

Dinu, Vasile; Baci, Leonina Emilia; Mortan, Maria; Veres, Vincentiu Andrei

Article

Effect of Economic, Institutional and Cultural Factors on the Implementation of EU Energy Policies

Amfiteatru Economic Journal

Provided in Cooperation with:

The Bucharest University of Economic Studies

Suggested Citation: Dinu, Vasile; Baci, Leonina Emilia; Mortan, Maria; Veres, Vincentiu Andrei (2023) : Effect of Economic, Institutional and Cultural Factors on the Implementation of EU Energy Policies, Amfiteatru Economic Journal, ISSN 2247-9104, The Bucharest University of Economic Studies, Bucharest, Vol. 25, Iss. 63, pp. 306-325, <https://doi.org/10.24818/EA/2023/63/306>

This Version is available at:

<https://hdl.handle.net/10419/281705>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/4.0/>

**EFFECT OF ECONOMIC, INSTITUTIONAL AND CULTURAL FACTORS
ON THE IMPLEMENTATION OF EU ENERGY POLICIES****Vasile Dinu¹**, **Leonina Emilia Baciu^{2*}**, **Maria Mortan³**
and **Vincentiu Andrei Vereş⁴**¹⁾*Bucharest University of Economic Studies, Bucharest, Romania*²⁾³⁾⁴⁾*Babeş-Bolyai University, Cluj-Napoca, Romania***Please cite this article as:**

Dinu, V., Baciu, L.E., Mortan, M. and Vereş, V.A., 2023. Effect of Economic, Institutional and Cultural Factors on the Implementation of EU Energy Policies. *Amfiteatru Economic*, 25(63), pp. 306-325.

DOI: [10.24818/EA/2023/63/306](https://doi.org/10.24818/EA/2023/63/306)

Article History:

Received: 20 December 2022

Revised: 9 February 2023

Accepted: 2 April 2023

Abstract

This study assesses the effect of economic, institutional, and cultural factors on green energy production. The present research considers only sources for which the European Union co-finances investment in production capacity; thus, we exclude hydroelectric power. The economic determinants are internal consumption and national income, the institutional ones are the Worldwide Governance Indicators, and the cultural ones are the national cultural indicators of Hofstede.

Data comprise the European Union countries for the 2007-2015 period, the longest time period in which the structure of the Union has remained mostly unchanged. We employ random effects panel data models and hierarchical clustering. Our main results emphasise the significant impact of internal energy consumption per capita, government effectiveness, rule of law, control of corruption, power distance, and uncertainty avoidance. The multidimensional hierarchical clustering points out three behavioural groups based on these variables. Two of them are quite homogeneous with respect to the geographical distribution of the countries on the European continent.

Keywords: Renewable energy, economic factors, institutional factors, Hofstede cultural values, hierarchical clustering

JEL classification: C23, Q42

* Corresponding author, **Leonina Emilia Baciu** – e-mail: leonina.baciu@econ.ubbcluj.ro



This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. © 2023 The Author(s).

Introduction

Interest in pollution and its climatic effects has increased steadily in the last century. But the evolution was not linear, the intensity of interest fluctuating over time. These have recently intensified, both globally and mostly in Europe, which wants to be the leader in greenhouse gas emissions (GHG) reduction policies and strategies. This increased interest is due to the increasingly visible effects of climate change, manifested by increasingly frequent natural disasters (Zhou et al., 2018). In these circumstances, the EU has set itself the goal of becoming a leader in climate policy and pollution reduction measures. The goals are ambitious and consist of reaching very low thresholds for carbon emissions and greenhouse gases that lead to global warming. These steps have not been taken since the beginning of the EU. Initially, the energy security strategies of the member countries were developed, regardless of the source of production. There have been changes along the way that have led to sustainability and ecology.

The first steps toward a global environmental policy were made through the 1992 Earth Summit held in Rio de Janeiro and through the international act called the Kyoto Protocol of 1997. Thus, the foundations for the measures that must be implemented in all countries of the world were laid. Later, these international concerns have intensified. The most cohesive document, with concrete measures that each state should take, was achieved through the Paris Agreement of 2015 (Savaresi, 2016). The main objective set was to “keep the increase in global average temperature well below 2°C above pre-industrial levels and continue efforts to limit the increase in temperature to 1.5°C above pre-industrial levels” (United Nations, 2015, p.2017). GHG (greenhouse gas) emissions come from various sources, but transport and household consumption prevail, the latter largely due to heating systems (Lamb et al., 2021). These include large amounts of electricity consumption. It is the main reason why the issue of decarbonisation is related to that of renewable energy.

The EU has mobilised to respond to this problem. Both the European Parliament and the European Council have established their own objectives aimed at energy efficiency, renewable energy sources, and the reduction of GHG emissions (Gökgöz and Güvercin, 2018). There are precise policies that arise from these goals, but the realistic probabilities of them being fully implemented are different. The difficulties in implementing them are largely due to the heterogeneity of energy production sources at the EU member level. This is because, although there is a common energy policy, it overlaps with the interests of member countries. In most states, ensuring national energy security takes precedence over procuring energy from sustainable sources.

Beyond the willingness of the member states to implement the common energy policies of the EU, other factors also come into play. First, the availability of renewable energy sources is different from country to country, both quantitatively and structurally. In Western and Northern European countries, there is a great potential for production from wind sources, for example Denmark (Mey and Diesendorf, 2018) or from the energy of the seas and oceans, for example in the Netherlands (Chowdhury et al., 2021). On the contrary, southern European countries benefit from very long sunny periods, facilitating solar energy production (Colasante et al., 2022). Another clean source of energy, with different potentials among European nations, is hydroelectric. However, its development is no longer supported in the EU, due to the destruction of natural habitats caused by the construction of hydroelectric plants (Kuriqi et al., 2021). Second, although in general the production variable costs associated with renewable sources are low, the initial fixed costs of developing production

capacities are high (Pali and Vadhera, 2016). This means that the creation of production capacities can be a decisive issue and is more easily addressed by developed countries. Third, we can talk about different institutional capacities from one country to another. The European Union offers financial support for the development of energy production capacities, but these funds must be absorbed through concrete projects. Decisive factors such as corruption control or good governance can come into force here. Fourth, it is important that the population also contributes to the greening of energy. For example, a handy solution is to install solar panels in your own home. Human behaviour can also contribute here, citizens being more or less interested in such investments. Therefore, it is possible that some national cultural variables influence the intensity with which a country develops its green energy production.

One part of the literature in this field is trying to highlight the determinants of countries' transitions toward the green economy, but the focus is mainly on economic factors. Our research complements these trends by introducing some institutional and cultural indicators at the national level into the models.

The purpose of the present research is to highlight the influence of economic, institutional, and cultural factors on the development of green energy production capacities.

