Abstract: This paper focuses on the analysis of trends in the development of nuclear energy in selected European and non-European countries in the context of the pace of renewable energy development in the world. The perception of Poles related to their openness to various energy sources against the background of European trends was also examined, as well as their ecological approach to the quality of the environment in this context. The survey was carried out using the Computer Assisted Web Interview (CAWI) technique. The total number of correctly completed forms was 923. To identify the ecological attitude, purchasing attitude, and the perception of nuclear energy, the research tool contained a number of statements on the issues studied, and the respondents assessed compliance with their opinion using a seven-point bipolar scale. The semantic differential was also used to gather opinions on the characteristics of nuclear energy. This paper shows that global trends are promoting the development of unstable renewable energy sources and the reduction of the share of nuclear power plants as an energy source. It has also been shown that the Organization for Economic Co-operation and Development (OECD) countries are more skeptical about nuclear power than countries that do not belong to the OECD (for example, China and Africa).

Keywords: perspectives for the development of energy; nuclear energy; renewable energy sources; social perception; ecological attitude

1. Introduction

By 2050, the World Nuclear Industry Status Report (WNISR) [1] predicts an almost 50% increase in energy consumption (compared to 2018). Most of this increase (Table 1) is expected to come from countries that are not members of the Organization for Economic Cooperation and Development (OECD), primarily to the rapidly growing economies of Asia [2,3]. The increase in energy consumption for 2018–2050 will take place in the agricultural and construction industries—at the level of 30%, in transport—at the level of 40%, and in the municipal and housing sector—at the level of 65% [4].

These changes are and will be related mainly to the growing incomes in the world scale, progressing urbanization, and increased access to electricity, i.e., with the progress of electrification, especially in non-OECD countries [4]. Energy consumption is also expected to increase by up to 79% [5]. In addition to the above-mentioned factors [1], it will be caused by the increase in the population of our planet [6] and the increasing standard of living in many countries [7,8]. Moreover, it will be related to the development of transport based on electric vehicles—both cars and electrified railways [9].

Table 2 shows the consumption of electricity from various sources in 2018–2050 [2,3]. The consumption of electricity from Renewable Energy Sources (RES) is to grow (on average) by 3.1% per year [10]. By comparison, crude oil is projected to grow by 0.6%, for coal by 0.4%, and for natural gas by 1.1% per year [11]. Growth is also expected for all
fossil fuels [11]. In contrast, the consumption of electricity generated by nuclear power plants is expected to increase quite slightly (1% per year) [12,13], thus the percentage of nuclear power in energy production will decline [14]. Total global consumption of natural gas is expected to increase by more than 40% by 2050 [11]. Not only the amount of gas used to produce electricity is to increase. More of this raw material is also to be used in industries—mainly chemical, metallurgical, and mining [1,11]. The total consumption of liquid fuels is to increase by over 20% [1]. The WNISR [1] report also predicts that the global coal consumption will decrease until 2030, since the coal used to generate electricity is to be replaced by natural gas and renewable energy sources [15]. However, in the years 2030–2040, a further increase in coal consumption is expected, which is to be a consequence of the growing consumption of this raw material in industry and electricity generation in Asian countries not belonging to the OECD (except China) [16,17]. The data analyses show that the demand in OECD countries in the analyzed period remains relatively stable [18,19], and the demand in non-OECD countries increases by about 45% [17,20].

Table 1. Average annual percent change in gross domestic product (GDP) in 2018–2050—own study based on data [2,3].

| OECD Countries | % Per Year | Non-OECD Countries | % Per Year |
|----------------|------------|---------------------|------------|
| Australia and New Zealand | 2.3 | India | 5.4 |
| Mexico and Chile | 2.0 | Africa | 3.9 |
| USA | 1.9 | Other Asia | 3.9 |
| Korea | 1.8 | China | 3.9 |
| Canada | 1.4 | Middle East | 2.5 |
| OECD Europe | 1.3 | Other Americas | 2.4 |
| Japan | 0.3 | Other Europe and Eurasia | 2.3 |
| | | Brazil | 1.5 |
| | | Russia | 1.1 |
| Total OECD countries | 1.5 | Total non-OECD countries | 3.8 |

Table 2. World consumption of electricity from various sources [%]—comparison of 2018 to the forecasts for 2050—own study based on data [2,3].

| Year | RES | Oil | Carbon | Natural Gas | Nuclear Energy |
|------|-----|-----|--------|-------------|----------------|
| 2018 | 15  | 32  | 26     | 22          | 5              |
| Forecast for 2050 | 28 | 27 | 20 | 22 | 4 |

The society is also aware of the threat of a climate catastrophe, therefore investing in coal ceases to be lucrative for business [21,22]. The climate policy of the European Union also promotes an end to fossil fuels [23,24]. Some Poles also believe that coal is not the future of the Polish energy and heating industry [25–28]. Many countries in the world perceive nuclear energy as an alternative [29–32], despite its many disadvantages and difficult-to-overcome social resistance to this type of energy source in some countries, including Poland [1,31]. In discussions about nuclear energy, a radical polarization of positions can be noticed: Both opponents of nuclear energy and its supporters present one-sided views [33–35]. Meanwhile, nuclear energy—as indeed any large-scale energy source—has its real advantages and disadvantages, which should be taken into account in discussions about the shape of the future energy system [1,36,37].

As of 1 July 2019, a total of 417 nuclear reactors started operating in 31 countries around the world, an increase compared to July 2018 (Table 3, Figure 1) [1–3]. The current global pool of all nuclear power plants has a combined nominal net capacity of 370 GW, an increase of 6.7 GW (+1.9%) compared to 2018 [1], with 46 reactors under construction over the same period. Four reactors are currently under construction and five projects have
been abandoned. Three of the four reactors are built in Asia and Eastern Europe [1,4,14]. In total, 16 countries are building nuclear power plants (Table 3 and Figure 1). In 2018, construction of five nuclear reactors began, one each in Bangladesh, Russia, Korea, and the United Kingdom (Figure 1) [38–40]. In the first half of 2019, only one such project was launched worldwide, in Russia. Russian companies are also building reactors in Bangladesh and Turkey. Russia is involved in four of the six projects of this type launched since the beginning of 2018.

Table 3. Countries building nuclear reactors—as of 2019 [1,38–40].

| Country     | Capacity (MW Net) | Construction Starts | Grid Connection |
|-------------|-------------------|---------------------|----------------|
| China       | 8800              | 2012–2017           | 2020–2023      |
| India       | 4824              | 2004–2017           | 2019–2023      |
| Russia      | 3379              | 2007–2019           | 2019–2023      |
| UAE*        | 5380              | 2012–2015           | 2020–2023      |
| Korea       | 5360              | 2012–2018           | 2019–2024      |
| Belarus     | 2218              | 2013–2014           | 2019–2020      |
| Bangladesh  | 2160              | 2017–2018           | 2023–2024      |
| Slovakia    | 880               | 1985                | 2020–2021      |
| USA         | 2234              | 2013                | 2021–2022      |
| Pakistan    | 2028              | 2015–2016           | 2020–2021      |
| Japan       | 3125              | 2007                | ?              |
| Argentina   | 25                | 2014                | 2021           |
| UK          | 1630              | 2018                | 2025           |
| Finland     | 1600              | 2005                | 2020           |
| France      | 1600              | 2007                | 2022           |
| Turkey      | 1114              | 2018                | 2024           |
| Total       | 44,557            | 1985–2019           | 2019–2025      |

UAE: The United Arab Emirates; ?: This table does not contain suspended or abandoned constructions.

Nuclear power is still used in a small part of the world—only 31 countries or 16% of the 193 members of the United Nations, have nuclear power plants [1,4,14]. This number has remained constant since Iran launched its first reactor in 2011. Only four countries (Mexico, China, Romania, Iran) have launched commercial reactors in the last 30 years, and three countries (Italy, Kazakhstan, Lithuania) have abandoned the program [1–3]. While there is
disagreement as to whether and what role nuclear energy may play in the future [41–43], in a world rapidly abandoning coal, it is clear that renewable energy will dominate the future energy system [44–47] and as its use accelerates, it will have an advantage over nuclear energy (Figures 2 and 3). Data on the volume of energy obtained from renewable sources in the European Union presented in Figures 2 and 3 show that the three largest sources of renewable energy are hydropower, on-shore wind, and biomass [6,8,27,28,30,48].

