Investments in renewable energy in tourism economy. Innovations perspective

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INTRODUCTION

Nowadays, paying attention to the issues of ecology and sustainability is not a fashion, but has become a necessity, and a new lifestyle. The entire world economy, every sector of it, should move in the direction of being greener. Climate change, the widening (on a global scale) disparities in development between different regions of the world, the growth of the global population, the destruction of wildlife, the rapid loss of biodiversity, the irreversible negative consequences of human activity on the environment point to the urgent need to move to a path of more environmentally friendly development by encouraging the adoption of sustainable practices and "cleaner industry".[1] One of the broad sectors intersecting with the processes of greening and sustainable development is the energy sector, including green energy. Anyway, observing the current development trends of the world economy, one can point to several particularly important problem areas relevant to modern economics.

One of them is certainly the issue of renewable energy sources (RES). Modern challenges of efficient energy management are even becoming the main axis of economic policy of countries, the subject of intensive scientific research and the key to broad economic development. Huge changes in the energy market are being noticed, there is even talk of a third industrial revolution. This also applies to the tourism economy, which is due to its scale and nature – the tourism economy is based on services, information and flexible structure.

Also in tourism, which is now seen as one of the most rapidly growing branches of the economy, the principles of sustainable development must be observed. Its development, (especially mass tourism), is inextricably linked to the natural environment. However, it should not be associated with negative impacts on the natural environment and local culture. The already mentioned renewable energy sources (RES) are of great importance in the development of sustainable tourism. They require large investments, support, but also

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[1] F. Farinelli, M. Bottini, S. Akkoyuniu, P. Aerni, *Green economy: the missing link towards a green economy*, „ATDF Journal" 2011, Vol. 8, Issue 3/4, p. 42–49.

knowledge that is not common. Renewable energy sources in tourism are not only a source of clean energy (they do not pollute the environment), but also contribute to greater modernity and attractiveness of the sector, higher quality of services provided.

Nowadays, conscious tourists increasingly choose places where RES is used,[2] even when it involves indirect investment costs contained, for example, in the higher price of using the facility. It is also worth mentioning that RES installations can also be tourist attractions in their own right (e.g. wind turbines or hydroelectric power plants).[3] The process of investment in renewable energy sources is inherently associated with new technologies that are innovative in nature. Thus, the concept of innovation as an important economic category additionally emerges.

In Polish conditions, the issue of innovation and investment in RES in the tourism economy is relatively new, little recognized, and requires a lot of research. To date, the scientific and especially practical achievements in this area are relatively small. There is a research gap in the tourism economy in the field of RES, particularly evident in Polish conditions – the paucity of knowledge and information mainly concerns the issues of investment and innovation. In particular, the issues related to determining the capacity to absorb innovations in the tourism economy in the field of RES has an unrecognized character. Thus, scientific research on the use of RES in the tourism economy is important and fulfills the not sufficiently recognized functions of scientific knowledge in the above-mentioned aspects – explanatory, diagnostic, prognostic and practical.[4]

The subject of the study covers the issues related to the use of renewable energy sources in tourism – from the process of technology implementation in tourism supply entities, i.e. investments, to the diagnosis of innovation absorption in the tourism economy in the field of renewable energy sources.

The theoretical considerations were supported by own research, conducted in cooperation with a professional research laboratory on a random sample of 1,200 entities operating in Section I of the Polish Classification of Activities (PAC) (divisions 55 and 56). An understanding of the tourism economy in its narrow scope was adopted for the research, as explained in the theoretical

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2 J. Chodkowska-Miszczuk, *Odnawialne źródła energii w rozwoju turystyki na obszarach chronionych w Polsce na przykładzie ośrodka turystyki religijnej w Kodniu*, „Studia Ecologucae et Bioethicae" 2016, Vol. 14 (2), s. 9–31.

3 Ibidem, s. 9–31.

4 Ł. Nawrot, M. Bednarska, P. Zmyślony, *Odnawialne źródła energii w gospodarce turystycznej jako obszar badań naukowych*, [w:] *Przeszłość, teraźniejszość i przyszłość turystyki*, pod red. B. Krakowiak, J. Latosińska, Wydaw. Uniwersytetu Łódzkiego, Łódź 2014, s. 85–98.

chapters. Practical considerations, including the system of public statistics, the system of national accounts and the comparability of survey results, were also of great importance.

This was the basis for building conclusions and verifying research hypotheses. A random stratified sampling by location (province) and type of business was used. The research was conducted from December 2017 to February 2018 using a computer-assisted telephone interview method with a survey questionnaire. Their purpose was to analyze investment processes and identify and classify the determinants of the ability to absorb innovations in the field of renewable energy sources by entities of the tourism economy. The main research problem, formulated in the form of a research question, to which answers were sought in the course of the research was: what is the capacity of the tourism economy to absorb innovations in renewable energy sources, as well as what are the determinants of this capacity and related investment demand? In the course of solving the main problem, it was reasonable to obtain answers to three specific questions:

1. What are the determinants of investment in RES in entities of the tourism economy?
2. To what extent is the ability to absorb innovations related to the investment attractiveness of the tourism economy, understood as the ability to compete for capital?
3. What is the nature and extent of diffusion of RES innovations in the tourism economy?

