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Mlaskawa, Julita

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Renewable Energy and Poverty in Sustainable Development of the European Union

Odnawialne Źródła Energii i ubóstwo a zrównoważony rozwój Unii Europejskiej

Julita Mlaskawa

WSB University, ul. Cieplaka 1C, 41-300 Dąbrowa Górnicza, Poland
E-mail: jmlaskawa@wsb.edu.pl, ORCID: 0000-0002-3655-8298

Abstract
The current socioeconomic development results in a number of consequences that lead to changes in the environment. These changes are often harmful and are associated with over- or misuse of natural resources. The issue of sustainable development is increasingly taking a prominent place in regional and local development strategies. Access to energy services is essential for social inclusion. Addressing poverty, including energy poverty, can bring a number of benefits related to reduced health expenditures, reduced air pollution, improved comfort and well-being, and improved household budgets, among other things. According to the results of the analysis, the utilisation of energy from renewable sources is intrinsically linked with the salary level - on average, a higher salary level is accompanied by a larger scale of utilising energy from renewable sources. In spite of the expected negative value, a similar relationship has been observed in the case of correlating the level of poverty with the use of energy from renewable sources - it is higher when the use of energy from renewable sources is higher. The performed study indicates the lack of adequately constructed support mechanisms for the poor in terms of financing and operating installations generating green energy, as well as the lack of proper education as regards local and global benefits resulting from prosumer energy. The desire to eliminate the abovementioned barriers necessitates the continuation of actions concerning synergistic accomplishment of the first and seventh targets, constituting two out of seventeen foundations of sustainable development.

Key words: sustainable development, renewable energy, poverty, energy poverty, decarbonisation
Słowa kluczowe: rozwój zrównoważony, energia odnawialna, ubóstwo, ubóstwo energetyczne, dekarbonizacja

Introduction
The current dynamic development of technology and progressive globalization are increasingly shaping the directions of change in modern societies. The socioeconomic development entails not only benefits but also a number of environmental costs associated with excessive and unsustainable exploitation of natural resources. The issue of sustainable development is more and more often at the forefront of development strategies, on the scale of international organisations, countries, regions, cities, and communes alike. Dynamic technological progress causes a constant increase in energy consumption. Due to the high costs and shortages of non-renewable sources, there is a growing demand for renewable energy (Wang et al., 2021; Sarkar et al., 2021). Actions intended to merge renewable and non-renewable energy are being initiated in the industry with an increasing frequency (Khan et al., 2020). Nowadays, the energy sector constitutes a considerable source of greenhouse gas emissions in the world, and coal-fired power stations are the largest source of carbon emissions in this sector (Friedlingstein et al., 2019). An increase in energy efficiency and the reduction of carbon dioxide emissions are key issues for many economies all over the world (Olczak et al., 2021; Liu et al., 2019; Höltl et al., 2017; Ju et al., 2016). In the climate policy of the EU, renewable energy has become a main factor, critical in the process of decarbonising economies, contributing to the alleviation of climate changes by reducing the dependence on fossil fuels and carbon dioxide emissions (Olczak et al., 2021; Burke et al., 2018; Diesendorf et al., 2018; European Commission, 2020a; European Com-

mission, 2020; Galvin et al., 2020). One significant element of sustainable development is complex decarbonisation implemented in all sectors of economy, in which the key role is played by the electricity generation system (Rockström et al., 2017). Decarbonisation can have a considerable impact on employment and economic growth. Synergistic implementation of policy related to energy, climate and economy, can lead to an overall higher GDP and translate into an increase in the standard and quality of life of a given society (Gielen et al., 2019).
In order to standardize action at the national level, in September 2015 the United Nations enacted a set of 17 Sustainable Development Goals (SDGs) with 169 sub-goals and just over 230 indicators. These goals are a continuation of the Millennium Development Goals, whose mission ended in 2015. Governments around the world – national, provincial, and municipal – face the challenge of aligning sustainable development goals and indicators by 2030 (Venkatesh, 2021). This paper discusses whether the implementation of two Sustainable Development Goals (SDGs) – goal one on poverty reduction and goal seven on clean and accessible energy – is being carried out in a synchronized and effective manner.

1. Literature review

In the past decades, universal access to electricity has become a component that enabled the dynamic development of modern societies and it still continues to be a key driver of economic growth and poverty reduction in developing countries (Hyun et al., 2021). The ongoing increase in energy demand is associated with continuous exploitation of natural resources and is often linked to greenhouse gas emissions and, consequently, to global warming. Climate change affects the way we use the planet's energy resources. Over the last 150 years, the temperature has risen by almost 0.8 ºC globally and by about 1 ºC in Europe. It is estimated that the global temperature could increase by another 1.8-4.0 ºC by 2100 (Pachauri et al., 2014). Rising temperatures result in a need to use more energy for cooling, so electricity is increasingly being used not only for heating, but also to reduce indoor temperatures. According to the IEA report, cooling will be the main driver of electricity consumption by 2050 (IEA, 2018).
Addressing poverty, the reduction of which is at the top of the political agenda in many developing countries, is also an important challenge for the world today. Poverty is a situation in which individuals (persons, families, or households) do not have sufficient resources to meet their needs and their standard of living decreases beyond the accepted minimum (Panek, 2007) so that these needs are unlikely to be met. Poverty associated with social exclusion prevents full participation in society due to lack of financial resources, lack of basic skills, or as a result of discrimination (Kawiorska et al., 2016). According to the UN definition, poverty is a limitation of choice and opportunities in life, and a violation of human dignity. It means not having the food and clothing a family needs, not being able to go to school or receive health care, not having access to land that can be farmed or work to earn a living, and not having access to credit. Poverty is also a threat and causes powerlessness, produces vulnerability to violence, and often involves living in precarious conditions without access to clean water and sanitation facilities (United Nations, 2021).
Despite the dynamic development and growing awareness of modern societies, poverty is still an important problem addressed in the policies of countries and international organizations. According to the information provided in the description of the first goal, 783 million people currently live below the international poverty line, i.e. on less than USD 1.90 per day. The problem of poverty has a particular effect on small, fragile, and conflict-affected states. An increase in poverty is also the result of natural disasters, which cause huge losses both to the civilian population and to government authorities and businesses; for example, in 2017, the economic losses caused by disasters, including three powerful hurricanes in the USA and the Caribbean, were estimated at more than $300 billion (United Nations, 2021). The level of importance of the problem of poverty is reflected in the content of the first Sustainable Development Goal of the United Nations: end poverty in all its forms everywhere by 2030 (Wang et al., 2020). That is why it is so important for economic growth to be planned in a coherent and consistent way and to combine actions implemented as part of the sustainable development goals.
A particular form of poverty is energy poverty, a situation where households do not have access to basic energy services. With nearly 34 million people in Europe unable to afford adequate heating in their homes in 2018, energy poverty is a particularly important challenge for EU countries (European Union, 2020). Energy poverty is defined as the inability of an individual or household to provide a minimum amount of energy (Zamfir et al., 2015) due to financial constraints or caused by insufficient access to energy sources and energy distribution services and infrastructure (Thomson et al., 2017; Siksnelyte-Butkiene et al., 2021). Energy poverty is also the lack of physical access to energy services (Castaño-Rosa et al., 2019) and the lack of choice in accessing adequate, affordable, reliable, high quality, safe, and environmentally acceptable energy services (Parajuli, 2011). The term energy poverty is also used to describe a situation where households lack the disposable income needed to meet their basic energy needs (Castaño-Rosa et al., 2019). As stated in recital 59 of the recast Electricity Directive, energy poverty results from a combination of low income, high energy expenditure, and low energy efficiency of residential buildings (European Union,2020; Robinson et al., 2018). Energy poverty is also defined as a situation where a household cannot afford the energy needed to provide adequate heating, cooling, lighting, and appliance use for its members (Thomson et al., 2017). Lack of access to transmission networks and outdated electricity distribution technologies, high energy prices, and costs related to environmental pollution caused by the use of conventional