**Figure 2.** The structure of RES in the European Union in 2005–2030—energy produced in (TWh)—own study based on data [7,48].

**Figure 3.** Total capacity in TWh in the European Union from renewable energy sources for the period 2005–2030—own study based on data [7,48].
By 2050, the EU aims to create a completely low-carbon electricity system [6,8,10]. This will require accelerating the current pace of renewable energy deployment (Figures 2 and 3). There is no EU-wide target for the development of nuclear energy, and the share of nuclear energy has been decreasing for decades [14].

Moreover, there are indications that nuclear energy, at the best, will marginally contribute to the development of a selected group of countries and markets, and will most likely continue to decline, one of the main reasons being economic factors [4,6,9]. This is also indicated by investment decisions in the field of renewable energy sources and in the implementation of nuclear projects (Table 4).

### Table 4. Global investment decisions in USD billion (approximate values) regarding RES and nuclear energy in 2004–2018 [1,8,9].

| Years | Types of Energy Sources—Investments in USD Billion |
|-------|--------------------------------------------------|
|       | Nuclear Energy | Wind | Solar | Other RES |
| 2004  | 0              | 20   | 10    | 10        |
| 2005  | 5              | 25   | 20    | 30        |
| 2006  | 10             | 35   | 20    | 60        |
| 2007  | 15             | 60   | 40    | 60        |
| 2008  | 20             | 75   | 60    | 25        |
| 2009  | 25             | 80   | 55    | 40        |
| 2010  | 35             | 100  | 110   | 45        |
| 2011  | 5              | 85   | 155   | 30        |
| 2012  | 25             | 80   | 140   | 35        |
| 2013  | 45             | 85   | 125   | 35        |
| 2014  | 10             | 110  | 150   | 40        |
| 2015  | 25             | 125  | 180   | 25        |
| 2016  | 15             | 124  | 135   | 20        |
| 2017  | 20             | 105  | 170   | 15        |
| 2018  | 30             | 140  | 145   | 20        |
| Total USD billion | 285 | 1249 | 1515 | 490 |

Table 5 compares investment decisions for the construction of new nuclear power plants with those for renewable energy from 2004 to 2018. The estimates of nuclear investments in the 2018 after WNISR [1] report are similar to those proposed by the Renewable Energy Policy Network for the 21st century [4,8,9], suggesting that new investments will amount to USD 33 billion. The Renewable Energy Policy Network for the 21st century (REN21) [8] report states that new renewable energy investments in 2018, excluding large hydropower plants, accounted for 65% of all new electricity generation capacity and totaled USD 273 billion [5–10]. Globally, the relative importance of Europe and North America for renewable energy investment is declining with the growing importance of Asia, especially China, India, and Japan (Table 5). The face value of China’s renewable energy investments increased from USD 26 billion in 2008 to USD 146 billion in 2017, before plunging sharply to USD 91 billion in 2018. Total investment in the nuclear sector in China in the same period was approximately USD 82 billion [1,8].

Falling global renewable energy sources costs are in contrast to nuclear energy costs, which are at the best constant and often are significantly increasing. Consequently, it is widely recognized that the cost of renewable energy sources are now much lower than that of nuclear or gas energy sources [14,31,49].

The draft of Poland’s Energy Policy until 2040 still focuses on nuclear energy and envisages its development up to 9 GW in 2043. The commissioning of the first nuclear unit is scheduled for 2033, and the next five—by 2043 [1,31]. The basic arguments of Polish government for the development of nuclear power are its low impact on the climate, and therefore no cost burden of the EU climate and environmental policy, and the stability of electricity generation [6,7]. In this way, coal-fired power plants are to be partially replaced [26,31,32]. Against it, however, the high and constantly growing construction costs,
The lack of solutions to the problem of securing radioactive waste, the long construction time of reactors and frequent delays with the completion of investments [1–3,32]. On the side of potential benefits for Poland, the use of the nuclear program to obtain highly enriched uranium $^{235}$U or plutonium $^{239}$Pu produced in the reactor, allowing Poland to acquire nuclear weapons, is also raised [26]. On the other hand, renewable energy sources (RES) are much smaller and require less resources, as well as investments in energy efficiency—thus they are available to individual investors and local communities [27,28,31].

Table 5. Comparison of investments in USD billion in RES in various countries of the world (approximate values) [1,8].

| Years | China | India | Asia without China and India | Middle East and Africa | Brazil | Americas without USA and Brazil | USA | Europe |
|-------|-------|-------|-----------------------------|------------------------|--------|-------------------------------|-----|--------|
| 2008  | 30    | 10    | 20                          | 1                      | 15     | 5                             | 40  | 80     |
| 2009  | 50    | 5     | 15                          | 1                      | 5      | 5                             | 30  | 90     |
| 2010  | 55    | 15    | 30                          | 2                      | 5      | 20                            | 40  | 108    |
| 2011  | 50    | 20    | 40                          | 2                      | 10     | 20                            | 50  | 130    |
| 2012  | 60    | 10    | 40                          | 4                      | 10     | 15                            | 45  | 97     |
| 2013  | 65    | 5     | 45                          | 5                      | 10     | 20                            | 40  | 59     |
| 2014  | 80    | 10    | 55                          | 5                      | 2      | 25                            | 45  | 75     |
| 2015  | 130   | 15    | 50                          | 10                     | 5      | 20                            | 49  | 70     |
| 2016  | 110   | 20    | 40                          | 5                      | 2      | 10                            | 48  | 75     |
| 2017  | 140   | 25    | 50                          | 10                     | 2      | 20                            | 50  | 50     |
| 2018  | 90    | 20    | 40                          | 20                     | 1      | 15                            | 50  | 70     |
| Total Billion of USD | 860 | 155 | 425 | 65 | 67 | 175 | 487 | 904 |

The aim of this study was to situate the Polish perception of the development of nuclear energy in the context of ecological attitudes, against the background of global energy issues. The research problem posed is to examine the attitudes of people living in the region of south-eastern Poland to the development of nuclear energy and their acceptance of various energy sources against the background of European trends. The following research questions were formulated: What is the perception of the inhabitants of south-eastern Poland about nuclear energy? Is the ecological attitude and purchasing attitude of the respondents related to the perception of nuclear energy? Are there any gender differences in the perception of nuclear power in the study group?

2. Research Material and Methodology

South-eastern Poland is a region characterized by a high quality of natural environment and, at the same time, distance from large centers of electricity generation. The management structure is dominated by small and medium-sized farms. It is a region adjacent to Ukraine, where the nuclear disaster took place in 1986. This event probably remains in collective social memory. The conducted research was aimed at identifying the perception of nuclear energy by respondents living in the south-eastern region of Poland in the context of their ecological attitudes.

The survey was conducted in March 2021. The spatial scope of the social survey covered south-eastern Poland. The subjects of the study were the inhabitants of the Podkarpackie and Lubelskie voivodships. The authors of this publication, due to their participation in the creation of regional strategic documents, are well acquainted with the socio-economic specificity of this region, therefore the geographical scope was adopted as a feature qualifying for research, the fact of living in the studied area. The study was partial. The research sample was selected by the snowball method in order to reach people living in the study area. First, the questionnaire was handed over to a group of several dozen people who met the precondition, and then these people invited other respondents. The total number of correctly completed forms was 923. The subject of the study was the respondents’
opinion on nuclear energy. The research tool was a questionnaire form. The survey was carried out using the Computer Assisted Web Interview (CAWI) technique. The survey was anonymous. The form consisted of three parts. In the first part, the respondents assessed a number of formulated theses. The respondents’ task was to assess the compliance of these theses with their beliefs. The assessment was made using a seven-point bipolar Likert scale, which contained a neutral mean value [50]. In the scale used, the value of 1 meant a definitely negative attitude, 4 meant indecision, and the value 7 meant strong support for the thesis assessed. The collected assessments were to provide information for the identification of the respondents’ ecological attitude, purchasing attitude, and attitude towards nuclear energy. The second part of the research tool contained a semantic differential relating to the basic, commonly perceived characteristics of nuclear power. The Osgood scale was a five-point scale, where one meant an adjective characterizing a negative assessment, and five an adjective with a positive connotation [51,52]. The third part gathers information on the basic socio-demographic characteristics of the respondents. The Statistica program was used for statistical analysis of the collected material [53].