The main issues highlighted in the article refer to: *Review of the field's literature* where an investigation is carried out with respect to the concerns of specialists about energy policies in the European Union, the specificities of some member countries, along with empirical studies that try to explain the issue of switching to renewable energy; The *Data and Methodology* section describes the database, consisting of EU countries in the 2007-2015 period, as well as details of the panel regression equations and the hierarchical clustering analysis found in the study; *Results and Discussions* that emphasise some main trends derived from the statistical analyses, but also compares our results with those of more or less similar studies; finally, *Conclusions* are presented that summarise the research carried out and make some policy recommendations which could have as a theoretical and practical basis for this study.

1. Literature review

Analysis of the field's literature shows that concern for renewable energy is primarily based on the following topics: EU energy policy as a whole, EU decarbonisation, challenges of energy transition, and factors that influence renewable energy production.

European Union Energy Policy

Even since the end of World War II, energy has become a major concern of European countries, being one major aspect even in the creation of the European Community.

Based on the energy issue, we identify three stages of EU development (Kilinc-Ata, 2016). The first stage concerned energy security, both globally and in each member. The second stage focused on economic and competitive market mechanisms, limiting monopolies in production, transport, and supply. The third stage focusses on energy in the context of sustainability and environmental protection. This staged history is easy to understand if we consider that, initially, the union of European states started with the Coal and Steel Community, the most important initial aspect in the European construction being given by the regulation of the markets of the two industrial products. A little later, in the late 1950s, a community for the regulation of atomic energy was also created (Cenevska, 2016). These

were the first approaches with respect to energy, in which certain policies and regulations were not conferred only on national authorities, but on supranational, community ones. In the stage that focused on market mechanisms, the competitiveness of the European common market was pursued through liberalisation, which, in most cases, involved the breaking of national monopolies (Pepermans, 2019). However, energy security was also not neglected, since Europe was continuously dependent on energy imports, especially from the East, which constituted an economic and strategic vulnerability (Chalvatzis and Ioannidis, 2017; Carfora et al., 2022). In order to achieve the proposed objectives, the EU needed a legal framework for the common policies. But this appeared only in 2005, following a decision of the European Council (Thaler, 2016). As a result of the political decision and under the title *Energy for a Changing World*, the sets of common policies were defined by the European Council two years later, in 2007. The next step was the establishment of the three objectives of the common energy policy included in the Lisbon Treaty (da Graça Carvalho, 2012). The first of them aims at competitiveness, including regulations of the national and European markets. The second objective is related to energy security: diversification of production sources, regulation of coal, oil, gas, and nuclear reserves, oil processing, and excess energy storage possibilities. The third objective is related to sustainability, referring to production from sustainable and non-polluting sources, consumption efficiency, and pollution rights transfer mechanisms between member countries.

European Union's Decarbonisation Objective

Currently, the EU's efforts are focused on the third objective, which summed up in one word means *decarbonisation*. Three main directions are targeted (EC, 2006): reducing GHG, increasing the share of renewable sources of energy, and increasing the efficiency of electricity use. Later, the transport sector received increasing attention. To operationalise efforts, gas emission quotas were established for each EU member (Zheng et al., 2019). Despite some reservations from both governments and the population, the direction initiated was followed consistently through the 2030 Climate and Energy Framework (European Commission, 2020), with new precise milestones. The first aims to reduce the GHG to 60% of the values of the last decade of the 20th century. The second benchmark requires increasing the share of green energy production to more than a quarter of total production. The third milestone requires an increase in energy efficiency of industrial processes by 27% by 2030 (Hafner and Raimondi, 2020, European Commission 2020).

As a response to EU policies, member states have initiated their own measures in accordance with European directives since 2008. However, these are very different from one country to another, both due to specific social and economic factors and due to more or less firm political will. The degree of implementation of the three essential objectives also differs. Reducing greenhouse gas emissions is close to achieving the goal. The increase in renewable energy production capacities has been achieved as an objective, on average, throughout the EU, but with very large variations from one country to another. The decrease in carbon emissions was greater than 23% in 2018 compared to 1990. However, the trend is not encouraging to reach the 2030 targets, as the global reduction in the EU is almost 50 million tons, while more than 80 million would be needed for this achievement. Furthermore, the result is partially false, because the reduction was achieved mainly due to industrial relocation to other countries, more than the increase in energy efficiency (Koch and Mama, 2019). Besides the environmental protection issues, transformations also correspond to the objective of energy security, with most fossil fuels being imported from outside the EU, from Russia, Asia and

Africa. Therefore, beyond being just an environmental issue, the development of green energy production capacities also benefits the economy and energy security (Gökgöz and Güvercin, 2018).

Challenges of Energy Transition

In the energy sector, responsibility is shared between European and national bodies. To show the significant differences, we exemplify the situation of four countries with different success rates in terms of energy transition.

Italy had a very high dependence on fossil fuels 20 years ago, accounting for about 88% of the energy consumed (Hafner and Raimondi, 2020). This share has decreased by 14% over the last 18 years. During that period, green energy production increased by 13% (Hafner and Raimondi, 2020). At the same time, it managed to increase its energy efficiency, significantly decreasing both total and relative consumption per inhabitant (Ali and Kirikkaleli, 2022). Among fossil fuels, oil-based production remained dominant. However, in contrast to that, there is an unfavourable situation with respect to transport oil consumption, which is continuously increasing.

Important changes have been made to the energy mix in *Great Britain*. Recently, the share of sources with low greenhouse gas emissions has reached half of the total, mainly given by natural gas. Wind power production has dramatically increased, from 3% to 15% in just 10 years. Hydropower production remains modest, at only 2%, but the decrease in the share of coal production from 29% to 7% is remarkable (International Energy Agency, 2019). These transformations were immediately reflected in the emissions, with CO₂ falling by more than 30% compared to 1990. The reduction in coal usage is especially commendable, as this country has a very closely linked economic and labour history to this raw material, ever since the advent of the industrial age (Mirzania et al., 2019). Decarbonisation was also helped by the EU policy on green certificates; the price of coal-based emissions increased spectacularly on the pollution rights market (Darmani et al., 2016).

A negative example is that of *Germany*, where there is a very large gap between goals and actual achievements. Setting 1990 as the reference year, this country aimed to reduce greenhouse gas emissions by 40% by 2020, by 55% by 2030 and by up to 95% in 2050. At the same time, domestic production of green energy should have increased to 18% in 2020 and to 60% in 2050 (Hafner and Raimondi, 2020). For reasons of internal policy, not imposed by the community institutions, the share of production from nuclear sources was reduced by 17% (Hansen et al., 2019). Renewable energy sources in Germany are based on wind power in the north of the country and mainly on solar systems in the south. Despite all these changes, total carbon emissions have increased almost every year for the past two decades. The main factor behind this situation is the increase in coal-fired power generation, which has replaced nuclear power. Globally speaking, Germany's production mix is unsuccessful, generating high costs per kwh to the end consumer. This causes great concerns in society due to the possibility of losing industrial competitiveness (Sato et al., 2019).