fossil energy sources result in growing problems in the electricity market and significantly restrict the achievement of individual sustainable economic development goals (Agyekum, 2020). Following the recognition by the European Economic and Social Committee (EESC) that energy poverty has an effect on the energy sector as well as health, consumer affairs, and housing, the Committee suggested that the EU should adopt a common general definition of energy poverty (Bouzarovski et al., 2012) Energy poverty affects about 1 in 10 European citizens and is noticeable in situations involving late payment of energy bills or living in thermal discomfort and social isolation (EPOV, 2018).

Analyses of energy poverty are carried out in different dimensions: some researchers focus mainly on social and health factors (Walker et al., 2016; Gillard et al., 2017; Kahouli, 2020; Thomson et al., 2017), while others study aspects related to economic factors (Kyprianou et al., 2020; Sokołowski et al., 2020) or the political situation prevailing in a particular region (Primc et al., 2020). Research on energy poverty is relevant to both developed and developing countries (Ayodele et al., 2018). The phenomenon of energy poverty involves one common condition: the inability to achieve the socially and materially necessary level of domestic energy services (Bouzarovski et al., 2015). For developing countries, energy poverty is usually understood as lack of access to energy services (Sokołowski, 2019; Sovacool, 2012), while in developed countries it is considered in terms of energy expenditure and income (Buzar, 2007). An additional complication in analyses of energy poverty is its complexity and dependence on time, place, and individual characteristics of households (e.g., household income, habits, and specific type of energy), needs, available technologies, and a number of external conditions (e.g., energy prices, climate conditions, and building energy performance) (Siksnelyte-Butkiene et al., 2021).

Another issue that affects energy poverty levels is the ownership structure. Consumers owning installations that produce energy from renewable sources are more environmentally conscious and motivated to take care of their property and the environment, because they see the direct effects of their actions. In the case of consumers who are not prosumers, i.e. who only use energy resources available in the grid, the tragedy of the commons phenomenon, which is often invoked in climate policy debates, is observed. Consumers who do not participate in the production of green energy become indirectly responsible for the greenhouse gas emissions that result from production of energy from fossil fuels. The concept of ownership on the national scale is also an important consideration. According to research results, with the exception of repressed countries, it can be said that the lower the level of economic freedom in a country, the more harmful the impact of the economy on the environment. The more economic freedom, the more prosperous the society, and thus the greater the likelihood of informed consumer choices and care for the environment and the development of green technologies (Weiss et al., 2019). Economic freedom also has a strong impact on the innovativeness of economies, which can work in favour of the climate. Companies based in countries that have a stable and effective legal system, are open to foreign cooperation, and do not interfere excessively with the activities of businesses are more likely to undertake innovative and sustainable projects (Zhu et al., 2017). Innovation of economies is one of the factors that can have a positive impact on climate in the long term through the emergence of new green technologies in the energy and waste disposal sectors (Barron, 2018).

In the context of climate change and the increasing demand for electricity, energy from renewable sources is becoming increasingly important. According to the definition contained in Article 2(1) of EU Directive 2018/2001, *energy from renewable sources* or *renewable energy* means *energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas* (European Parliament, 2018).

The requirement to be proactive in promoting energy from renewable sources is provided for in the seventh Sustainable Development Goal. The seventh goal is to ensure access to affordable, reliable, sustainable, and modern energy for all (United Nations, 2021). The way to achieve this objective is by increasing access to clean energy and innovative technologies for its production; it is also recommended to increase the use of renewable energy sources in buildings, transport, and industry. Action is needed to increase public and private investment in renewable energy and to define regulatory frameworks and innovative business models in transforming the world's energy systems. Energy production continues to be the major cause of climate change, accounting for about 60% of global greenhouse gas emissions. There are still 3 billion people dependent on coal, wood, charcoal, and animal waste for cooking and heating. In 2012, pollution emitted from burning of heating fuel caused 4.3 million deaths, 60% of which involved women and girls. In 2015, the share of renewable energy in the total energy consumption reached 17.5% which means that as much as 82.5% of the consumed energy came from energy sources that were non-renewable and thus not environmentally friendly (United Nations, 2021). According to the Sustainable Development Goals, access to clean, affordable, and reliable energy is one of the prerequisites on the way to alleviation of poverty. The study of the relationship between poverty and the level of renewable energy use creates opportunities for synergistic implementation of the two Sustainable Development Goals through activities involved in identification and development of modern, environmentally friendly ways to meet the needs of modern societies. Access to energy services is essential for social inclusion. Addressing poverty can thus bring numerous benefits, including reduced health expenditures, reduced air pollution, improved comfort and well-being, and improved household budgets. Taken together, these benefits can directly contribute to boosting economic growth and prosperity in the European Union. According to Recommendation C(2020)9600 issued by the Directorate-General for Energy, national long-term energy efficiency strategies should be focused on protecting households affected by energy poverty and on empowering vulnerable energy consumers, while helping them save money on their energy bills, providing healthier living conditions, and reducing energy poverty (European Union, 2020).