With regards to this part of the collected research material, a cluster analysis was carried out using the Ward’s method [54]. This type of analysis allows for the identification of structures in the collected data and grouping them according to their characteristic features [55,56]. Cluster analysis makes it possible to distinguish homogeneous subsets of objects of the studied population by combining them into groups that are relatively homogeneous internally and relatively diverse among themselves [57]. Extracting clusters are based on the variables characterizing the analyzed objects. In this study, these variables were the assessment of compliance of the respondents’ beliefs with the formulated theses. Thanks to this method, it is possible, inter alia, to detect any regularity. The structure of the number of grades made on the bipolar Likert scale was also calculated. This made it possible to determine the number and degree of support for theses prepared in order to verify the respondents’ attitudes. Average measures were used to describe the collected numerical material—arithmetic mean and median (middle value). The classical measure of variability in the form of the standard deviation was calculated [57], and the measures of the central tendency in the form of quartiles were calculated, dividing a given group into four equal parts (Q1 = 25% of observations, Me = 50% of observations, Q3 = 75% of observations) [53].

The semantic differential (Osgood scale) was used to determine the opinions of the respondents on the features of nuclear power. A five-point scale was used to express the difference between the used opposing adjectives describing the studied features of nuclear power [51,52]. In order to identify the relationship between the studied variables, a linear correlation was calculated. It allows for the identification of the relationship between the variables and determines the strength of the linear relationship [53].

3. Results

The analysis of the clusters in the “binding distance to the binding stages” part showed an increase in the distance above y = 88.48. Cutting the dendrogram in this position allowed for the separation of four clusters (Figure 4). The first of them included theses numbered 2, 3, 5, 19, 17, 21, 20, 18. This cluster includes two smaller ones. One that combines an ecological attitude with a positive attitude towards traditional food, and the other one that combines the features of a rational purchasing attitude. However, it should be remembered that this is one larger focus. The second cluster combined the theses of a wait-and-see nature of nuclear energy (theses 6, 13, 7). The theses in this focus related to the benefits of this energy. The fourth most numerous group combined theses concerning various aspects of nuclear power (theses 4, 8, 16, 14, 15, 9, 12). This group includes theses relating to the self-assessment of knowledge related to nuclear energy, checking the state of this knowledge and relating to the availability of information on this subject. There are also theses regarding support for building a power plant close to home and the need to regulate
the human population. The last focus combined theses relating to concerns related to nuclear power plants (theses 10, 11).

Figure 4. Cluster analysis dendrogram (own research). These numbers: 2—consumption needs to be reduced due to finite raw material resources; 3—the increasing demand for energy can be met by developing the use of renewable energy sources; 4—nuclear power is emission-free; 5—reducing CO₂ emissions is necessary to halt climate change; 6—I think that Poland should have its own nuclear power plants; 7—building a nuclear power plant is an element of making Poland independent from Russian energy supplies; 8—Poland has significant fuel resources to power nuclear power plants; 9—Poland should aim to have nuclear weapons; 10—a nuclear power plant has a negative effect on food quality; 11—there is a high risk of nuclear power plant failures; 12—it is necessary to regulate the human population due to the spectre of overpopulation, hunger, and lack of new energy sources; 13—new technologies in nuclear energy are the future of humanity; 14—the availability of knowledge about nuclear energy is sufficient; 15—I am well versed in nuclear energy issues; 16—I support the construction of a nuclear power plant in my district; 17—I only buy as much food and other products as I need at any given time; 18—when I buy, I pay attention to whether the product has quality certificates, ecological labels, other markings attesting to environmental friendliness; 19—traditionally produced food is more nutritious than industrially produced food; 20—foods containing genetic modifications may pose a risk to the consumer; 21—I am able to pay 10% more for organic, wholesome, and safe food.

Table 6 presents the structure of evaluations of phrases representing the studied issues using a seven-point bipolar scale. The structure according to the direction of evaluation (supporting or contradicting a given thesis) was also presented. On the other hand, Table 7 presents the assessment of theses concerning the ecological and purchasing attitudes in a similar way.

The data presented in Table 6 show that although 37.6% of respondents consider nuclear power plants to be dangerous, most (61.3%) expressed the expectation of building a nuclear power plant in Poland and saw it as a way of an energy independent country (65.2%). Most of the respondents (57.2%) were aware of the lack of knowledge about nuclear energy, and claimed that the availability of knowledge on this subject was insufficient (59%). This was confirmed by the opinion on nuclear fuel resources in Poland, where 38.4% did not have an opinion, and 25.2% expressed a misconception. From among the respondents, 38.9% claimed that nuclear energy has no negative impact on the quality of food and expressed an opinion about the positive role of this form of energy in the future (71.5%). More than half of the respondents (54.1%) did not support Poland’s possession of nuclear weapons. Almost one third of the respondents (32.4%) did not oppose the
construction of a nuclear power plant in the vicinity of their place of residence, 49.6% were against, and 24.6% of the respondents expressed strong opposition.

Table 6. Assessment structure of statements representing issues related to nuclear power using a seven-point bipolar scale and a group of assessments according to the direction of assessment (own research).

| Theses and Their Numbers | Definitely Not | No | Probably Not | Neither Yes Nor No | Probably Yes | Yes | Definitely Yes | Rating Groups [%] |
|--------------------------|----------------|----|--------------|--------------------|--------------|-----|----------------|------------------|
| Nuclear power is emission-free (4) | 9.3 | 11.7 | 16.6 | 27.5 | 15.9 | 11.9 | 7.0 | 37.6 | 27.5 | 34.9 |
| I think that Poland should have its own nuclear power plants (6) | 6.7 | 7.7 | 7.4 | 16.9 | 16.5 | 15.8 | 29.0 | 21.8 | 16.9 | 61.3 |
| Building a nuclear power plant is an element of making Poland independent from Russian energy supplies (7) | 4.6 | 3.9 | 7.0 | 19.3 | 21.8 | 19.6 | 23.8 | 15.5 | 19.3 | 65.2 |
| Poland has significant fuel resources to power nuclear power plants (8) | 6.6 | 9.5 | 20.3 | 38.4 | 15.0 | 6.5 | 3.8 | 36.4 | 38.4 | 25.2 |
| Poland should aim to have nuclear weapons (9) | 24.1 | 15.5 | 14.5 | 16.8 | 12.0 | 5.9 | 11.3 | 54.1 | 16.8 | 29.1 |
| Nuclear power plant has a negative impact on food quality (10) | 11.2 | 12.8 | 15.0 | 28.3 | 14.5 | 9.8 | 8.6 | 38.9 | 28.3 | 32.8 |
| There is a high risk of nuclear power plant failures (11) | 10.2 | 16.8 | 17.1 | 17.0 | 16.3 | 10.6 | 12.0 | 44.1 | 17.0 | 38.9 |
| New technologies in nuclear energy are the future of humanity (13) | 2.6 | 3.3 | 6.4 | 16.3 | 22.4 | 23.0 | 26.1 | 12.2 | 16.3 | 71.5 |
| The availability of knowledge about nuclear energy is sufficient (14) | 16.4 | 21.8 | 20.9 | 16.8 | 13.3 | 6.8 | 4.0 | 59.0 | 16.8 | 24.2 |
| I am well versed in nuclear energy issues (15) | 16.6 | 20.5 | 20.2 | 22.0 | 12.7 | 5.3 | 2.8 | 57.2 | 22.0 | 20.8 |
| I support the construction of a nuclear power plant in my district (16) | 24.6 | 13.2 | 11.8 | 18.0 | 11.8 | 9.4 | 11.2 | 49.6 | 18.0 | 32.4 |

In order to identify the ecological attitude of the respondents, these were formulated regarding the need to reduce consumption, develop renewable energy sources, reduce CO₂ emissions, and regulate the human population. Apart from the latter postulate, where 58.7% of the respondents objected, all the other theses gained clear support. Over 2/3 of the respondents (69.7%) supported the postulate of the need to limit consumption, while 82.8% saw the need to limit carbon dioxide emissions. Equally strong support (88.1%) was obtained by the theses concerning the possibility of covering the growing demand for energy with energy from renewable sources. Therefore, it can be concluded that the studied group showed a high level of ecological sensitivity.