In *Poland*, in 2019 almost 80% of the energy production was based on coal, the share of renewable sources oscillating in recent years around 13%-14% (Hafner and Raimondi, 2020). The lack of progress is mainly due to the opposition of the population. A significant part of the workforce is employed in the coal industry and the activities that depend on it (Sokołowski et al., 2022). Government authorities aim to phase out coal-fired power by 2040, but to still keep it prevalent. Future policies (Horizon 2040) envisage an increase in

renewable sources production to more than a quarter of the total. These will be primarily based on solar energy and, in the long term, on wind sources located off the coast (Igliński et al., 2022). As in Germany, significant population resistance to these changes is expected.

Renewable energy production determinants

The EU has ambitious plans for decarbonisation and, in this endeavour, a major objective is the production of renewable energy. Although there is a common European policy, most decisions are taken by national authorities, so the transition to green energy is far from uniform. Gaps between EU states are due to very different factors. This diversity can be explained by both political will and objective local circumstances. Some econometric studies have tried to highlight, through regression models, the main determinants of the transition to green energy. Economic variables were generally taken into account: fuel prices, consumption, energy imports, carbon emissions, etc. (see, for example, Kilinc-Ata, 2016 for the US and Europe). Other studies are more focused on specific markets. An early survey was carried out by Carley (2009) for the US states. Using panel data for the 1998-2006 period, the influence of an intervention policy instrument operating in the American states is analysed: RPS (Renewable Portfolio Standard). Econometric estimates show the lack of feasibility of the administrative tools used, as the implementation or lack of these policies does not influence the energy production mix. Some control variables were identified as relevant: the type of regulatory institutions, regional average income, energy consumption, and its price. Also, for the US, Delmas and Montes-Sancho (2011) show that the implementation of two federal policies (Renewable Portfolio Standard, RPS and Mandatory Green Power Option, MGPO) is favoured not by the public implementation capacities, but by the local industry and private citizens. The EU has developed its own instruments to encourage the development of renewable energy production, including FIT (Feed-in Tariffs). Their different efficiency on the territories of the EU countries was tested econometrically by Jenner et al. (2013) based on panel data from 1992-2008. The results show different effects on green energy production, under the influence of the moderating role of some economic factors, although researchers have insisted on the economic determinants of renewable energy production. Some approaches test the influence of several institutional variables (Filimonova et al., 2021), but they emphasise consumption, not production. Other approaches are more descriptive, explaining causality mechanisms, or exemplifying particular situations in some countries. Institutional variables are also analysed in relation to the innovative capacity to generate new technical solutions for clean energy (Li and Shao, 2021).

Summarising the findings in the literature review, we can conclude that the EU's energy policy has three pillars: security, competitive market, and decarbonisation. The legislative framework was created, as well as the implementation strategies with the related funding support. However, the member states apply the policy for the development of renewable energy production very differently. As we have seen in the four Community states that we exemplified, political and economic heterogeneity is high. Added to this is the more or less firm will of the population for change. Therefore, the situation is complex and should be approached accordingly. We found the lack of an empirical study in the literature that highlights the role of economic, institutional, and cultural determinants in the development of renewable energy production capacities. As a result, our study attempts to fill this gap by using historical data for countries in the European Union. Following the literature review and our own reasoning regarding possible causal relationships, we formulate a set of research hypotheses.

H1: *Renewable energy production is influenced by national economic factors.*

As already mentioned, the development of clean energy production capacities involves high initial costs. Even though these costs are partly borne by EU funding mechanisms, they must be co-financed by national governments and the population. Therefore, it is reasonable to assume that national income is likely to be a positive determinant. Another possible factor is energy consumption, which puts pressure on demand.

H2: *Renewable energy production is influenced by institutional and good governance factors.* Institutional factors are important for good fund management and are generally involved when there are structural changes. Negative phenomena, such as corruption, slow down transformation processes, including, for example, the process of attracting European funding.

H3: *Renewable energy production is influenced by cultural factors.*

Transformations brought about by the greening of energy production also imply a share of population support. This is mostly related to understanding and accepting the phenomenon. Short-term-orientated citizens who have an egocentric approach are less inclined to accept the economic and social changes brought about by this transition.

2. Research methodology

Panel data econometrics and hierarchical clustering are used to achieve the objectives of this study. Regressions are estimated as random-effects panel models having the following structure:

$$RENERG_{it} = \alpha_0 + \alpha_1 ECON_{it} + \alpha_2 INSTIT_{it} + \alpha_3 CULTURAL_{it} + u_{it} \quad (1)$$

Where: $i = \overline{1, N}$ stands for the UE-27 countries, and $t = \overline{1, T}$ for each year in the 2007-2015 studied period.

ECON is the economic variables vector (HIDRO, CONSENERG, GDPCAP), *INSTIT* is the institutional, good governance variables vector (VOICEACC, POLSTAB, GOVEFF, REGQUAL, RULELAW, CTRLCORR), while *CULTURAL* is the Hofstede's national cultural variables vector (POWERDIST, INDIVID, MASCULIN, UNCERTAV, LONGTOR, INDULG). Table no. 1 presents the full description of the variables.

Statistical analysis is complemented by hierarchical clustering, using Ward's linkage as a clustering method and Euclidean distance to measure proximities between countries and between groups. These specifications have proven to be the most robust for our case study, given the number of countries and the nature of the variables used (see Ferreira and Hitchcock, 2009, for a simulation comparison between different variants of hierarchical classification).