The analysis of the topic is based on data for 19 selected European Union countries for the period of 2011-2018. Due to the COVID-19 pandemic and its negative impact on human lives, employment and income, the years 2019-2020 were excluded from the analysis. This period will be analysed in a separate paper by way of a comparative analysis of the pre-pandemic period and the situation during the pandemic. The subject of renewable energy sources, in the context of the pollution associated with the production of electricity from fossil sources, is becoming an increasingly important social issue. In the first hypothesis, H1: *renewable energy use is significantly related to wage levels*, a discussion was undertaken on whether financial surpluses from wage increases are invested in renewable electricity sources (RES). The second area of analysis was the relationship between the level of green energy and the level of poverty in the respective country, which was formulated as part the second hypothesis – H2: *the increase in the use of renewable energy is negatively correlated with the level of poverty (POV)*. The above assumption is based on the need to make capital expenditures necessary for the construction and start-up of RES installations. Green electricity is produced free of charge and in an environmentally friendly manner, i.e. without polluting the environment or causing additional environmental, health, and social costs. Another problem discussed in the paper is the relationship presented in the third hypothesis – H3: *the higher the share of renewable energy in the gross final energy consumption, the lower on average the percentage of the population below the poverty line*. The relationship presented in the hypothesis quoted above puts into question whether the target group benefiting from RES are people below or above the poverty line, i.e. whether the assistance programmes launched in individual countries support simultaneously the development of clean and accessible energy and the fight against poverty, or whether they implement the aforementioned objectives separately without verifying the impact of the measures implemented on the remaining sustainable development goals.

2. Methodology

An evaluation of the relationship between renewable energy use and welfare of the population in the studied countries was carried out using panel models. The use of these models is justified due to the fact that the study included a cross-sectional time series in which both the number of countries (n = 19) and the number of periods (t = 8) was small. Panel models were estimated based on a sample of 19 x 8 = 152 observations.

Panel models can take the form of models with decomposition of the free term (fixed effects models, FEM) or models with decomposition of the random element (random effects models, REM). The FEM and REM models can be generally written as follows:

$$y_{it} = m_i + bx_{it} + e_{it} \tag{1}$$

where:

m_i - a general free term;

b - a structural parameter that expresses the effect of the explanatory variable X;

x_{it} - the implementation of the explanatory variable for the i^{th} object in the t^{th} period;

e_{it} - residuals meeting the classical assumptions: $E(e_{it}) = 0$ and $Var(e_{it}) = S_e^2$.

In the FEM model, m_i is decomposed into free (fixed) terms for each group separately. The model, therefore, takes the following form:

$$y_{it} = a_1 d_{1it} + a_2 d_{2it} + ... + a_k d_{kit} + bx_{it} + e_{it} = a_i + bx_{it} + e_{it} \tag{2}$$

where:

a_i - specific free terms;

di - Boolean variables whose value is equal to 1 when $j = i$.

In the REM model, m_i expresses specific random elements. This model can be written as follows:

$$y_{it} = a + bx_{it} + e_{it} + u_i, \tag{3}$$

where:

$E(u_i) = 0$, $Var(u_i) = S_e^2$, $Cov(e_{it}, u_i) = 0$.

When analysing a univariate model (with group effects), the significance of individual effects must be checked using the Wald test. The null hypothesis is that the conditions imposed on the model ($\alpha_1 = \alpha_2 = \cdots = \alpha_N = \mu$) are true and the model estimation should occur without individual effects. If $p < \alpha$, the null hypothesis is rejected in favour of the alternative hypothesis: individual effects are present. The validity of introduction of individual effects into the random effects model is verified by testing whether the variance of the random element is different from zero. Zero variance indicates that there is no variability in the individual element and that it is constant across all test subjects, which makes it possible to replace it with a common free term. LM test statistic is used to verify the hypotheses of the Breusch-Pagan test. If the test statistic converges with the $\chi^2(1)$ distribution, then there is no reason to reject the null hypothesis. If the value of the test statistic exceeds the critical value, it is rejected, which suggests the significance of individual effects in the random effects model.

When all assumptions for the fixed effects and random effects models have been met, a decision must be made as to which model is better suited to the phenomenon under analysis. For this purpose, the Hausman test is carried out, which makes it possible to determine the nature of the specific effects present. It examines the correlation between the explanatory variables and the random effects. A value of *p* that is lower than the fixed boundary level means that a fixed effects model (with decomposition of the free term) is preferable. The null hypothesis is that the assumption of independence of exogenous variables from individual effects is met and the random effects estimator is more efficient. Rejection of the null hypothesis means that the fixed effects estimator is unbiased and more efficient than the random effects estimator. The panel model estimation was performed using the Gretl software.

3. Research results

In the first stage of the analysis, which is shown in model 1 (Table 1), the relationship between the electricity capacity of renewable energy (MW) – total [EC] and the average annual wages – constant prices at 2019 [AWW] (in USD PPPs) was evaluated. The model makes it possible to determine what percentage of the variance of EC is explained by the variability of wages. The results of [0]the Hausman test (χ^2 (1) = 0.014; p = 0.904) indicate that a decomposition of the random element is appropriate. The results of the Breusch-Pagan test confirm the validity of the group decomposition, i.e. by country (χ^2 (1) = 501.957; p < 0.0001). The time effects (in the Wald test χ^2 (7) = 20.206; p = 0.005), which were included in the model as binary variables (reference year: 2011), are also significant.

Table 1. Results of the estimation of the model of renewable energy use as a function of wages - model 1: *EC = f(AAV)*, own calculations based on data: OECD.STAT, ESTAT, IRENA (2020), Renewable Capacity Statistics 2020; & IRENA (2020), Renewable Energy Statistics 2020, The International Renewable Energy Agency, Abu Dhabi

	B	*S(B)*	*z*	*p*	
const	−7,398.71	11,277.60	−0.656	0.5118	
AAW [thousand]	578.70	261.83	2.210	0.0271	**
dt_2	1,548.26	1,280.35	1.209	0.2266	
dt_3	2,399.68	1,279.95	1.875	0.0608	*
dt_4	2,942.82	1,280.27	2.299	0.0215	**
dt_5	3,525.80	1,293.93	2.725	0.0064	***
dt_6	4,086.66	1,322.64	3.090	0.0020	***
dt_7	4,813.37	1,347.38	3.572	0.0004	***
dt_8	5,416.90	1,400.27	3.868	0.0001	***
Breusch-Pagan test	χ^2 (1) = 501.957; p < 0.0001***				
Wald test for time effects	χ^2 (7) = 20.206; p = 0.005***				
Joint test on named regressors	χ^2 (1) = 4.885; p = 0.027**				
Hausman test	χ^2 (1) = 0.014; p = 0.904				

B – regression coefficient, S(B) – standard error, z – Wald-statistics, p – probability in the Wald test.

According to the results of the analysis, renewable energy use (EC, in thousands) is significantly related to wage levels (B = 578.7, p = 0.0271). The correlation is positive: higher wage levels are accompanied, on average, by a greater scale of renewable energy use. Ceteris paribus, wages higher by 1 thousand are associated with renewable energy use increased by 578.7 on average. Time effects for individual years are also significant: this does not apply only to the binary variable for 2012 (p = 0.2266). The results obtained confirm the assumption presented in the first hypothesis, H1: *renewable energy use is significantly related to wage levels*. An increase in the use of green energy, especially in the investment phase, requires certain financial outlays, while an increase in wages makes it possible to find financial resources to invest in installations producing electricity from renewable sources. The described relation is important also due to the increased environmental awareness of the public in the analysed countries. Europeans are increasingly aware of the need to invest in green technologies and are increasingly willing to contribute to an innovative and sustainable economy.