Regarding the purchasing attitude, the theses concerning the supply of necessary products without the tendency to stockpile were formulated, identifying the perception of traditional, genetically modified food, and conscious purchasing. All formulations were supported by the respondents, which may indicate a rational purchasing attitude characterized by the search for safe and wholesome food. Most of the respondents (74.8%) declared making purchases on an ongoing basis, without the tendency to stock up, and were willing to incur higher costs of organic food (71.6%). The theses characterizing the purchasing attitude have been formulated in such a way that their support gives an image
of the pro-ecological profile of the consumer. It should be stated that the obtained results confirm this attitude of the respondents.

Table 7. The structure of evaluations of phrases representing issues related to the ecological attitude and purchasing attitude using a seven-point bipolar scale and a group of evaluations according to the direction of assessment (own research).

| Theses and Their Numbers                                                                 | Assessment [%] | Rating Groups [%] |
|------------------------------------------------------------------------------------------|----------------|------------------|
|                                                                                         | Definitely Not| No               |
| Consumption needs to be reduced due to finite raw material resources. (2)               | 3.4            | 3.8              |
|                                                                                         | 8.8            | 14.4             |
|                                                                                         | 27.0           | 21.3             |
|                                                                                         | 21.3           | 15.9             |
|                                                                                         | 14.4           | 69.7             |
| The increasing demand for energy can be met by developing the use of renewable energy sources. (3) |                |                  |
|                                                                                         | 0.7            | 1.8              |
|                                                                                         | 3.7            | 5.7              |
|                                                                                         | 15.9           | 25.8             |
|                                                                                         | 46.4           | 6.2              |
|                                                                                         | 5.7            | 88.1             |
| Reducing CO\(_2\) emissions is necessary to halt climate change. (5)                  | 2.0            | 2.6              |
|                                                                                         | 2.9            | 9.8              |
|                                                                                         | 16.6           | 25.7             |
|                                                                                         | 40.5           | 7.5              |
|                                                                                         | 9.8            | 82.8             |
| It is necessary to regulate the human population due to the spectre of overpopulation, hunger, and lack of new energy sources. (12) | 28.4           | 16.9             |
|                                                                                         | 13.4           | 15.8             |
|                                                                                         | 12.6           | 6.7              |
|                                                                                         | 6.2            | 58.7             |
|                                                                                         | 15.8           | 25.5             |
| I only buy as much food and other products as I need at any given time. (17)          | 2.9            | 4.0              |
|                                                                                         | 10.2           | 8.1              |
|                                                                                         | 22.6           | 27.4             |
|                                                                                         | 24.7           | 17.1             |
|                                                                                         | 8.1            | 74.8             |
| When I buy, I pay attention to whether the product has quality certificates, ecological labels, other markings attesting to environmental friendliness. (18) | 8.8            | 12.6             |
|                                                                                         | 16.0           | 15.3             |
|                                                                                         | 22.6           | 13.0             |
|                                                                                         | 11.7           | 37.4             |
|                                                                                         | 15.3           | 47.3             |
| Traditionally produced food is more nutritious than industrially produced food. (19)   | 0.7            | 1.5              |
|                                                                                         | 3.1            | 10.4             |
|                                                                                         | 15.3           | 21.5             |
|                                                                                         | 47.6           | 5.3              |
|                                                                                         | 10.4           | 84.3             |
| Foods containing genetic modifications may pose a risk to the consumer. (20)         | 5.1            | 7.7              |
|                                                                                         | 10.0           | 15.0             |
|                                                                                         | 20.5           | 19.7             |
|                                                                                         | 22.1           | 22.8             |
|                                                                                         | 15.0           | 62.3             |
| I am able to pay 10% more for organic, wholesome, and safe food. (21)                | 4.1            | 4.3              |
|                                                                                         | 8.8            | 11.2             |
|                                                                                         | 24.1           | 20.2             |
|                                                                                         | 27.4           | 17.2             |
|                                                                                         | 11.2           | 71.6             |

The examined group of people was diversified in terms of age, ranging from 17 to 77 years of age. The arithmetic mean age was 27.3 years. The classical measure of variability was used, the standard deviation was 9.8 years. This means that the average values deviated from the average by 9.8 years. The median, i.e., the middle value, which is an average measure less sensitive to the impact of extreme values, was 23 years. Quartiles were also calculated to measure the position of the observations. First quartile Q1 = 21 years, which means that 25% of observations were less than this value. The second quartile is the median Q2 = Me, thus half of the data were in the range of 17–23 years. The third quartile was Q3 = 31, which means that 75% of the respondents were under the age of 31. Modal—measure of central tendency, i.e., the most frequent value Mo = 22 years, indicates that it was the most frequent age given. People at this age constituted 15.6% of the respondents.

In order to identify the relationship between the studied variables, the Pearson correlation analysis was performed. The results are presented in Tables 8–10. Table 8 presents the results of the analysis of the correlation between age and the evaluations of statements relating to ecological and purchasing attitudes, as well as opinions on nuclear energy. In
the conducted analysis, no correlation was found between the age of the respondents and their ecological attitude. Some elements of the purchasing attitude, such as the tendency to look for high-quality food and the aversion to genetic modification, were positively correlated with age.

Table 8. The values of Pearson’s correlation coefficients between the assessments of individual theses and the age of respondents * (own research).

| Number and Content of the Theses Being Assessed | R   |
|-------------------------------------------------|-----|
| 2—Consumption needs to be reduced due to finite raw material resources. | 0.0301 |
| 3—The increasing demand for energy can be met by developing the use of renewable energy sources. | -0.0096 |
| 4—Nuclear power is emission-free. | 0.1074 * |
| 5—Reducing CO₂ emissions is necessary to halt climate change. | 0.0432 |
| 6—I think that Poland should have its own nuclear power plants. | -0.0679 * |
| 7—Building a nuclear power plant is an element of making Poland independent from Russian energy supplies. | -0.0786 * |
| 8—Poland has significant fuel resources to power nuclear power plants. | -0.0072 |
| 9—Poland should aim to have nuclear weapons. | -0.1459 * |
| 10—Nuclear power plant has a negative impact on food quality. | 0.0198 |
| 11—There is a high risk of nuclear power plant failures. | 0.0645 |
| 12—It is necessary to regulate the human population due to the spectre of overpopulation, hunger, and lack of new energy sources. | -0.0658 * |
| 13—New technologies in nuclear energy are the future of humanity. | -0.0926 * |
| 14—The availability of knowledge about nuclear energy is sufficient. | -0.0396 |
| 15—I am well versed in nuclear energy issues. | 0.0295 |
| 16—I support the construction of a nuclear power plant in my district. | -0.0745 * |
| 17—I only buy as much food and other products as I need at any given time. | -0.0154 |
| 18—When I buy, I pay attention to whether the product has quality certificates, ecological labels, other markings attesting to environmental friendliness. | 0.1304 * |
| 19—Traditionally produced food is more nutritious than industrially produced food. | 0.0892 * |
| 20—Foods containing genetic modifications may pose a risk to the consumer. | 0.1230 * |
| 21—I am able to pay 10% more for organic, wholesome, and safe food. | 0.0452 |

*: Statistically significant coefficients are marked with an asterisk.

