a direct and very strong link between these and they influence each other.

Concluding all of the above, the connection between energy justice and ethical dilemmas has led to the emergence of a rich literature and in-depth research characterized by an increased number of EU plans to develop its own energy system.

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