Table no. 1. Variables used and their descriptive statistics

Variable	Explanations	Mean	Std. dev. ^s	Min	Max
RENERG	Share of renewable energy production, excluding hydroelectric sources. This includes solar sources, wind energy, geothermal sources, ocean tides, biomass and biofuels.	10.8	9.70	0	65.4
HIDRO	Share of energy production from hydroelectric sources.	12.8	16.5	0	66.6
CONSENERG	Average energy consumption per inhabitant, in Mwh.	6.57	3.33	2.39	17.2
GDPCAP	Gross domestic product per capita, in thousands of USD.	34.3	22.4	5.88	124
VOICEACC	Voice and Accountability. The way in which the inhabitants of a state get involved in the election of public authorities, and aspects of free expression and freedom of the press.	84.4	11.1	57.7	100
POLSTAB	Political Stability and Absence of Violence. Measure citizens' perceptions of internal political stability and the violence generated by political processes.	73.3	15.8	30.3	100
GOVEFF	Government Effectiveness. It evaluates the opinion of the citizens regarding the quality of the services of the government bodies and the dissociation between the group's political objectives and those of the members of the society.	81.9	13.1	43.5	100
REGQUAL	Regulatory Quality. Perceptions of citizens and businessmen about the capacities and will of public authorities to support the private economic environment.	85.2	9.34	63.9	100
RULELAW	Rule of Law. It estimates the opinions and perceptions of citizens about the observance of rules and legislation in society, with an emphasis on private economic contracts, property rights, the functioning of the police and courts.	82.8	13.4	50.7	100
CTRLCOOR	Control of Corruption. Estimates the perceptions related to the way in which government authorities act for their own interest, including corruption at national, regional or local levels.	79.2	15.5	44.5	100
INSTIT	Global institutional quality variable. Calculated as the arithmetic mean of the variables VOICEACC, POLSTAB, GOVEFF, REGQUAL, RULELAW, CTRLCORR (own calculations).	69.8	10.1	46.9	84.8
POWERDIST	Power Distance. The indicator evaluates the relations between public power and citizens and the reaction of the latter toward authorities.	51.0	20.1	11	100

Variable	Explanations	Mean	Std. dev. [§]	Min	Max
INDIVID	Individualism-Collectivism. Individualism places the goals and interests of the individual in the foreground, and collectivism emphasises the goals of the community or the nation.	58.7	17.4	27	89
MASCULIN	Maculinity-Femininity. Masculinity prioritises success, heroism, material reward, and competitive society, while femininity indicates concerns rather related to social aspects, cooperation, and consensus.	46.6	24.2	5	100
UUNCERTAV	Uncertainty Avoidance. The indicator is a measure of tolerance towards unpredictable situations.	71.3	22.2	23	100
LONGTOR	Long-Term Orientation versus Short-Term Normative Orientation. People with high values of this indicator are primarily orientated towards pragmatism, savings, and good quality education, while low values indicate an orientation towards traditions and resistance to change.	57.0	16.5	24	83
INDULG	Indulgence versus Restraint. High indulgence implies the satisfaction of basic human desires and those related to fun at low cost. High restraint indicates a high degree of restraint regarding the fulfilment of one's own needs and their restriction through social regulations.	44.1	19.2	13	78

[§]Std. dev. = standard deviation

Source: authors' computations based on the sample data.

The data come entirely from highly reliable international sources, the World Bank (2022) and the Hofstede Institute (2022). To ensure the stability of the sample, the period 2007-2015 was chosen when the European Union was stable from the point of view of the states that make it (EU-27). Evaluation of the degree of penetration of green energy was done through the RENERG variable, which shows the proportion of green energy (solar sources, wind energy, geothermal sources, ocean tides, biomass, and biofuels). Hydroelectric energy is not included here, because it is not subject to EU policies, so it does not benefit from financial support for infrastructure development. The determinants considered comprise three groups of factors: economic, institutional, and cultural.

3. Results and discussions

Econometric tests (Hausmann) indicated random effects for all regression specifications, to the detriment of the fixed effects models (p-value above the threshold of 0.05). In models 1 to 7 (Table no. 2), we introduced only the economic factors as determinants. Among them, electricity consumption per inhabitant (CONSENERG) is the most significant, and the sign and significance are preserved, regardless of whether it appears in the model as a single determinant or together with other factors. The result correlates with economic logic. High energy consumption causes a corresponding demand that must be satisfied, preferably at a low cost. Green alternative energies are cheap from the perspective of the raw materials used,

but the initial investments are high. However, the financial support of the European Union targets precisely these production capacities.

Table no. 2. Effects of economic factors on renewable energy; random effects panel models; dependent variables RENERG

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
HIDRO	0.031 (0.40)	0.034 (0.44)	0.046 (0.59)	0.044 (0.57)	0.030 (0.39)	0.037 (0.47)	0.046 (0.58)
CONSENERG	***0.578 (3.49)	***0.505 (4.75)			***0.633 (3.90)	***0.431 (3.02)	
GDPCAP	*-0.049 (-1.43)		***0.046 (2.82)		-0.025 (-1.04)		0.002 (0.07)
INSTIT	0.877 (1.58)			***0.131 (3.67)		0.036 (0.77)	**0.128 (2.31)
CONSTANTA	2.172 (0.58)	***7.061 (3.49)	***8.651 (4.31)	1.083 (0.34)	***7.123 (3.48)	4.974 (1.41)	1.205 (0.32)

Note: ***, **, *: significant at 1%, 5% and 10%.

Source: authors' calculations in STATA.

GDP per capita does not have a stable and obvious influence; its significance only appears when it is alone in the regression. This is not very convincing, and the effect may be due to the lack of other explanatory variables. The phenomenon is known in the literature as OVB (omitted-variable bias). The different specifications of models 1-7 were tested because there are collinearity problems between the economic variables used in the study (Table no. 3).

Table no. 3. Correlation coefficients between economic factors and the dependent variable

	(1)	(2)	(3)	(4)	(5)
RENERG (1)	1.00				
HIDRO (2)	-0.04	1.00			
CONSENERG (3)	0.18	-0.01	1.00		
GDPCAP (4)	0.10	-0.01	0.74	1.00	
INSTIT (5)	0.14	-0.01	0.68	0.74	1.00

Source: authors' calculations in STATA.

The presence of more or less hydroelectric power in a country is not statistically significant. It was perhaps expected that high water power production would act as a drag on other green sources, as production can fluctuate for all of them. These production fluctuations depend on the whims of nature and do not coincide with current consumption values, which can lead to imbalances in the national energy system. At the European level, this phenomenon is calmed by the intra-community energy trade. Consequently, we partially accept hypothesis H1, with energy consumption being statistically significant but GDP per capita and hydroelectric production not.

The global influence of institutional factors (INSTIT variable) is ambiguous, statistical representativeness is not maintained in all econometric specifications. It is possible that this fact also manifests itself due to the multitude of phenomena included in a single aggregate

variable. To elucidate the influence of institutional determinants, we analyse them separately in regressions (models 8-14 in Table no. 4).