Table 9. Values of Pearson’s correlation coefficients between the assessments of the semantic differential and the age of the respondents * (own research).

| The Number and Content of the Semantic Differential | R   |
|----------------------------------------------------|-----|
| 22—The nuclear fuel base in Poland is (1—small; 5—large). | -0.0883 * |
| 23—The safety of nuclear power is (1—dangerous; 5—safe). | -0.0831 * |
| 24—Environmental pollution caused by nuclear power is (1—large; 5—small). | 0.0028 |
| 25—Nuclear energy costs are (1—high; 5—small). | 0.0283 |
| 26—The use of water by nuclear power is (1—large; 5—small). | 0.0065 |
| 27—The disposal of radioactive waste is (1—difficult; 5—easy). | -0.0665 * |
| 28—How does a nuclear power plant affect the labor market? (1—reduces the number of jobs; 5—increases the number of jobs). | 0.0433 |
| 29—The risk of nuclear power plant failure is (1—high; 5—low). | -0.0439 |
| 30—The risk of food contamination through nuclear power plant failures is (1—high; 5—low). | -0.0222 |

*: Statistically significant coefficients are marked with an asterisk.

The wording regarding nuclear power was positive, so higher ratings meant greater support for these technologies. In correlation with age, a number of negative, statistically significant coefficients were found. It follows that with the age of the respondents, the support for the construction of a nuclear power plant in Poland decreased, and the belief that it is a way of energy independence, especially in the context of the need to import nuclear fuel, decreased. With age, support for the construction of a nuclear power plant close to the respondents’ place of residence also decreased.
Table 10. The values of Pearson’s correlation coefficients between the assessments of individual theses* (own research).

|   | 2      | 3      | 5      | 12     | 17     | 18     | 19     | 20     | 21     |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 4 | 0.0985*| -0.0260| 0.0961*| 0.0664*| 0.0425 | 0.0618 | -0.0258| -0.0747*| 0.0341 |
| 6 | -0.0457| -0.0629| 0.0203 | 0.0445 | 0.0005 | -0.1056*| -0.0789*| -0.1540*| -0.0007|
| 7 | 0.0158 | 0.0443 | 0.0541 | 0.0348 | 0.0166 | -0.0301| 0.0585 | -0.0510 | 0.0035 |
| 8 | 0.0941*| 0.0283 | 0.0072 | 0.0951*| 0.0070 | 0.0986*| -0.0349| 0.0141 | 0.0178 |
| 9 | -0.1133*| -0.0525| -0.1587*| 0.1649*| -0.0542| -0.0607 | -0.0192| 0.0279 | -0.0032|
| 10| 0.1583*| 0.1110*| 0.0845*| 0.0178 | 0.0244 | 0.1329*| 0.1044*| 0.2759*| 0.0787*|
| 11| 0.1667*| 0.1125*| 0.1224*| 0.0185 | 0.0009| 0.1769*| 0.1416*| 0.3363*| 0.0319 |
| 12| -0.0066| 0.0689*| 0.1099*| 0.0346 | 0.0295| 0.0004 | -0.0036| -0.1195*| 0.0854 |
| 14| 0.0142 | 0.0048 | -0.0369| 0.0635 | 0.0855*| 0.0652*| -0.0783*| 0.0129 | -0.0217|
| 15| -0.0520| -0.1068*| -0.0822*| 0.0430| 0.0700*| 0.1290*| -0.0733*| -0.0804*| -0.0010|
| 16| -0.0355| -0.1402*| -0.0516| 0.1330*| 0.0594| -0.0398| -0.1627*| -0.2373*| 0.0001 |

*: Statistically significant coefficients are marked with an asterisk;**: Description of the variables as in Table 8.

Table 9 presents the results of correlation between the assessments of the semantic differential of nuclear technologies and the age of the respondents. These analyses show that with age, the concern about the safety of nuclear technologies, the belief that there was no fuel base, and the concern about the disposal of radioactive waste grew.

Table 10 presents the results of the Pearson correlation analysis between the assessments of statements relating to the ecological and purchasing attitudes with those relating to nuclear power.

The data in Table 10 show that support for the construction of a nuclear power plant in Poland (thesis 6) is negatively, significantly correlated with the pro-ecological purchasing attitude (theses 18, 19, 20). This means that the surveyed people looking for safe food did not support the construction of a nuclear power plant. At the same time, a positive correlation was found between the belief that a nuclear power plant has harmful effects on food (thesis 10), the purchasing attitudes discussed (theses 18, 19, 20, 21), and the features of an ecological attitude (theses 2, 3, 5). The same relationship concerned fears of nuclear power plant accidents (thesis 11) with pro-ecological purchasing attitudes (theses 18, 19, 20).

It is worth noting that the negative, significant correlation coefficients proving that people who assess their knowledge of nuclear energy as higher (thesis 15) are more skeptical about the expectation that RES will cover the growing energy demand (thesis 3), as well as the need to reduce CO\textsubscript{2} emissions (thesis 5). This relationship is similar in relation to the perception of traditional food and food containing GMO components (theses 19, 20). The belief that the importance of this energy source will increase in the future (thesis 13) was related to the belief that it is necessary to reduce CO\textsubscript{2} emissions (thesis 4), hopes related to renewable energy sources (thesis 3), the tendency to bear higher costs of safe food (thesis 21), and the lack of trust to genetically modified food (thesis 20).

Acceptance of the location of a nuclear power plant near the place of residence (thesis 16) was inversely correlated with the expectation of the development of renewable energy sources (thesis 3), the belief in the high quality of traditional food (thesis 19), and the lack of trust in genetically modified food (thesis 20). The conducted research shows that people with a pro-ecological attitude are reluctant to nuclear energy, show a lower level of trust in this energy, and are more afraid of failure and contamination of the natural environment.

The study with the use of a semantic differential, referring to selected features of nuclear power, showed differences in the perception of this issue between the respondents’ gender (Figures 5 and 6). It should be emphasized that in the presented antonyms, grade 1 meant an adjective carrying negative meanings, and grade 5—a positive meaning.
Figure 5. Categorized mean values of the semantic differential regarding the characteristics of nuclear energy (own research). Theses numbers: 22—the nuclear fuel base in Poland is (1—small; 5—large); 23—the safety of nuclear power is (1—dangerous; 5—safe); 24—environmental pollution caused by nuclear power is (1—large; 5—small); 25—nuclear energy costs are (1—high; 5—small).

Figure 6. Categorized mean values of the semantic differential regarding the characteristics of nuclear power (own research). Theses numbers: 26—The use of water by nuclear power is (1—large; 5—small); 27—the disposal of radioactive waste is (1—difficult; 5—easy); 28—how does a nuclear power plant affect the labor market? (1—reduces the number of jobs; 5—increases the number of jobs); 29—the risk of nuclear power plant failure is (1—high; 5—low); 30—the risk of food contamination through nuclear power plant failures is (1—high; 5—low).

Figure 5 shows the average scores of the differential broken down by gender of the respondents. The level of nuclear fuel resources in Poland marked with the number 22 was
assessed relatively low, which is confirmed in reality, as Poland does not have significant resources of this raw material. The men showed more knowledge on the subject. The number 23 stands for the safety of nuclear power. The respondents assessed this issue in various ways. The mean scores of the women were close to the neutral value, while the men showed moderate confidence. Similarly, women assessed both the environmental pollution caused by nuclear energy (thesis 24) and the costs of nuclear energy (thesis 25) as worse.

Among the examined features of nuclear power related to water use, the impact on food quality, the labour market, the possibility of an accident, and waste disposal, are all features that were rated quite low. Average values were placed on the side of adjectives describing the negative nature of the examined feature (Figure 6). The lowest average score was obtained for nuclear waste disposal, which means that respondents perceive problems with radioactive waste. The highest average ratings were recorded for the failure risk assessment. Women were more skeptical than men about waste disposal, the risk of food contamination, and the risk of failure. Men, on the other hand, assessed the use of water worse than women and the impact of nuclear energy on the labour market.