The next step of the analysis shown in model 2 (Table 2) was to evaluate the relationship between the electricity capacity of renewable energy (MW) – total [EC] and poverty (POV). The model makes it possible to determine what percentage of the variance of POV is explained by the variability of EC. The results of the Hausman test (χ^2 (1) = 60.326; p = 0.904) indicate that a decomposition of the free term is appropriate. The results of the F test confirm the validity of the group decomposition, i.e. by country (F(1; 132) = 1,038.62; p < 0.0001). Also, the time effects are not statistically significant.

Table 2. Results of the estimation of the model of poverty as a function of renewable energy use – model 2: *POV = f(EC)*, own calculations based on data: OECD.STAT, ESTAT, IRENA (2020), Renewable Capacity Statistics 2020; & IRENA (2020), Renewable Energy Statistics 2020, The International Renewable Energy Agency, Abu Dhabi

	B	*S(B)*	*z*	*p*	
const	3,382.44	62.3744	54.23	<0.0001	***
EC	0.0066	0.0034	1.93	0.0556	*
LSDV R^2	0.9984				
Test F	F(18; 132) = 1038.62; p < 0.0001***				
Joint test on named regressors	F(1; 132) = 3.731 p = 0.056*				
Hausman test	χ^2 (1) = 60.326; p = < 0.0001***				

B – regression coefficient, S(B) – standard error, z – Wald-statistics, p – probability in the Wald test.

Poverty level (POV) is positively correlated with renewable energy use (B = 0.0066; p = 0.0556) – it is higher when renewable energy use is higher. Ceteris paribus, the poverty level increases on average by 0.0066 as EC increases by a unit (Table 2). The model is estimated based on a cross-sectional time series sample and takes into account differences between countries due to both phenomena considered herein. As can be inferred from the correlation coefficients between these variables for each country (Table 4), in most cases the correlation coefficients (determined based on time samples for each country separately and for 152 observations combined) are positive. The expected (negative) value of the correlation coefficient between POV and EC was identified only for a few countries: Finland (r = -0.708), France (r = -0.481), Greece (r = -0.631), Poland (r = -0.663), and Slovakia (r = -0.623). In contrast, the correlation value is weak for the Czech Republic, Ireland, and Portugal. The above results provide a basis for rejecting hypothesis two: an increase in renewable energy use is negatively correlated with poverty level (POV). Despite the expected negative value, the results obtained in the study show that an increase in the level of renewable energy use is positively related to poverty levels. The reason for this may be the lack of systemic financial support programs for individuals and legal entities wishing to use RES installations. Although electricity produced in installations that use renewable energy sources is free, a certain amount of investment is required to purchase and operate such installations. The cost of green energy production has been steadily decreasing, but it is still relatively high, especially for those below the poverty line. The transition to climate neutrality may moderately increase inequality across income classes, with low-income households suffering the most negative effects (Fragkos et al., 2021).

Similar conclusions were drawn for the relationship between the percentage of people below the poverty line (POV_perc) and the share of renewable energy in gross final energy consumption [SRE] (%) (model 3, Table 3). The model makes it possible to determine what percentage of the variance of POV_perc is explained by the variation of the share of renewable energy in gross final energy consumption (SRE). The results of the Hausman test (χ^2 (1) = 0.711; p = 0.399) indicate that a decomposition of the random element is appropriate. The results of the Breusch-Pagan test confirm the validity of the group decomposition, i.e. by country (χ^2 (1) = 467.382; p < 0.0001). The relationship between these variables is statistically significant (p = 0.0429) and positive (B = 0.0713): the higher the share of renewable energy in gross final energy consumption, the higher on average the percentage of population below the poverty line. Ceteris paribus, an SRE higher by 1 percentage point is associated with an increase in the percentage of poor people by 0.07 percentage points on average.

Table 3. Results of the estimation of the model of poverty as a function of renewable energy use – model 3: *POV_perc = f(SRE)*, own calculations based on data: OECD.STAT, ESTAT, IRENA (2020), Renewable Capacity Statistics 2020; & IRENA (2020), Renewable Energy Statistics 2020, The International Renewable Energy Agency, Abu Dhabi

	B	*S(B)*	*z*	*p*	
const	14.3648		12.870	<0.0001	***
SRE	0.0713	0.0352	2.025	0.0429	**
Breusch-Pagan test	χ^2 (1) = 467.382; p < 0.0001***				
Joint test on named regressors	χ^2 (1) = 4.099; p = 0.043**				
Hausman test	χ^2 (1) = 0.711; p = 0.399				

B – regression coefficient, S(B) – standard error, z – Wald-statistics, p – probability in the Wald test.

The correlation between SRE and POV_perc is positive for most countries. The expected negative value of the correlation applies only to Finland (r = -0.745), France (r = -0.498), Greece (r = -0.624), and Slovakia (r = -0.872). The results obtained contradict the third hypothesis, H3: *the higher the share of renewable energy in the gross final energy consumption, the lower on average the percentage of the population below the poverty line*. An increase in the share of green energy does not lead to a reduction of the number of people below the poverty line, which means that the people who invest in RES are consumers who live above the poverty line and are able to obtain loans or have sufficient financial resources for investment in RES. The analysed data indicates a lack of appropriately structured support mechanisms for the poor in financing and operating green energy installations and a lack of adequate education on the local and global benefits of energy production by prosumers.

The Pearsons' correlation coefficient (Table 4) complements the analysis performed as part of models 1-3. Of the 19 countries studied, special attention should be paid to the correlation values recorded for Finland and France. In the case of these two countries, the values obtained show a negative correlation between renewable energy use and poverty indicators, i.e. a decrease in poverty indicators with an increase in RES use was recorded, while an increase in the value of the wage index shows a positive correlation between the indicators. France and Finland are therefore perfect examples of the assumptions outlined in the research hypotheses.