**Table no. 4. Effects of institutional factors on renewable energy;
random effects panel estimations; dependent variable RENERG**

	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
HIDRO	0.008 (0.11)	0.027 (0.35)	0.028 (0.36)	0.051 (0.69)	0.016 (0.20)	0.036 (0.48)	0.035 (0.48)
CONSENERG	***0.479 (3.22)	***0.638 (3.87)	***0.636 (3.93)	***0.614 (3.89)	***0.615 (3.75)	***0.627 (3.89)	***0.643 (3.95)
GDPCAP	-0.021 (-0.99)	-0.026 (-1.05)	-0.025 (-1.06)	-0.024 (-1.05)	-0.025 (-1.04)	-0.027 (-1.14)	-0.025 (-1.95)
VOICEACC	*-0.359 (-1.88)	0.022 (0.19)					
POLSTAB	-0.203 (-3.26)		*-0.112 (-1.81)				
GOVEFF	***0.486 (3.73)			***0.361 (4.15)			
REGQUAL	*-0.558 (-1.65)				-0.117 (-1.06)		
RULELAW	**0.313 (1.98)					***0.262 (2.82)	
CTRLCORR	**0.264 (1.97)						**0.180 (2.15)
CONSTANTA	14.35 (1.33)	5.339 (0.55)	***15.35 (3.06)	***-22.6 (-3.04)	*17.38 (1.76)	*-14.54 (-1.83)	-7.25 (-1.04)

Note: ***, **, * : significant at 1%, 5% and 10%.

Source: authors' calculations in STATA.

GOVEFF, RULELOW and CTRLCORR have positive coefficients and are significant. This result was predictable, because the process of accessing financeable investments from European sources involves phenomena of correct and quick assessment of projects and appeals, efficient resolution of possible legal disputes, decision-making transparency, and lack of corruption, in order not to block funding by European bodies. Similar results of the influence of institutional factors have been highlighted in the literature, but on consumption, not production (Chen et al., 2021). In model 8, the results are severely affected by the high collinearity between the institutional variables (Table no. 5). Consequently, to be more certain of a more correctly estimated effect of each factor, we refer to models 9-14.

Table no. 5. Correlation coefficients between institutional factors

	(6)	(7)	(8)	(9)	(10)	(11)
VOICEACC (6)	1.00					
POLSTAB (7)	0.59	1.00				
GOVEFF (8)	0.92	0.58	1.00			
REGQUAL (9)	0.88	0.57	0.86	1.00		
RULELAW (10)	0.94	0.56	0.96	0.88	1.00	
CTRLCORR (11)	0.96	0.53	0.94	0.87	0.96	1.00

Source: authors' calculations in STATA.

These results allow us to partially accept the H2 hypothesis – there are some institutional variables that significantly influence renewable energy production.

Although national cultural variables are not as closely correlated with each other (as can be seen in Table no. 6) as is the case with institutional factors, they can still pose collinearity problems. For this reason, they were successively included in regressions (Models 15-20, Table no. 7).

Table no. 6. Correlation coefficients between national cultural factors

	(12)	(13)	(14)	(15)	(16)	(17)
POWERDIST (12)	1.00					
INDIVID (13)	-0.54	1.00				
MASCULIN (14)	0.21	0.08	1.00			
UNCERTAV (15)	0.58	-0.59	0.18	1.00		
LONGTOR (16)	0.12	0.21	0.07	-0.01	1.00	
INDULG (17)	-0.49	0.35	-0.07	-0.37	-0.41	1.00

Source: authors' calculations in STATA.

Table no. 7. Effects of national cultural factors on renewable energy; random effects panel estimations; dependent variable RENERG

	Model 15	Model 16	Model 17	Model 18	Model 19	Model 20
HIDRO	0.001 (0.01)	0.043 (0.54)	0.016 (0.20)	0.011 (0.15)	0.025 (0.33)	0.031 (0.40)
CONSENERG	***0.574 (3.46)	***0.574 (3.49)	***0.580 (3.50)	***0.583 (3.51)	***0.581 (3.51)	***0.579 (3.50)
GDPCAP	-0.047 (-1.68)	*-0.048 (-1.73)	*-0.049 (-1.43)	*-0.050 (-1.75)	*-0.049 (-1.75)	*-0.049 (-1.73)
INSTIT	0.085 (1.53)	0.088 (1.58)	0.087 (1.57)	0.088 (1.58)	0.088 (1.59)	0.088 (1.58)
POWERDIST	***-0.201 (-2.71)					
INDIVID		0.108 (1.11)				
MASCULIN			-0.077 (-1.11)			
UNCERTAV				**0.159 (-2.34)		
LONGTOR					*-0.173 (-1.78)	
INDULG						0.119 (1.40)
CONSTANTA	**12.96 (2.42)	-4.308 (-0.62)	5.991 (1.18)	**13.77 (2.24)	*12.05 (1.81)	-3.07 (-0.58)

Note: ***, **, *: significant at 1%, 5% and 10%.

Source: authors' calculations in STATA.

Only POWERDIST and UNCERTAV are significant at the 5% threshold. In societies where POWERDIST takes lower values, citizens strive to equalise the distribution of power and demand justification for power inequalities. This phenomenon has also recently been manifested in the energy market. This is very necessary for all people. Fluctuations in energy prices make many people vulnerable. They want cheap energy, including increasing national production from other sources. And if investments in small-capacity production (for example through solar panels), are largely financed by European money, they can even become participants in energy production. Looking at the other statistically significant cultural factor, in societies where UNCERTAV is high, there is increased rigidity to new things or situations. For example, an individual producer of energy generated by solar panels placed in his home will face new situations, even of a legal nature. These can be manifested, for example, through bilateral contracts for the supply and reception of produced and consumed energy. It is undoubtedly a newly created situation that is not easily accepted in more conservative societies. Conversely, in countries where UNCERTAV is low, the attitude is more relaxed, and the future and the changing environment are accepted much more easily. The role of good governance and cultural factors in the attraction and management of European structural and investment funds was highlighted by Blanco-Alcántara et al. (2022), but does not specifically refer to renewable energy investments. Consequently we partially accept hypothesis H3, there are some significant cultural factors on the success of the energy transition.

Regression analysis manages to identify the main determinants of the development of renewable energy production. However, in this general context, there are notable exceptions, behavioural outliers. We observed, for example, that the level of per capita energy consumption is a strong incentive, the CONSENERG variable being highly significant in all econometric specifications. However, it is interesting to identify some atypical behaviours and possibly their causes. For example, we compared the relative positions of the EU countries in relation to the RENERG and CONSENERG variables, the geographical distribution of the 27 countries being shown in Figure no. 1.