The analysis of the conducted semantic differential shows considerable skepticism with regards to the features of nuclear power. This stands in opposition to supporting the thesis that Poland should have nuclear power plants. As already mentioned, a strong support for this thesis was expressed by 29.0% of the respondents, and any support was expressed by 61.3% of the respondents.

4. Discussion

Many nuclear power experts believe that nuclear power plants are the largest stable low-emission energy source [29,32,58], as energy sources such as wind turbines and photovoltaics supply electricity unstably [59–61]. Therefore, the possibility of ensuring a stable electricity supply by nuclear power plants is their clear advantage [4,5,14]. There is still no industrialized country that would effectively decarbonize the economy based on wind and solar energy [62,63]. Meanwhile, there is a need to maintain reserve capacity in thermal power plants, and nuclear power plants could play a significant role here [12,13,15,64].

However, the literature study shows that global trends promote the development of unstable Renewable Energy Sources (RES) and the reduction of the share of nuclear power plants as an energy source [1–10,65]. It should be emphasized that OECD countries are more skeptical about the nuclear energy [1,10,59] than non-OECD countries (China, India, generally Asia, Africa or South America) [66–69]. Countries outside the OECD are developing not only nuclear energy, but also accelerated the development of energy from renewable sources, catching up with and even surpassing the USA and Europe [29,45,46]. It seems that in Europe memories of the Chernobyl disaster (26 April 1986) and the Fukushima disaster (11 March 2011) are still fresh [7,10,33], thus EU trends are evolving towards renewable energies sources [1,24,27–29]. However, some expert reports show that the nuclear power plant is the safest source of carbon-free energy [70,71]. It seems that, social discontent and the high cost of building nuclear power plants are probably contributing to the fact that many countries are withdrawing from nuclear energy (Europe, USA, and Japan) [1,11–13].

It should be noted that as investigated in this study the Polish group of respondents show ecological attitudes, to a certain extent, corresponding to EU trends in terms of the development of renewable energy sources [1,26–28]. On the other hand, Polish energy policy is open to the development of nuclear energy [30,31]. The Polish concept of a return to nuclear energy officially appeared in 2005, when the Council of Ministers adopted the document “Poland’s Energy Policy until 2025”. Since then, each of the subsequent regulations designing the Polish energy policy provides for work on the construction of such a power plant [32]. It is also worth mentioning that in January 2007 a special parliamentary commission for nuclear energy was established. In addition, Polish Energy Group S.A. in 2011, selected three potential locations for the first nuclear power plant. All
these selected places are located in northern Poland, where there are mainly large-scale farms and flat areas. The respondents from the research in this study came from southeastern Poland, where there are small and medium-sized farms, and the population is oriented on local and regional, not global, scale. In this region of the country, the side benefits of decentralizing the energy system (RES system) may be significant [26–28].

This study shows, that the investigated Polish group of respondents are divided in their opinion, since they associate the safety of the environment and the food produced in it as one that should not be exposed to breakdown and water contamination due to improper disposal of radioactive waste [25,26]. The research also showed a relationship between the respondents’ concerns about nuclear power plant accidents and their pro-ecological purchasing attitudes [27]. People from this investigation, with a pro-ecological attitude, are also reluctant to nuclear energy and show a lower level of trust in this type of energy and are more afraid of failure and contamination of the natural environment [28]. On the other hand, investigated respondents (mainly men), are more skeptical about the expectation that RES will cover the growing demand for energy. This could be due to a more pragmatic approach of men to the nuclear power plants and a broader and rational knowledge of various aspects of nuclear energy sources [25]. The survey also showed the respondents’ understanding of the need to care for the natural environment, reduce consumption, and reduce greenhouse gas emissions. Moreover, among the identified features of the purchasing attitude, avoidance of buying excessive amounts of products, searching for high-quality products, and the tendency to incur slightly higher costs for this type of products dominated.

In response to the research questions posed at the outset, it should be stated that the perception of nuclear energy among the surveyed respondents from Poland was moderately positive. A large proportion of respondents support the construction of nuclear power plants in Poland and have high hopes for the future with this source of energy. However, as already mentioned, another part of the respondents expressed concerns about the management of radioactive waste and did not support the construction of a nuclear power plant near their place of residence. Concerns about the possible negative impact of a nuclear power plant on food were not supported by 39% of respondents, and 44% were not afraid of a possible accident. In many issues, the attitude of the respondents indicated that they were not able to define their firm beliefs, which means that there is a need for wider social education explaining the issues of nuclear energy. The attitudes of some of the respondents regarding nuclear energy therefore correspond to the plans of the Polish Energy Policy until 2025 [25,31] and the trends observed in non-European countries, also shown in this study [1,29,32].

5. Conclusions

Global trends in nuclear energy show that today this energy is too expensive and too slow to build and enter individual countries to meet the world’s energy challenges in the decades to come. Moreover, there are indications that nuclear energy will contribute to the development of a select group of countries and markets, including Poland. However, they are many countries, where this type of energy sources will most likely continue to decline, due to economic factors as one of the main reasons. Implementation of nuclear projects and other energy sources are not only an important indicator of what the future energy mix will look like, but can be taken as a barometer of the current level of technology cost certainty and global and regional policy. At the same time, it should be emphasized that the falling global costs of renewable energy is in contrast to the costs of nuclear energy, which are constantly rising, and at the best remain constant.

By 2050, the European Union aims to create a completely low-carbon electricity system. This will require accelerating the current pace of implementation of different energy sources, including renewable energy sources. It must be stated, that there is no EU-wide target for the development of nuclear energy. Concerning the investigation of Polish respondents,
opinions on nuclear energy and RES are divided, and the issue of building nuclear reactors in Poland is open.

In response to the other research question posed, it should be stated that the ecological attitude and the purchasing attitude of the respondents are related to the perception of nuclear energy. Respondents who are more sensitive to environmental issues, were more concerned about nuclear power. Likewise, people looking for organic food have been more skeptical about this source of energy. Moreover, the analysis of the semantic differential shows that nuclear energy is perceived differently depending on the gender. In the study group, women had greater concerns about the safety of nuclear power, the risk of an accident or environmental contamination. Men, on the other hand, assessed the analyzed phenomena from a broader perspective, related to the labor market and national security.

Author Contributions: Conceptualization, A.B. and K.K.; methodology, A.B. and K.K.; software, A.B., K.K. and M.W.; validation, A.B., K.K. and M.W.; formal analysis, A.B., K.K., and M.W.; compiled by A.B. and K.K.; resources, A.B., K.K. and M.W.; data processing, A.B. and K.K.; writing—original project preparation, A.B. and K.K.; writing—review and editing, A.B. and K.K.; visualization, A.B. and K.K. All authors have read and agreed to the published version of the manuscript.

Funding: These studies received no external funding. The APCs were funded by Rzeszow University of Technology and University of Life Sciences in Lublin, Poland.

Conflicts of Interest: The authors declare no conflict of interest.