Table 4. Pearsons' correlation coefficient (r) – total and by country, own calculations based on data: OECD.STAT, ESTAT, IRENA (2020), Renewable Capacity Statistics 2020; & IRENA (2020), Renewable Energy Statistics 2020, The International Renewable Energy Agency, Abu Dhabi

	EC	EC_pc	SRE	EC	EC_pc	SRE	EC	EC_pc	SRE	EC	EC_pc	SRE	EC	EC_pc	SRE
	Austria			Belgium			Czech Republic			Denmark			Estonia		
POV	0.589	0.557	0.056	0.853	0.849	0.835	-0.235	-0.246	-0.153	0.897	0.890	0.870	0.900	0.901	0.778
POV_perc	-0.518	-0.546	-0.807	0.724	0.719	0.699	-0.301	-0.308	-0.212	0.753	0.746	0.708	0.905	0.907	0.776
AAW	0.967	0.965	0.763	0.728	0.734	0.764	0.614	0.568	0.535	0.875	0.869	0.933	0.815	0.813	0.963
	Finland			France			Germany			Greece			Hungary		
POV	-0.708	-0.705	-0.745	-0.481	-0.473	-0.498	0.479	0.492	0.453	-0.631	-0.655	-0.624	-0.787	-0.788	0.835
POV_perc	-0.760	-0.756	-0.801	-0.762	-0.755	-0.768	-0.180	-0.162	-0.169	-0.547	-0.572	-0.553	-0.740	-0.740	0.818
AAW	0.753	0.757	0.440	0.992	0.991	0.925	0.993	0.991	0.964	-0.909	-0.895	-0.870	0.798	0.798	-0.839
	Ireland			Italy			Lithuania			Netherlands			Poland		
POV	0.295	0.307	0.379	0.551	0.515	0.494	0.830	0.828	0.781	0.935	0.936	0.929	-0.663	-0.663	-0.080
POV_perc	-0.105	-0.091	-0.009	0.271	0.258	0.184	0.923	0.924	0.846	0.920	0.921	0.915	-0.654	-0.654	-0.074
AAW	0.302	0.285	0.196	-0.223	-0.268	-0.281	0.962	0.971	0.833	0.284	0.290	0.166	0.848	0.849	0.248
	Portugal			Slovakia			Spain			Sweden			Total[a]		
POV	-0.415	-0.405	0.068	-0.623	-0.502	-0.875	0.539	0.598	0.696	0.939	0.939	0.926	0.879	0.022	-0.268
POV_perc	-0.192	-0.181	0.297	-0.624	-0.497	-0.872	0.533	0.594	0.696	0.768	0.782	0.778	0.186	-0.013	0.058
AAW	-0.593	-0.596	-0.676	0.288	0.101	0.608	-0.805	-0.765	-0.683	0.983	0.987	0.994	0.328	0.453	0.069

S(B)
1.1157

	Negative correlation
	Positive correlation
	Very weak relationship

[a] n = 152 (estimate for the entire sample, without group and time decomposition)

The situation is slightly worse for Greece and Slovakia, which have a negative correlation between green energy and poverty indicators. In the case of Greece, a negative correlation was also observed for the relationship between energy indicators and wage levels, which contradicts the third hypothesis. Another group of countries with similar correlation levels are Poland and Hungary; for those countries, a negative correlation between green energy (except for the SRE indicator) and poverty was recorded, while wages indicate a positive correlation, which may indicate an improvement in the financial situation of the inhabitants of a country. In the case of Belgium, Denmark, Estonia, Lithuania, and Sweden, the correlation between the studied indicators is positive in all cases, i.e. an increase in renewable energy use coincides with an increase in poverty and an increase in wages. Such a situation may indicate an improvement in the financial situation of those above the poverty line and an increasing poverty of those at the bottom of the wealth pyramid. In the other countries analysed, no clear trend in the correlation between the analysed indicators was observed.

4. Discussion

An analysis of the level of electricity capacity of renewable energy (MW) - total (EC) and electricity capacity of renewable energy (MW) per 10,000 inhabitants [EC_pc] from 2011 to 2018 indicated a high rate of change and high levels of differences between the countries (Table 5). Based on an analysis of only the rate of the change in the EC indicator, the leaders in the ranking showing an increase of more than 100% are the Netherlands (207%), Poland (175%), Lithuania (132%), and Ireland (116%). Such a high increase in the EC indicator was the result of a low level of RES in those countries in 2011, which is also evident in the values of the rate of change of the [EC_pc] indicator, which in the examined period was equal to 3.79, 1.4, 1.75, and 4,27, respectively. For these four countries, the most favourable situation was found in Ireland, where a 116% increase in RES allowed a 4.27% increase in EC_pc, and in the Netherlands, where a 207% increase in RES corresponded to a 3.79% increase in the RES share in total energy produced.

Table 5. Electricity capacity of renewable energy (MW) – total and per 10,000 inhabitants, own calculations based on data: IRENA (2020), Renewable Capacity Statistics 2020; & IRENA (2020), Renewable Energy Statistics 2020, The International Renewable Energy Agency, Abu Dhabi

Country	2011	2012	2013	2014	2015	2016	2017	2018
Electricity capacity of renewable energy (MW) – total [EC]								
Austria	16,708	16,656	17,192	17,839	18,473	19,336	19,596	20,358
Belgium	4,198	5,123	5,766	5,993	6,363	6,735	7,432	8,242
Czech Republic	3,681	3,998	4,095	4,170	4,214	4,212	4,272	4,265
Denmark	5,124	5,949	6,584	6,750	7,109	7,410	8,196	8,925
Estonia	334	441	519	561	594	607	615	609
Finland	5,282	5,329	5,632	5,863	6,258	6,862	7,628	7,698
France	34,788	37,085	38,657	40,543	42,792	44,840	47,814	50,527
Germany	67,421	78,150	83,766	90,325	97,851	104,436	112,514	119,296
Greece	5,521	6,570	7,672	8,010	8,138	8,424	8,686	9,020
Hungary	890	724	749	1,024	1,077	1,048	1,194	1,599
Ireland	1,867	1,999	2,312	2,592	2,760	3,101	3,671	4,038
Italy	40,824	46,721	48,857	49,526	50,417	51,195	52,128	53,161
Lithuania	351	451	527	545	693	768	787	815
Netherlands	3,193	3,555	4,265	4,702	5,727	7,114	7,916	9,803
Poland	3,019	4,094	5,116	5,638	6,919	7,881	7,982	8,300
Portugal	10,548	10,955	11,143	11,573	12,153	13,217	13,555	13,767
Slovakia	2,301	2,335	2,359	2,380	2,384	2,397	2,385	2,330
Spain	43,920	46,413	47,676	47,711	47,742	47,773	47,921	48,257
Sweden	23,469	24,293	24,645	25,528	26,869	27,805	28,337	29,244
Electricity capacity of renewable energy (MW) per 10,000 inhabitants [EC_pc]								
Austria	19.95	19.81	20.34	20.97	21.52	22.22	22.34	23.08
Belgium	3.82	4.62	5.18	5.36	5.66	5.95	6.55	7.23
Czech Republic	3.51	3.81	3.89	3.97	4.00	3.99	4.04	4.02
Denmark	9.21	10.66	11.75	11.99	12.56	12.98	14.26	15.44
Estonia	2.51	3.33	3.93	4.27	4.51	4.61	4.68	4.61
Finland	9.83	9.87	10.38	10.76	11.44	12.51	13.86	13.96
France	5.35	5.68	5.89	6.13	6.44	6.73	7.16	7.54
Germany	8.40	9.73	10.40	11.18	12.05	12.71	13.63	14.41
Greece	4.96	5.93	6.97	7.33	7.49	7.81	8.07	8.40
Hungary	0.89	0.73	0.76	1.04	1.09	1.07	1.22	1.63
Ireland	4.09	4.36	5.02	5.59	5.90	6.56	7.67	8.36
Italy	6.88	7.87	8.19	8.15	8.29	8.44	8.60	8.79
Lithuania	1.15	1.50	1.77	1.85	2.37	2.66	2.76	2.90
Netherlands	1.92	2.12	2.54	2.79	3.39	4.19	4.63	5.71
Poland	0.79	1.08	1.34	1.48	1.82	2.08	2.10	2.19
Portugal	9.98	10.39	10.63	11.10	11.71	12.78	13.15	13.38
Slovakia	4.27	4.32	4.36	4.39	4.40	4.42	4.39	4.28
Spain	9.41	9.91	10.2	10.26	10.28	10.29	10.30	10.34
Sweden	24.93	25.62	25.79	26.47	27.57	28.23	28.35	28.90