Countries that occupy the top positions in terms of the percentage of renewable energy, although they have a rather modest energy consumption per inhabitant, are coloured dark green. For example, Denmark produces (mostly from wind sources) as a multi-year average 41% green energy (excluding hydro sources), ranking first in the EU, although the energy consumption per capita is 6183 Kwh, below the EU average (6566 Kwh multiannual average). Other countries that are in similar situations are Portugal, Spain, Italy (with many sunny days per year, so high solar energy production capacity), Ireland (with high wind and ocean tidal production capacities), but also Lithuania and Latvia, which have diversified sources of green energy, but have proven a very good absorption capacity of European financing for non-conventional energy production. At the opposite pole (marked on the map with the lightest shade of green) are countries that produce little green energy, even if they are under high pressure from high consumption. The causes here are very diverse. For example, France has a very high energy production low-cost nuclear power, and so little motivation to develop other generation facilities. Here, the percentage of green energy reaches only 3.58% as a multi-year average. Another example is Malta, with a percentage of green energy of only 1.58%, despite very good natural conditions for capturing solar energy. In the other countries in this group, the Czech Republic, Luxembourg, or Slovenia, there seems to be insufficient motivation to develop clean energy production capacities. This may be of interest to the population, the authorities, or both. In the other groups, there is an

intermediate situation, in which green energy production is positively correlated with domestic consumption. Figure no. 1 points out that there is no geographical grouping of these behaviours. Practically, heterogeneity is very high in each group, both in terms of geographical position on the continent, national income, the abundance of internal energy resources, etc. As a result, the phenomenon is much more complex, and in order to better characterise the behavioural patterns of countries, economic, institutional, and cultural factors must be taken into account simultaneously.



Figure no. 1. Distribution of EU countries according to the normalised difference between the percentage of renewable energy and energy consumption per inhabitant

To better distinguish the behaviour typology of the European Union countries based on their general behaviour in terms of renewable energy sources, we resort to cluster analysis. We construct the clusters based on the dependent variable (RENERG), the economic variables GDPCAP and CONSENERG, and the institutional (GOVEFF, RULELOW and CTRLCORR) and cultural factors that emerged as significant in the panel regressions. Since the original sample is panel one, we will use the average of the 2007 – 2015 period. Hierarchical clustering based on Ward's linkage and multidimensional Euclidean distance (as a measure for proximities between countries and between groups). These specifications have proven to be the most robust in our case, given the number of countries and the nature of the variables used (Ferreira and Hitchcock, 2009, for a comparison through simulations between different variants of hierarchical classification). To establish the final number of groups, we employ the ANOVA method, with the principle of minimum variance within groups and maximum variance between groups. This resulted in three groups of 9 countries each, which we named Green, Yellow, and Red. The average values of the groups in relation to the

considered variables are reproduced in Table no. 8, and the geographical distribution of the countries in the three groups is illustrated in Figure no. 2.

Table no. 8. Clustering statistics – The average values of the variables in the groups

	Green	Yellow	Red
RENERG	15.9	8.8	7.8
CONSENERG	9457	6035	4206
GDPGAP	58051	28270	16677
GOVEFF	94.8	83.8	67.1
RULELAW	96.6	85.3	66.5
CTRLCORR	95.5	81.0	61.1
POWERDIST	29.9	59.7	63.3
UNCERTAV	48.8	87.0	78.2

Source: authors' calculations in STATA.

We note that there is no clear stratification of the three groups in relation to the variables considered.

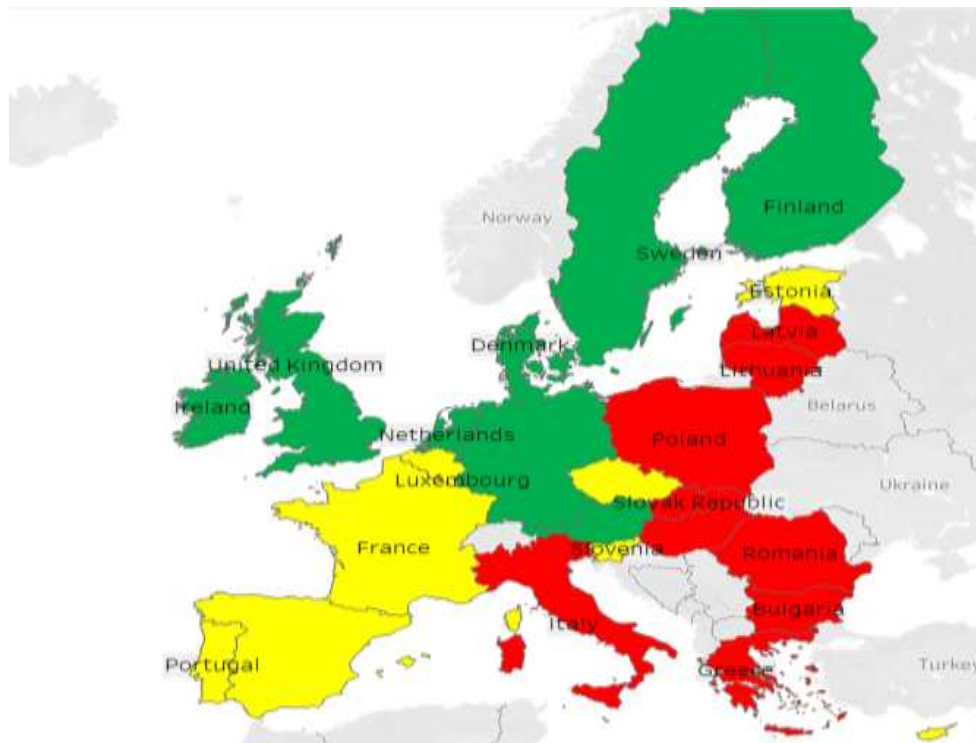


Figure no. 2. Distribution of EU countries in the groups resulting from clustering

The Green group appears to stand out, as it has the highest average percentage of green energy production, the highest averages of the economic and institutional variables, and the lowest averages of POWERDIST and UNCERTAVID. Between the Yellow and the Red

groups, we cannot speak of a clear order relationship. The RENERG variable has quite close average values, although the Yellow group clearly dominates in terms of energy consumption, national income, and good governance. The situation is even more confusing regarding the cultural factors, countries in the Yellow group having lower values for POWERDIST, while the Red ones for UNCERTAV. The geographical distribution of the countries is shown (Figure no. 2) that there is a certain spatial grouping of common behaviours of the same group. The Red group includes countries in the northwest of the continent. It has a composition dominated by ex-communist countries, plus Greece and Italy, which have similar values of institutional and cultural factors. The Yellow group is the most geographically heterogeneous, comprising states of very different positioned positions.

Conclusions

The issue of renewable energy is not new in the literature in this field. However, it has been circulating more and more in recent years due to the increasingly obvious climate changes. Global decarbonisation policies and the EU in particular are increasingly consistent. Of course, they cover several aspects, but renewable energy production remains at the forefront. However, there are also implementation problems that differ from country to country. These differences come from different sources. Natural conditions, political will, economic and technological capabilities, governance efficiency, and cultural variables are very heterogeneous in European states. These have effects on the adoption of the energy transition, with the share of renewable production varying in 2015 between 65.4% in Denmark (which is also the world leader) and 3.7% in Slovenia. Studies in the field have focused on explaining these gaps through economic factors. Institutional factors have only been timidly explored, whereas cultural ones have not been explored at all. Our study adds to the literature by simultaneously exploring the set of possible determinants.