References
1. WNISR, The World Nuclear Industry Status Report. 2019. Available online: https://www.worldnuclearreport.org/IMG/pdf/wnisr2019-v2-HR.pdf (accessed on 8 April 2021).
2. International Energy Outlook, Projections to 2050. U.S. Energy Information Administration, Office of Energy Analysis U.S. Department of Energy, Washington, DC. 2019. Available online: https://www.eia.gov/outlooks/ieo/pdf/ieo2019.pdf (accessed on 8 April 2021).
3. International Energy Outlook, Independent Statistics & Analysis. Center for Strategic and International Studies, Washington, DC. 2020. Available online: https://www.eia.gov/outlooks/ieo/pdf/ieo2020.pdf (accessed on 8 April 2021).
4. BP Statistical Review of World Energy. UK and Rest of World, BP Distribution Services. 2019. Available online: http://www.bpgroup.caltech.edu/aph150_human_impacts/assets/pdfs/BP_2019.pdf (accessed on 8 April 2021).
5. IPCC Special Report. 2018. Available online: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_Chapter1_Low_Res.pdf (accessed on 9 April 2021).
6. Strategic Plan for 2020–2025. Centre for International Governance Innovation. 2019. Available online: https://www.cigionline.org/sites/default/files/documents/Strategic_Plan-2020-web-2.pdf (accessed on 9 April 2021).
7. EU Energy Trends to 2030. Publications Office of European Union, Luxembourg. 2010. Available online: https://www.cigionline.org/sites/default/files/documents/Strategic_Plan-2020-web-2.pdf (accessed on 9 April 2021).
8. REN21, Renewable Energy Policy, Network for the 21st Century. National Technical University of Athens (NTUA). 2019. Available online: https://www.ren21.net/wp-content/uploads/2019/05/gsr_2019_full_report_en.pdf (accessed on 12 April 2021).
9. FS-UNEP/BNEF, Global Trends in Renewable Energy Investment, Bloomberg NEF. 2020. Available online: https://www.fs-unep-centre.org/wp-content/uploads/2020/06/GTR_2020.pdf (accessed on 12 April 2021).
10. European Commission—DG Energy. Clean Energy for All Europeans. Joao Heredia Policy Officer. 2019. Available online: File://C:/Users/ALEKSA--11/AppData/Local/Temp/RECG032017_European%20Commission.pdf (accessed on 8 April 2021).
11. Azam, A.; Rafiq, M.; Shafique, M.; Zhang, H.; Yuan, J. Analyzing the effect of natural gas, nuclear energy and renewable energy on GDP and carbon emissions: A multi-variate panel data analysis. Energy 2021, 219, 119592. [CrossRef]
12. Nazlioglua, S.; Soytash, U. Oil price, agricultural commodity prices, and the dollar: A panel cointegration and causality analysis. Energy Econ. 2012, 34, 1098–1104. [CrossRef]
13. Qi, W.; Qi, M.; Ji, Y. The effect path of public acceptance of nuclear energy. Energy Policy 2020, 144, 111655. [CrossRef]
14. IEA. International Energy Agency. 2020. Available online: https://www.iea.org (accessed on 15 May 2021).
15. Axon, C.J.; Darton, R.C. Sustainability and risk—A review of energy security. Sustain. Prod. Consum. 2021, 27, 1195–1204. [CrossRef]
16. Khan, I.; Hou, F.; Zakari, A.I.; Tawiah, V.K. The dynamic links among energy transitions, energy consumption, and sustainable economic growth: A novel framework for IEA countries. Energy 2021, 222, 119935. [CrossRef]
17. Sharma, R.; Sinha, A.; Kautish, P. Does renewable energy consumption reduce ecological footprint? Evidence from eight developing countries of Asia. J. Clean. Prod. 2021, 285, 124867. [CrossRef]
18. Mohsin, M.; Hanif, I.; Taghizadeh-Hesary, F.; Abbas, Q.; Iqbal, W. Nexus between energy efficiency and electricity reforms: A DEA-Based way forward for clean power development. Energy Policy 2021, 149, 112052. [CrossRef]
19. Saidi, K.; Omri, A. Reducing CO2 emissions in OECD countries: Do renewable and nuclear energy matter? *Prog. Nucl. Energy* 2020, 126, 103425. [CrossRef]
20. Kalair, A.; Abas, N.; Saleem, M.S.; Kalair, A.R.; Khan, N. Role of energy storage systems in energy transition from fossil fuels to renewables. *Energ Storage* 2021, 3, 35. [CrossRef]
21. McMahon, J. New Solar + Battery Price Crushes Fossil Fuels, Buries Nuclear. *Forbes*. 2021. Available online: https://www.forbes.com/sites/jeffmcmahon/2019/07/01/new-solar--battery-price-crushes-fossil-fuels-buri (accessed on 12 April 2021).
22. Shirley, S.H.; Tsuysoshi, O.; Jiemin, L.; Alsisius, D.L.; Agnes, S.F.C. Exploring public perceptions of benefits and risks, trust, and acceptance of nuclear energy in Thailand and Vietnam: A qualitative approach. *Energy Policy* 2019, 127, 259–268. [CrossRef]
23. Bian, Q.; Han, Z.; Veethye, J.; Ma, B. Risk perceptions of nuclear energy, climate change, and earthquake: How are they correlated and differentiated by ideologies? *Clim. Risk Manag.* 2021, 32, 100297. [CrossRef]
24. Sonnberger, M.; Ruuddat, M.; Arnold, A.; Scheer, D.; Poortinga, W.; Böhm, R.; Bertoldo, R.; Mays, C.; Pidgeon, N.; Poumadere, M.; et al. Climate concerned but anti-nuclear: Exploring (dis)approval of nuclear energy in four European countries. *Energy Res. Soc. Sci.* 2021, 75, 102008. [CrossRef]
25. Bukowski, M.; Majewski, J.; Sobolewska, A. Macroeconomic Electric Energy Production Efficiency of Photovoltaic Panels in Single-Family Homes in Poland. *Energies* 2021, 14, 126. [CrossRef]
26. Przygrodzki, M.; Kubek, P. The Polish Practice of Probabilistic Approach in Power System Development Planning. *Energies* 2020, 14, 161. [CrossRef]
27. Iglinski, B.; Cichosz, M.; Kujawski, W.; Płaskacz-Dziuba, M.; Buczkowski, R. Helioenergy in Poland—Current state, surveys and prospects. *Renewable Sustain. Energy Rev.* 2016, 58, 862–870. [CrossRef]
28. Iglinski, B.; Iglinski, A.; Kozinski, G.; Skrzatek, M.; Buczkowski, R. Wind energy in Poland—History, current state, surveys, Renewable Energy Sources Act, SWOT analysis. *Renew. Sustain. Energy Rev.* 2016, 64, 19–33. [CrossRef]
29. Wang, J.; Kim, S. Comparative Analysis of Public Attitudes toward Nuclear Power Energy across 27 European Countries by Applying the Multilevel Model. *Sustainability* 2018, 10, 1518. [CrossRef]
30. World Nuclear Performance Report. 2020. Available online: https://www.world-nuclear.org/getmedia/3418bf4a-5891-4ba1-b673-677f87c2-d83d8907264d/performance-report-2020 (accessed on 9 April 2021).
31. Gajda, P.; Galosz, W.; Kuczyńska, U.; Przybyszewska, A.; Rajewski, A.; Sawicki, Ł. Energetyka Jadrowa dla Polski—Report. Instytut Sobieskiego (Nuclear Power for Poland—Report. Sobieski Institute), Warszawa. 2019. Available online: https://sobieski.org.pl/energetyka-jadrowa-dla-polski/ (accessed on 13 April 2021).
32. CRSP Report. Advanced Nuclear Reactors: Technology Overview and Current Issues. 2019. Available online: https://www.everycrsreport.com/reports/R45706.html (accessed on 15 May 2021).
33. Takebayashi, Y.; Lyamzina, Y.; Suzuki, Y.; Murakami, M. Risk Perception and Anxiety Regarding Radiation after the 2011 Fukushima Nuclear Power Plant Accident: A Systematic Qualitative Review. *Int. J. Environ. Res. Public Health* 2017, 14, 1306. [CrossRef] [PubMed]
34. Cvetković, V.M.; Očal, A.; Lyamzina, Y.; Noji, E.K.; Nikolić, N.; Milošević, G. Nuclear Power Risk Perception in Serbia: Fear of Exposure to Radiation vs. Social Benefits. *Energies* 2021, 14, 2464. [CrossRef]