The study consists of four logically and substantively related chapters.

The first chapter includes a consideration of the essence and dimensions of the green (sustainable) economy, with a particular focus on the tourism economy.

The second chapter describes tourism investment in the system of the national economy from a multisectoral perspective. It includes theoretical considerations on the subject, but also, based on CSO data, presents the development of investment in tourism. Section I according to the Polish classification of activities was adopted as the research plane. Chapter two concludes by drawing attention to the importance of green investments in tourism.

The third chapter characterizes renewable energy sources, and describes in detail selected sources most often used by tourism entrepreneurs – solar panels, photovoltaic panels, geothermal power, heat pumps, biomass and home wind turbines. The chapter concludes with an analysis of the importance of RES in the Polish economy, taking into account the tourism industry.

The fourth chapter contains a description of the conducted own research, an analysis of the obtained results and formulated conclusions relating to the possibility of using renewable energy sources in tourism enterprises. Based on the data obtained in the course of the research, an econometric model was constructed regarding the ability to absorb innovations. Factor analysis, cluster analysis were used to analyze the data. All this became the basis for the verification of the adopted hypotheses, the formulation of research conclusions.

In general, the work focuses on the problem of investment, innovation in renewable energy sources, for which the research plane is the tourism economy, whose narrow and broad nature is explained in the theoretical part. In the empirical part, for the reasons already mentioned, the focus is on Section I – accommodation and food as the most significant from the supply side group of service providers in the tourism market.

The publication is the result of the research project "Determinants of ability to absorb innovations in the tourism economy in relation to renewable energy", which was financed from the funds of the National Science Center granted under Decision No. DEC-2012/05/B/HS4/00953.

Chapter 1.
TOURISM ECONOMY VS. A "GREEN ECONOMY"

1.1. The essence of a green economy

The term *green economy* was first used in 1989 in the *Blueprint for a Green Economy* report prepared for the UK government. Its authors were D. Pearce, A. Markandya and E.B. Barbier. It was intended to support the British government in introducing the idea of sustainable development.[1] Subsequent editions of the report, in 1991 and 1994, expanded the original focus to include global environmental problems such as the climate change, the ozone layer depletion, the tropical forest devastation, the degradation, and loss of natural resources, etc.[2] As the debate on the subject has grown, the concept of a green economy has been gaining popularity as a way to maintain economic development while meeting the climate goals set with the Kyoto Protocol and the Paris Agreement. The debate on the subject has also been stimulated by new plans by the European Commission, which, as part of its recovery from the coronavirus pandemic, intends to strengthen measures leading to the European Union's climate neutrality by 2050.[3]

A green economy is a management model whose scope of ecological solutions increases.[4] It is a term commonly used today to emphasize the importance

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1 B. Ryszawska, *Zielona gospodarka – teoretyczne podstawy koncepcji i pomiar jej wdrażania w UE*, Seria: Monografie i Opracowania, nr 247, Wydaw. UE we Wrocławiu, Wrocław 2013, s. 51; M. Adamowicz, *Zielona gospodarka, zielony wzrost i zazielenienie jako formy realizacji koncepcji zrównoważonego rozwoju*, „Wieś i Rolnictwo" 2021, nr 2 (191), s. 13–35.

2 M. Adamowicz, *Zielona gospodarka, zielony wzrost i zazielenienie…*, op. cit., s. 13–35.

3 *Green Economy – wpływ zielonej ekonomii na klimat i rozwój gospodarczy*, po red. A. Juszczak, W. Rabiega, Wydaw. Polski Instytut Ekonomiczny, Warszawa 2021, s. 7.

4 The opposite of the *green economy* is the *brown economy* based on the intensive use of fossil fuels and other non-renewable resources. It is the result of a liberal conception of the market, in which the free movement of capital, goods, services and labor was supposed to ensure economic growth and, consequently, the prosperity of entrepreneurs, owners of capital and all citizens. The main measure of economic growth is GDP. This assumes that growth is unlimited, and GDP grows mainly through the use of natural resources, including energy resources. Side effects are atmospheric emissions, waste and pollution – sources: K. Benammar, N. Gressel,

of ecology and the assumptions of sustainable development in modern economic processes, in virtually all aspects of human life and activity. It includes: green products and services, green investments, green innovations, green economic sectors, green public procurement, and green jobs.[5] Such an approach stems from the need for rational use of resources in the context of environmental threats and problems of the modern world that affect the economy (e.g.: greenhouse effect, high levels of emissions of harmful substances, depletion of resources used so far). This is to solve pressing environmental problems. The aim of this approach is to try to find a balance between:[6]

- the current needs of people and the needs of future generations;
- the economic, social and environmental impacts of the activities carried out; the needs of different communities and populations.