When analysing the rate of changes in the value of [EC_pc], special attention should be paid to Denmark (an increase by 6.23% from 9.21 to 15.44) and Germany (an increase by 6.01% from 8.40 to 14.41). The highest value of EC_pc was observed in Sweden (28.90) and Austria (23.08), which was associated with an increase in RES production of 25% and 22%, respectively.

In the assessment of the changes in the share of renewable energy in the gross final energy consumption [SRE] (Table 6), the highest rate of change was recorded in Denmark (an increase by 12.02%) with a simultaneous relatively high value of the SRE indicator, which ensured the achievement of the target, set in the Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018, that at least 27% of the energy consumed in the EU per year should come from renewable sources (European Parliament, 2018) as early as in 2018.

The countries that met the requirement set forth in the Regulation in 2018 are Sweden (54.64%), Finland (41.16%), Austria (33.81%), Portugal (30.21%), and Estonia (29.99%). However, an important condition to bear in mind is that *the target for renewable energy is binding at Union level and that it will be fulfilled through Member States' contributions guided by the need to deliver collectively the Union target* (European Parliament, 2018a).

In the case of an analysis of the POV_perc indicator values (Table 7), the largest decreases in poverty levels were observed in Greece and Poland (17%,) and in Hungary (11%). Only Hungary managed to exceed the average value of the POV_perc indicator, which was equal to 16.08% for the group of the studied countries in 2018. Poland and Greece, despite a large change in the value of the indicator, are still in the group of countries for which the value

Table 6. Share of renewable energy in gross final energy consumption [SRE] (%), own calculations based on data: Share of renewable energy in gross final energy consumption [T2020_31] ESTAT

Country	2011	2012	2013	2014	2015	2016	2017	2018
Austria	31.55	32.74	32.67	33.55	33.50	33.37	33.14	33.81
Belgium	6.28	7.09	7.65	8.04	8.03	8.75	9.11	9.48
Czech Republic	10.95	12.81	13.93	15.07	15.07	14.92	14.80	15.14
Denmark	23.39	25.47	27.17	29.32	30.87	32.05	34.68	35.41
Estonia	25.35	25.52	25.32	26.14	28.53	28.72	29.17	29.99
Finland	32.66	34.34	36.73	38.78	39.32	39.01	40.92	41.16
France	10.86	13.27	13.91	14.42	14.86	15.50	15.90	16.44
Germany	12.45	13.54	13.76	14.39	14.91	14.89	15.48	16.67
Greece	11.15	13.74	15.33	15.68	15.69	15.39	17.30	18.05
Hungary	13.97	15.53	16.21	14.62	14.50	14.38	13.54	12.54
Ireland	6.57	7.01	7.58	8.57	9.04	9.17	10.47	10.89
Italy	12.88	15.44	16.74	17.08	17.53	17.42	18.27	17.80
Lithuania	19.94	21.44	22.69	23.59	25.75	25.61	26.04	24.70
Netherlands	4.52	4.66	4.69	5.42	5.67	5.80	6.46	7.34
Poland	10.35	10.97	11.46	11.61	11.89	11.40	11.12	11.48
Portugal	24.61	24.58	25.70	29.51	30.52	30.87	30.61	30.21
Slovakia	10.35	10.45	10.13	11.71	12.88	12.03	11.47	11.90
Spain	13.25	14.31	15.35	16.16	16.26	17.42	17.56	17.45
Sweden	48.14	50.03	50.79	51.82	52.95	53.33	54.16	54.65

Table 7. At risk of poverty rate (cut-off point: 60% of median equivalised income after social transfers), own calculations based on data: At-risk-of-poverty rate by poverty threshold, age and sex – EU-SILC and ECHP surveys, ESTAT

Country	2011	2012	2013	2014	2015	2016	2017	2018
Thousand persons [POV]								
Austria	1,207	1,201	1,203	1,185	1,178	1,208	1,245	1,238
Belgium	1,657	1,667	1,652	1,704	1,649	1,730	1,777	1,844
Czech Republic	1,022	990	886	1,002	1,006	1,001	948	996
Denmark	665	662	664	678	686	675	704	728
Estonia	232	233	248	285	281	283	274	286
Finland	725	704	632	688	668	630	621	652
France	8,605	8,707	8,518	8,302	8,474	8,562	8,310	8,497
Germany	12,814	13,030	12,845	13,337	13,428	13,418	13,139	13,048
Greece	2,349	2,536	2,529	2,384	2,293	2,256	2,151	1,954
Hungary	1,382	1,403	1,461	1,458	1,448	1,398	1,293	1,227
Ireland	680	749	723	779	760	799	751	726
Italy	11,889	11,729	11,667	11,790	12,130	12,481	12,235	12,229
Lithuania	586	559	611	564	649	632	652	644
Netherlands	1,816	1,678	1,735	1,937	1,945	2,132	2,230	2,247
Poland	6,623	6,478	6,520	6,424	6,595	6,481	5,609	5,472
Portugal	1,919	1,887	1,966	2,030	2,019	1,960	1,887	1,777
Slovakia	700	716	694	659	643	668	650	655
Spain	9,550	9,656	9,425	10,218	10,178	10,269	9,950	9,950
Sweden	1,442	1,444	1,528	1,505	1,588	1,598	1,578	1,660
Number of persons per 100.000 inhabitants [POV_perc]								
Austria	14.41	14.28	14.23	13.93	13.72	13.88	14.19	14.03
Belgium	15.06	15.05	14.83	15.24	14.67	15.29	15.65	16.18
Czech Republic	9.75	9.42	8.43	9.53	9.55	9.48	8.96	9.39
Denmark	11.96	11.86	11.85	12.05	12.12	11.83	12.25	12.59
Estonia	17.45	17.58	18.79	21.66	21.37	21.51	20.83	21.68
Finland	13.49	13.03	11.65	12.62	12.21	11.48	11.28	11.83
France	13.24	13.34	12.98	12.55	12.75	12.85	12.44	12.68
Germany	15.97	16.22	15.95	16.51	16.54	16.33	15.92	15.76
Greece	21.12	22.87	22.98	21.82	21.12	20.92	19.98	18.19
Hungary	13.84	14.13	14.74	14.76	14.69	14.22	13.20	12.55
Ireland	14.88	16.32	15.68	16.80	16.25	16.91	15.70	15.03
Italy	20.03	19.75	19.55	19.40	19.95	20.57	20.19	20.22
Lithuania	19.20	18.61	20.56	19.16	22.22	21.88	22.89	22.93
Netherlands	10.90	10.03	10.34	11.51	11.51	12.56	13.06	13.08
Poland	17.40	17.02	17.13	16.90	17.35	17.07	14.77	14.41
Portugal	18.15	17.90	18.75	19.47	19.46	18.95	18.30	17.27
Slovakia	12.98	13.25	12.83	12.17	11.86	12.31	11.96	12.03
Spain	20.46	20.62	20.17	21.97	21.91	22.11	21.38	21.33
Sweden	15.32	15.23	15.99	15.60	16.29	16.22	15.79	16.40