35. Paraschiv, F.; Mohamad, D. The Nuclear Power Dilemma—Between Perception and Reality. *Energies* 2020, 13, 6074. [CrossRef]
36. Kirikkaleli, D.; Adedoyin, F.F.; Bekun, F.V. Nuclear energy consumption and economic growth in the UK: Evidence from wavelet coherence approach. *J. Public Aff.* 2021, 21, e2130. [CrossRef]
37. Nazlioglu, S.; Lebe, F.; Kayhan, S. Nuclear energy consumption and economic growth in OECD countries: Cross-sectionally dependent heterogeneous panel causality analysis. *Energy Policy* 2011, 39, 6615–6621. [CrossRef]
38. Hickey, S.M.; Malkawi, S.; Khalil, A. Nuclear power in the Middle East: Financing and geopolitics in the state nuclear power programs of Turkey, Egypt, Jordan and the United Arab Emirates. *Energy Res. Soc. Sci.* 2021, 74, 101961. [CrossRef]
39. Kim, J.-H.; Yoo, S.-H. Comparison of the economic effects of nuclear power and renewable energy deployment in South Korea. *Renew. Sustain. Energy Rev.* 2021, 135, 110236. [CrossRef]
40. Meyer, T. Relational territoriality and the spatial embeddedness of nuclear energy: A comparison of two nuclear power plants in Germany and France. *Energy Res. Soc. Sci.* 2021, 71, 101823. [CrossRef]
41. Pompioni, F.; Hart, J. The greenhouse gas emissions of nuclear energy—Life cycle assessment of a European pressurized reactor. *Appl. Energy* 2021, 290, 116743. [CrossRef]
42. Shirizadeh, B.; Quirion, P. Low-carbon options for the French power sector: What role for renewables, nuclear energy and carbon capture and storage? *Energy Econ.* 2021, 95, 105004. [CrossRef]
43. Rios, A. Green’s Function Techniques for Infinite Nuclear Systems. *Front. Phys.* 2020, 8, 387. [CrossRef]
44. Chenet, H.; Ryan-Collins, J.; Lerven, F. Finance, climate-change and radical uncertainty: Towards a precautionary approach to financial policy. *Ecol. Econ.* 2021, 183, 106957. [CrossRef]
45. Suman, S. Hybrid nuclear-renewable energy systems: A review. *J. Clean. Prod.* 2018, 181, 166–177. [CrossRef]
46. Wang, M.; Yao, M.; Wang, S.; Qian, H.; Zhang, P.; Wang, Y.; Sun, Y.; Wei, W. Study of the emissions and spatial distributions of various power-generation technologies in China. *J. Environ. Manag.* 2021, 278, 111401. [CrossRef]
47. Murshed, M. Can regional trade integration facilitate renewable energy transition to ensure energy sustainability in South Asia? *Energy Rep.* 2021, 7, 808–821. [CrossRef]
48. GUS. Główny Urząd Statystyczny (Central Statistical Office), Warszawa. 2019. Available online: https://stat.gov.pl/obszary-tematyczne/inne-opracowania/inne-opracowania-zbiorcze/polska-w-liczbach (accessed on 15 April 2021).
49. Levenda, A.M.; Behrsin, L.; Disano, F. Renewable energy for whom? A global systematic review of the environmental justice implications of renewable energy technologies. Energy Res. Soc. Sci. 2021, 71, 101837. [CrossRef]
50. Chyung, S.Y.; Roberts, K.; Swanson, I.; Hankinson, A. Evidence-Based Survey Design: The Use of a Midpoint on the Likert Scale. Perform. Improv. 2017, 56, 15–23. [CrossRef]
51. Steinberg, L.; Rogers, A. Changing the Scale: The Effect of Modifying Response Scale Labels on the Measurement of Personality and Affect. Multivar. Behav. Res. 2020. [CrossRef] [PubMed]
52. Ploder, A.; Eder, A. Semantic Differential. In International Encyclopedia of the Social & Behavioral Sciences, 2nd ed.; Elsevier: Amsterdam, The Netherlands, 2015; pp. 563–571. [CrossRef]
53. Aczel, A.D. Statystyka w Zarządzaniu. Wydawnictwo Naukowe PWN, 2018. (Original: Aczel, A.D. Complete Business Statistics, Seventh Edition, McGraw-Hill Irwin Companies, New York, 2009). Available online: https://ksiegarnia.pwn.pl/Statystyka-w-zarzadzaniu,731934758,p.html (accessed on 15 April 2021).
54. Blashfield, R.K. The Growth of Cluster Analysis: Tryon, Ward, And Johnson. Multivar. Behav. Res. 1980, 15, 439–458. [CrossRef]
55. Härdle, W.K.; Simar, L. Cluster Analysis. In Applied Multivariate Statistical Analysis; Springer: Cham, Switzerland, 2019. [CrossRef]
56. Agboola, S.; Joel, M.B.M. Classification of Some Seasonal Diseases: A Hierarchical Clustering Approach. Biomed. Stat. Inform. 2017, 2, 122–127. [CrossRef]
57. Bielecka, A. Statystyka dla Menedżerów. Teoria i Praktyka (Statistics for Managers. Theory and Practice); Wolters Kluwer Polska: Warszawa, Poland, 2011; ISBN 9788363391386.
58. Holden, E.; Linnerud, K.; Rygg, B.J. A review of dominant sustainable energy narratives. Renew. Sustain. Energy Rev. 2021, 144, 110955. [CrossRef]
59. Oudes, D.; Stremke, S. Next generation solar power plants? A comparative analysis of frontrunner solar landscapes in Europe. Renew. Sustain. Energy Rev. 2021, 145, 111101. [CrossRef]
60. Hashemizadeh, A.; Ju, Y.; Mojtaba, S.; Bamakan, H.; Le, H.P. Renewable energy investment risk assessment in belt and road initiative countries under uncertainty conditions. Energy 2021, 214, 118923. [CrossRef]
61. Lopez, A.; Mai, T.; Lantz, E.; Harrison-Atlas, D.; Williams, T.; Maclaurin, G. Land use and turbine technology influences on wind potential in the United States. Energy 2021, 223, 120044. [CrossRef]
62. Chen, W.-M.; Kim, H.; Yamaguchi, H. Renewable energy in eastern Asia: Renewable energy policy review and comparative SWOT analysis for promoting renewable energy in Japan, South Korea, and Taiwan. Energy Policy 2014, 74, 319–329. [CrossRef]
63. Stephens, S.; Michael, B.; Robinson, K. The social license to operate in the onshore wind energy industry: A comparative case study of Scotland and South Africa. Energy Policy 2021, 148 Pt B, 111981. [CrossRef]
64. Lee, C.; Wang, C.; Ho, S.; Wu, T. The impact of natural disaster on energy consumption: International evidence. Energy Econ. 2021, 97, 105021. [CrossRef]
65. Walmsley, M.R.W.; Walmsley, T.G.; Atkins, M.J. Achieving 33% renewable electricity generation by 2020 in California. Energy 2015, 92, 260–269. [CrossRef]
66. Liu, J.; Murshed, M.; Chen, F.; Shalbaz, M.; Kirikkaleli, D.; Khan, Z. An empirical analysis of the household consumption-induced carbon emissions in China. Sustain. Prod. Consum. 2021, 26, 943–957. [CrossRef]
67. Pandey, P.; Sharma, A. Knowledge politics, vulnerability and recognition-based justice: Public participation in renewable energy transitions in India. Energy Res. Soc. Sci. 2021, 71, 101824. [CrossRef]
68. Rabaia, M.K.H.; Abdelkareem, M.A.; Sayed, E.T.; Elsaid, K.; Chae, K.J.; Wilberforce, T.; Olabi, A.G. Environmental impacts of solar energy systems: A review. Sci. Total Environ. 2021, 754, 141989. [CrossRef]
69. Kudelin, A.; Kutcherov, V. Wind ENERGY in Russia: The current state and development trends. Energy Strategy Rev. 2020, 9, 100627. [CrossRef] 
70. UNSCEAR Report, Sources, Effects and Risks of Ionizing Radiation. United Nations Scientific Committee on the Effects of Atomic Radiation 2020. Available online: https://www.unscear.org/docs/publications/2020/UNSCEAR_2020_AnnexB_AvanceCopy.pdf (accessed on 15 April 2021).
71. Report by the Director General, The Fukushima Daiichi Accident; IAEA: Vienna, Austria, 2015; ISBN 978-92-0-107015-9. Available online: https://www-pub.iaea.org/mtcd/publications/pdf/pub1710-reportbythedg-web.pdf (accessed on 15 April 2021).