Our results indicate a very high importance of energy consumption per inhabitant. This result is consistent with economic theory, consumption putting pressure on demand and, therefore, implicitly on the increase of production capacities. We would have expected hydroelectric production to be significant, due to the fact that it is already a green energy, so a country with high values has no serious incentives to develop production from other renewable sources. However, the econometric results do not confirm this mechanism. Due to the fact that the EU, through various mechanisms, finances green energy investment projects, we expected that the absorption of these funds would be influenced by good governance indicators. Even if not all of them turned out to be significant, we highlighted the positive effect of governance efficiency, compliance with laws, and corruption control. Beyond the economic capacities and efficiency of institutions, energy transformations are difficult to implement if there is no support from the population, especially in terms of how they accept the necessary changes. Multiple mechanisms could act here, from accepting the common good in relation to the personal one, to prioritising long-term objectives in relation to immediate ones, etc. The econometric results highlighted two cultural values of Hofstede (2011) with an impact on the acceptance of the energy transition. Since econometrics deals with causal relationships only globally, across all countries, we also resorted to descriptive statistics. Through the hierarchical cluster analysis, we identified three groups of countries, with relatively homogeneous behaviours in each.

Our study may have implications for national representatives responsible for the implementation of EU energy policies. They can identify the mix of factors affecting the development of green energy production. The potential output resulting from the regression can be compared to the actual output. Differences could be assessed and possibly explained by other factors. Furthermore, among the factors identified in our model, government authorities can assess which are influenceable, with a subsequent effect on the energy mix. Theoretically, the most difficult to influence are the cultural determinants, which essentially relate to the way of thinking of the population. However, here, too, it is possible to act through promotion and information policies in order to change some perceptions or better understand the stakes of energy transformations.

References

- Ali, M. and Kirikkaleli, D., 2022. The asymmetric effect of renewable energy and trade on consumption- based CO₂ emissions: the case of Italy. *Integrated Environmental Assessment and Management*, [e-journal] 18(3), pp.784-795. <https://dx.doi.org/10.1002/ieam.4516>.
- Blanco-Alcántara, D., Gallud Cano, J. and Lopez-de-Silanes, F., 2022. Determinants of the use of European Structural and Investment Funds. *The European Journal of Finance*, [e-journal], pp.1-26. <https://dx.doi.org/10.1080/1351847X.2022.2102433>.
- Carfora, A., Pansini, R. V. and Scandurra, G., 2022. Energy dependence, renewable energy generation and import demand: Are EU countries resilient?. *Renewable Energy*, [e-journal] 195, pp.1262-1274. <https://dx.doi.org/10.1016/j.renene.2022.06.098>.
- Carley, S., 2009. State renewable energy electricity policies: An empirical evaluation of effectiveness. *Energy Policy*, [e-journal] 37(8), pp.3071-3081. <https://dx.doi.org/10.1016/j.enpol.2009.03.062>.
- Cenevska, I., 2016. *The European Atomic Energy Community in the European Union Context: The 'Outsider' Within: Brill*.
- Chalvatzis, K.J., and Ioannidis, A., 2017. Energy supply security in the EU: Benchmarking diversity and dependence of primary energy. *Applied Energy*, [e-journal] 207, pp.465-476. <https://dx.doi.org/10.1016/j.apenergy.2017.07.010>.
- Chen, C., Pinar, M., and Stengos, T., 2021. Determinants of renewable energy consumption: Importance of democratic institutions. *Renewable Energy*, [e-journal] 179, pp.75-83 <https://dx.doi.org/10.1016/j.renene.2021.07.030>.
- Chowdhury, M.S., Rahman, K.S., Selvanathan, V., Nuthammachot, N., Suklueng, M., Mostafaeipour, A., Habib, A., Akhtaruzzaman, Md., Amin, N. and Techato, K., 2021. Current trends and prospects of tidal energy technology. *Environment, Development and Sustainability*, [online] 23(6), pp.8179-8194. <https://doi.org/10.1007/s10668-020-01013-4>.
- Colasante, A., D'Adamo, I., and Morone, P., 2022. What drives the solar energy transition? The effect of policies, incentives and behavior in a cross-country comparison. *Energy Research & Social Science*, [e-journal] 85, 102405. <https://dx.doi.org/10.1016/j.erss.2021.102405>.
- da Graça Carvalho, M., 2012. EU energy and climate change strategy. *Energy*, [e-journal] 40(1), pp.19-22. <https://dx.doi.org/10.1016/j.energy.2012.01.012>.

- Darmani, A., Rickne, A., Hidalgo, A., and Arvidsson, N., 2016. When outcomes are the reflection of the analysis criteria: A review of the tradable green certificate assessments. *Renewable and Sustainable Energy Reviews*, [e-journal] 62, pp.372-381. <https://dx.doi.org/10.1016/j.rser.2016.04.037>.
- Delmas, M. A., and Montes-Sancho, M. J., 2011. US state policies for renewable energy: Context and effectiveness. *Energy Policy*, [e-journal] 39(5), pp.2273-2288. <https://dx.doi.org/10.1016/j.enpol.2011.01.034>.
- European Commission, 2006. *Green Paper: A European strategy for sustainable, competitive and secure energy*. [pdf] European Commission. Available at: <https://europa.eu/documents/comm/green_papers/pdf/com2006_105_en.pdf> [Accessed 1 September 2022].
- European Commission, 2020. *2030 climate & energy framework*. [online] Available at: <https://ec.europa.eu/clima/policies/strategies/2030_en> [Accessed 5 September 2022].
- Ferreira, L., and Hitchcock, D. B., 2009. A comparison of hierarchical methods for clustering functional data. *Communications in Statistics-Simulation and Computation*, [e-journal] 38(9), pp.1925-1949. <https://dx.doi.org/10.1080/03610910903168603>.
- Filimonova, I.V., Nemov, V.Y., Komarova, A.V., Mishenin, M.V., and Kozhevnikov, V.D., 2021. Relationship of renewable energy consumption to economic, environmental and institutional factors in Europe. *Energy Reports*, [e-journal] 7, pp.358-365. <https://dx.doi.org/10.1016/j.egyr.2021.07.115>.
- Gökgöz, F., and Güvercin, M. T., 2018. Energy security and renewable energy efficiency in EU. *Renewable and Sustainable Energy Reviews*, [e-journal] 96, pp.226-239. <https://dx.doi.org/10.1016/j.rser.2018.07.046>.
- Hafner, M., and Raimondi, P. P., 2020. Priorities and challenges of the EU energy transition: From the European Green Package to the new Green Deal. *Russian Journal of Economics*, [e-journal] 6, pp.374-389. <https://dx.doi.org/10.32609/j.ruje6.55375>.
- Hansen, K., Mathiesen, B.V., and Skov, I.R., 2019. Full energy system transition towards 100% renewable energy in Germany in 2050. *Renewable and Sustainable Energy Reviews*, [e-journal] 102, pp.1-13. <https://dx.doi.org/10.1016/j.rser.2018.11.038>.
- Hofstede, G., 2011. Dimensionalizing cultures: The Hofstede model in context. *Online Readings in Psychology and Culture*, [e-journal] 2(1), pp.2307-0919.
- Hofstede Institut, 2022. *National culture*. [online] Hofstede Insights. Available at: <<https://www.hofstede-insights.com/models/national-culture/>> [Accessed 10 October 2022].
- International Energy Agency, 2019. *Energy policies of IEA countries: United Kingdom 2019 review*. [online] International Energy Agency. Available at: <<https://www.iea.org/reports/world-energy-outlook-2019>> [Accessed 1 September 2022].
- Igliński, B., Pietrzak, M.B., Kiełkowska, U., Skrzatek, M., Kumar, G., and Piechota, G., 2022. The assessment of renewable energy in Poland on the background of the world renewable energy sector. *Energy*, [e-journal] 261, 125319. <https://dx.doi.org/10.1016/j.energy.2022.125319>.
- Jenner, S., Groba, F., and Indvik, J., 2013. Assessing the strength and effectiveness of renewable electricity feed-in tariffs in European Union countries. *Energy Policy*, [e-journal] 52, pp.385-401. <https://dx.doi.org/10.1016/j.enpol.2012.09.046>.