of POV_perc remained above the average value. An unfavourable situation was noted in Belgium, Estonia, Lithuania, the Netherlands, and Sweden, where the value of the indicator increased by 1.12, 4.23, 3.73, 2.18, and 1.08, respectively. The value of the indicator for Estonia is the second highest, which proves that the country has a growing problem of with poverty. The most favourable situation was observed in the Czech Republic where POV_perc is equal to 9.55.
The analysis of the variability of wages (Table 8) indicated a lower amplitude compared to the rate of change observed for the indicators describing green energy. The highest value of the *Average annual wages – constant prices in 2019* [AWW] in 2018, which exceeded the amount of USD 50,000, was recorded in 5 countries (Austria, Belgium, Denmark, Germany, and the Netherlands) for which the rate of changes in wages over the period of 2011-2018 ranged from 0.2% for the Netherlands to 10.9% for Germany. The lowest value of AWW in 2018, which was less than USD 30,000, was recorded for seven countries, and it is particularly worrying that the group of these countries included countries with a high increase in AWW (Estonia 32.7% and Lithuania 36.1%), as well as in countries with a decrease in wages by as much as 9.6% (Greece). This situation is a consequence of great disproportions in wealth between the Member States of the European Union and indicates a problem related to the lack of a systemic approach to implementation of sustainable development goals, in particular in the context of the first goal.

Table 8. Average annual wages – constant prices at 2019 [AWW] (in USD PPPs), own calculations based on data: OECD.Stat

Country	2011	2012	2013	2014	2015	2016	2017	2018
Austria	52,179	52,446	52,510	52,711	53,052	53,589	53,437	53,561
Belgium	53,886	54,295	54,845	55,117	54,737	54,884	54,626	55,066
Czech Republic	24,072	24,060	23,806	24,304	24,970	25,819	26,889	28,360
Denmark	53,668	53,593	53,949	54,978	55,943	56,883	56,277	56,828
Estonia	21,479	21,798	22,333	23,548	24,629	25,841	26,555	28,499
Finland	44,528	44,574	44,138	44,138	44,616	44,976	44,864	45,023
France	43,682	43,975	44,345	44,651	45,088	45,610	46,163	46,256
Germany	47,739	48,392	48,862	49,700	50,878	51,623	52,181	52,930
Greece	30,398	28,972	27,100	27,574	27,449	27,395	27,322	27,480
Hungary	22,543	21,664	21,414	21,148	21,450	21,810	23,527	24,703
Ireland	49,746	49,194	47,972	47,597	48,408	49,030	49,585	49,695
Italy	39,328	38,086	38,205	38,354	38,691	38,982	38,707	38,853
Lithuania	20,106	20,412	21,226	22,180	23,593	24,854	26,258	27,368
Netherlands	56,588	56,820	57,020	56,712	57,378	57,573	57,138	56,709
Poland	24,536	24,320	24,597	25,098	25,648	26,934	28,071	30,091
Portugal	27,385	26,209	26,712	26,253	26,176	26,024	26,141	26,413
Slovakia	21,071	20,813	20,966	21,377	22,230	22,947	23,610	24,254
Spain	40,302	39,176	39,178	39,056	39,638	39,413	38,898	38,554
Sweden	42,180	43,133	43,647	44,240	44,849	45,552	45,818	46,062

In the comparative analysis of the changes in the EC per capita and the changes in wages in the EU-19 countries between 2011 and 2018 (Table 9), no clear trend was observed. The following four basic groups of countries can be distinguished:

A. Countries where the change in EC per capita significantly exceeds that in AWW and both values are positive (Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Hungary, Lithuania, Netherlands, and Poland).
B. Countries where the change in EC per capita exceeds that of AWW, both values are positive, and the change in AWW is equal to at least 50% of the value of the change in EC_pc (Sweden).
C. Countries where the change in AWW exceeds that in EC per capita and both values are positive (Czech Republic and Slovakia).
D. Countries where the change in AWW is negative (Greece, Ireland, Italy, Portugal, and Spain).

In the case of countries from groups A, B, and C, a comparison of the changes in EC per capita with the changes in wages in the EU-19 countries in 2011-2018 presents a picture analogous to the results shown in model 1 according to which, on average, a higher level of wages is accompanied by a greater scale of renewable energy use. What sets the groups apart is the difference in the values of the changes in the individual indicators. As for countries in group D, there was a decrease in the value of AWW, while EC per capita increased. The produced results comply with the studies presented in the literature, according to which an increase in salaries is positively correlated with the total consumption of electrical energy, as well as with the level of electrical energy originating from renewable sources (Qiu et al., 2018). The relationship between sustainable economic development and renewable energy is also studied via a bidirectional analysis of primary variables of economic growth and the consumption of renewable electrical energy (Armeanu et al., 2017; Pedroni, 2004). The results of studies performed by Apergis and Apergis (2020) indicate the existence of bidirectional causality of economic growth and the consumption of electrical energy from renewable sources in a short- and long-term perspective. The economic growth depends largely on energy sources. Most studies point to the existence of positive correlation (Khuong et al., 2020) between the utilisation of electrical energy and the level of economic growth. Another important issue is an analysis of correlation in the context of utilising a specific energy source.