- Kilinc-Ata, N., 2016. The evaluation of renewable energy policies across EU countries and US states: An econometric approach. *Energy for Sustainable Development*, [e-journal] 31, pp.83-90. <https://dx.doi.org/10.1016/j.esd.2015.12.006>.
- Koch, N., and Mama, H.B., 2019. Does the EU Emissions Trading System induce investment leakage? Evidence from German multinational firms. *Energy Economics*, [e-journal] 81, pp. 479-492. <https://dx.doi.org/10.1016/j.eneco.2019.04.018>.
- Kuriqi, A., Pinheiro, A.N., Sordo-Ward, A., Bejarano, M.D. and Garrote, L., 2021. Ecological impacts of run-of-river hydropower plants - Current status and future prospects on the brink of energy transition. *Renewable and Sustainable Energy Reviews*, [e-journal] 142, article no. 110833. <https://dx.doi.org/10.1016/j.rser.2021.110833>.
- Lamb, W.F., Wiedmann, T., Pongratz, J., Andrew, R., Crippa, M., Olivier, J.G.J., Wiedenhofer, D., Mattioli, G., Khourdajie, A.A., House, J., Pachauri, S., Figueroa, M., Saheb, Y., Slade, R., Hubacek, K., Sun, L., Ribeiro, S.K., Khennas, S., Can, S. de la R. du, Chapungu, L., Davis, S.J., Bashmakov, I., Dai, H., Dhakal, S., Tan, X., Geng, Y., Gu, B. and Minx, J., 2021. A review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018. *Environmental Research Letters*, [online] 16(7), article no. 073005. <https://doi.org/10.1088/1748-9326/abee4e>.
- Li, S., and Shao, Q., 2021. Exploring the determinants of renewable energy innovation considering the institutional factors: A negative binomial analysis. *Technology in Society*, [e-journal] 67, 101680. <https://dx.doi.org/10.1016/j.techsoc.2021.101680>.
- Mey, F., and Diesendorf, M., 2018. Who owns an energy transition? Strategic action fields and community wind energy in Denmark. *Energy Research & Social Science*, [e-journal] 35, pp.108-117. <https://dx.doi.org/10.1016/j.erss.2017.10.044>.
- Mirzania, P., Ford, A., Andrews, D., Ofori, G., and Maidment, G., 2019. The impact of policy changes: The opportunities of Community Renewable Energy projects in the UK and the barriers they face. *Energy Policy*, [e-journal] 129, pp.1282-1296. <https://dx.doi.org/10.1016/j.enpol.2019.02.066>.
- Pali, B.S., and Vadhera, S., 2016, Renewable energy systems for generating electric power: A review. In *2016 IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES)* (pp. 1-6). IEEE.
- Pepermans, G., 2019. European energy market liberalization: experiences and challenges. *International Journal of Economic Policy Studies*, [online] 13(1), pp.3-26. <https://doi.org/10.1007/s42495-018-0009-0>.
- Sato, M., Singer, G., Dussaux, D., and Lovo, S., 2019. International and sectoral variation in industrial energy prices 1995-2015. *Energy Economics*, [e-journal] 78, pp.235-258. <https://dx.doi.org/10.1016/j.eneco.2018.11.008>.
- Savaresi, A., 2016. The Paris Agreement: a new beginning?. *Journal of Energy & Natural Resources Law*, [e-journal] 34(1), pp.16-26. <https://dx.doi.org/10.1080/02646811.2016.1133983>.
- Sokołowski, J., Frankowski, J., Mazurkiewicz, J., and Lewandowski, P., 2022. Hard coal phase-out and the labour market transition pathways: The case of Poland. *Environmental Innovation and Societal Transitions*, [e-journal] 43, pp.80-98. <https://dx.doi.org/10.1016/j.eist.2022.03.003>.

- Thaler, P., 2016. The European Commission and the European Council: coordinated agenda setting in European energy policy. *Journal of European Integration*, [e-journal] 38(5), pp.571-585. <https://dx.doi.org/10.1080/07036337.2016.1178252>.
- United Nations, 2015, *Paris agreement*. In *Report of the Conference of the Parties to the United Nations Framework Convention on Climate Change*, [pdf] Available at: <https://unfccc.int/sites/default/files/english_paris_agreement.pdf> [Accessed 10 September 2022].
- World Bank, 2022. *World Bank. Data. Indicators. Climate change, Economy & Growth*. [online] Available at: <<https://data.worldbank.org/indicator>> [Accessed November 2022].
- Zheng, X., Streimikiene, D., Balezentis, T., Mardani, A., Cavallaro, F., and Liao, H., 2019. A review of greenhouse gas emission profiles, dynamics, and climate change mitigation efforts across the key climate change players. *Journal of Cleaner Production*, [e-journal] 234, pp.1113-1133. <https://dx.doi.org/10.1016/j.jclepro.2019.06.140>.
- Zhou, L., Wu, X., Xu, Z., and Fujita, H., 2018. Emergency decision making for natural disasters: An overview. *International Journal of Disaster Risk Reduction*, [e-journal] 27, pp.567-576. <https://dx.doi.org/10.1016/j.ijdr.2017.09.037>.