Table 9. Comparison of the change in EC per capita and the change in wages in EU-19 countries, 2011-2018, own calculations based on data: OECD.STAT, ESTAT, IRENA (2020), Renewable Capacity Statistics 2020; & IRENA (2020), Renewable Energy Statistics 2020, The International Renewable Energy Agency, Abu Dhabi

Specification		Change compared to the previous year [%]							2018/2011
		2012	2013	2014	2015	2016	2017	2018	
Austria	EC_pc	-0.7%	2.7%	3.1%	2.6%	3.3%	0.5%	3.3%	15.7%
	AWW	0.5%	0.1%	0.4%	0.6%	1.0%	-0.3%	0.2%	2.6%
Belgium	EC_pc	21.2%	11.9%	3.6%	5.6%	5.2%	9.9%	10.4%	89.5%
	AWW	0.8%	1.0%	0.5%	-0.7%	0.3%	-0.5%	0.8%	2.2%
Czech Republic	EC_pc	8.4%	2.3%	1.9%	0.8%	-0.2%	1.2%	-0.4%	14.5%
	AWW	-0.1%	-1.1%	2.1%	2.7%	3.4%	4.1%	5.5%	17.8%
Denmark	EC_pc	15.7%	10.2%	2.1%	4.7%	3.4%	9.8%	8.3%	67.5%
	AWW	-0.1%	0.7%	1.9%	1.8%	1.7%	-1.1%	1.0%	5.9%
Estonia	EC_pc	32.5%	17.9%	8.6%	5.8%	2.2%	1.4%	-1.3%	83.5%
	AWW	1.5%	2.5%	5.4%	4.6%	4.9%	2.8%	7.3%	32.7%
Finland	EC_pc	0.4%	5.2%	3.6%	6.3%	9.3%	10.8%	0.7%	42.1%
	AWW	0.1%	-1.0%	0.0%	1.1%	0.8%	-0.2%	0.4%	1.1%
France	EC_pc	6.1%	3.7%	4.0%	5.1%	4.5%	6.4%	5.3%	40.8%
	AWW	0.7%	0.8%	0.7%	1.0%	1.2%	1.2%	0.2%	5.9%
Germany	EC_pc	15.8%	6.9%	7.5%	7.8%	5.5%	7.3%	5.7%	71.4%
	AWW	1.4%	1.0%	1.7%	2.4%	1.5%	1.1%	1.4%	10.9%
Greece	EC_pc	19.4%	17.7%	5.1%	2.2%	4.2%	3.3%	4.1%	69.2%
	AWW	-4.7%	-6.5%	1.8%	-0.5%	-0.2%	-0.3%	0.6%	-9.6%
Hungary	EC_pc	-18.2%	3.7%	37.2%	5.4%	-2.4%	14.3%	34.1%	83.4%
	AWW	-3.9%	-1.2%	-1.2%	1.4%	1.7%	7.9%	5.0%	9.6%
Ireland	EC_pc	6.6%	15.1%	11.4%	5.6%	11.2%	16.9%	9.0%	104.7%
	AWW	-1.1%	-2.5%	-0.8%	1.7%	1.3%	1.1%	0.2%	-0.1%
Italy	EC_pc	14.4%	4.1%	-0.5%	1.8%	1.8%	2.0%	2.2%	27.8%
	AWW	-3.2%	0.3%	0.4%	0.9%	0.8%	-0.7%	0.4%	-1.2%
Lithuania	EC_pc	30.5%	18.1%	4.4%	28.1%	12.0%	4.0%	5.0%	152.1%
	AWW	1.5%	4.0%	4.5%	6.4%	5.3%	5.7%	4.2%	36.1%
Netherlands	EC_pc	10.8%	19.6%	9.9%	21.3%	23.6%	10.6%	23.1%	197.6%
	AWW	0.4%	0.4%	-0.5%	1.2%	0.3%	-0.8%	-0.8%	0.2%
Poland	EC_pc	35.6%	25.0%	10.3%	22.8%	14.0%	1.3%	4.0%	175.6%
	AWW	-0.9%	1.1%	2.0%	2.2%	5.0%	4.2%	7.2%	22.6%
Portugal	EC_pc	4.2%	2.3%	4.5%	5.5%	9.1%	2.9%	1.7%	34.1%
	AWW	-4.3%	1.9%	-1.7%	-0.3%	-0.6%	0.5%	1.0%	-3.6%
Slovakia	EC_pc	1.3%	0.9%	0.8%	0.1%	0.5%	-0.6%	-2.4%	0.3%
	AWW	-1.2%	0.7%	2.0%	4.0%	3.2%	2.9%	2.7%	15.1%
Spain	EC_pc	5.3%	2.9%	0.5%	0.2%	0.1%	0.1%	0.4%	9.9%
	AWW	-2.8%	0.0%	-0.3%	1.5%	-0.6%	-1.3%	-0.9%	-4.3%
Sweden	EC_pc	2.8%	0.7%	2.6%	4.1%	2.4%	0.4%	1.9%	15.9%
	AWW	2.3%	1.2%	1.4%	1.4%	1.6%	0.6%	0.5%	9.2%

Conclusions

Despite the synergistic nature of the sustainable development goals, the different action items are carried out in an individual manner. The success of the program requires cooperation in the actions aimed at the achievement of the different goals. The analysis confirmed a coincidence between an increase in the level of use of energy from renewable sources with an increase in the level of wages. In the case of the analysis of the relationship between the renewable energy indicators and the poverty indicators, a negative relationship was observed: an increase in the use and share of renewable energy coincided with an increase in the poverty indicators. This situation is due to fact that certain investment outlays must be incurred in order to launch RES installations and for financial reasons, such outlays are affordable to persons who live above the poverty level. The increase in the number of poor people with a concomitant increase in the level of RES energy indicates a lack of, or deficits in, the mechanisms applied to support poor persons who want to use environmentally friendly renewable energy sources.

On the one hand, consumers can benefit from the lower prices of energy; on the other hand, prior to that, they must pay the costs of installations generating energy from renewable sources. Subsidies and tax reliefs for renewable energy often do not cover the total costs of the assembly and activation of an installation. In addition, an investor's own contribution is required, which cannot be afforded by the poorest. Therefore, it seems extremely important to properly administer support measures for RES by precisely defining the criteria determining the intensity of support for specific social groups (Abrell et al., 2019; Abrell et al., 2019A). Dispersed renewable energy systems are becoming a strong element of local sustainable development strategies (Frank et al., 2018). The construction of a sustainable energy mix on a local scale, with a simultaneous drop in the share of coal, undoubtedly contributes to a decrease in the emission of pollutants into the environment (Kaczmarczyk et al., 2020). A combination of a bottom-up approach for individual countries with actions implemented on the scale of the European Union and globally allows for the creation of a coherent global set of assumptions related to the development of technologies supporting the decarbonisation process (Gielen et al., 2019). Renewable energy is a crucial element of sustainable economic development (Sebri et al., 2014). It is therefore necessary to constantly monitor development trends regarding modern technologies enabling the production of green energy from renewable sources, and to identify barriers obstructing the decarbonisation process of the energy sector, both on a local and a global scale.

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