A green economy model considers the following to be the most important: decoupling economic growth from increased consumption of natural resources, development of renewable energy sources, energy efficiency, clean production, protection of biodiversity, an application of the principles of intergenerational and interregional justice, accountability of public entities, businesses and investors, respect, and transparency.[7] It is supposed to affect the development of society, contribute to the well-being of the population, to the rational use of natural resources, to ensure social progress.[8] A green economy can be defined in various ways (table 1), for instance, conceptually, from a theoretical perspective, it allows the creation of social and economic strategies, development policies and programs.

On the other hand, when analyzing it from the perspective of an application and implementation, it enables the preparation and implementation of plans and practical actions, such as green products and services, green investments, green economic sectors, and green jobs.[9]

Forget sustainability: go for green entrepreneurship; https://www.thnk.org/insights/go-for-green-entrepreneurship/, (03.05.2022); B. Ryszawska, *Zielona gospodarka…*, op. cit., s. 74; M. Ślebocka, A. Tylman, *Zielona gospodarka a finansowo-prawne dylematy zrównoważonego rozwoju*, „Nierówności Gospodarcze a Wzrost Gospodarczy" 2014, nr 4 (40), s. 293–303.

5 P. Szyja, *Zielona gospodarka w Polsce – stan obecny i perspektywy*, „Nierówności społeczne a wzrost gospodarczy" 2015, Nr 4 (1), s. 432–447.

6 K. Benammar, N. Gressel, *Forget sustainability: go for green entrepreneurship*; https://www.thnk.org/insights/go-for-green-entrepreneurship/, (03.05.2022).

7 B. Ryszawska, *Zielona gospodarka…*, op. cit., s. 75.

8 N.V. Stukalo, A. Simakhova, *Social dimension of Green Economy*, „Filosofija. Sociologija" 2019, Vol. 30, No. 2, p. 91–99.

9 A. Jezierska-Thöle, M. Gwiaździńska-Goraj, M. Dudzińska, *Environmental, Social, and Economic Aspects of The Green Economy in Polish Rural Areas – A Spatial Analysis*, „Energies" 2022, Vol. 15, p. 1–21.

Table 1. Definitions of a green economy

Author of the definition	A green economy:
The European Commission	is low-carbon and resource-efficient, providing growth, creating jobs and eradicating poverty by investing in and protecting the natural capital on which the survival of the planet depends
UNEP – United Nations Environment Programme	is an economy whose pursuit results in long-term improvements in human well-being and social equality, while significantly reducing environmental risks (associated with the occurrence of undesirable environmental events and resource depletion) and environmental devastation; it is low-carbon, resource-efficient and socially inclusive
T. Jackson	is the direction of transformation of the economy and the entire economy-society-environment system; is ethical, responsible, based on respect for the planet and human beings
M. Burchard-Dziubińska	influences the growth of human well-being and social equality, while reducing environmental risks and natural resource scarcity
B. Ryszawska	is a new stage in the process of civilization, whose permanent element is respect for the boundaries of the planet, reducing aggressive economic and environmental expansion, which in fact threaten the quality of life of people and entire ecosystems
J. Godlewska	is such a direction of socio-economic development that more effectively enables the realization of the goals of sustainable development

Sources: *Zielone miejsca pracy w turystyce – szansa dla Małopolski*, pod red. M. Leńczuk, A. Chrześcijanek, E. Guzik, Wydaw. WUP w Krakowie, Kraków 2014, s. 12; J. Godlewska, *Teoretyczne i praktyczne aspekty rozwoju zrównoważonego turystyki na obszarach przyrodniczo cennych*, [w:] *Rozwój trwały i zrównoważony*, pod red. B. Kożuchowskiej, Prace Naukowe UE we Wrocławiu, nr 452, Wrocław 2016, s. 189; B. Ryszawska, *Zielona gospodarka…*, op. cit., s. 53, 57, 58; A. Łaniewska, S. Łaniewski, *Środowiskowe i ekonomiczne aspekty zielonej gospodarki w regionach przyrodniczych Polski i Białorusi*, Oficyna Wydawnicza Politechniki Białostockiej, Białystok 2020, s. 54; A. Grudziński, *Wybrane narzędzia usprawniające proces zazielenienia gospodarki*, „Rynek – Społeczeństwo – Kultura" 2018, nr 4 (30), s. 39–44.

A green economy is defined differently, but some common aspects can be found. These include, for example, saving natural resources, protecting the environment, reducing emissions of greenhouse gases and other pollutants, protecting biodiversity, human welfare, and social justice.[10] Definitions of a green economy highlight its certain aspects, so it can be seen as:[11]

- the direction of transformation of the economy and the entire socio-economic-environmental system;

[10] J. Godlewska, *Teoretyczne i praktyczne aspekty rozwoju zrównoważonego turystyki…*, op. cit., s. 189.

[11] B. Ryszawska, *Zielona gospodarka…*, op. cit., s. 53.

- a process of civilization change, necessitated by the transcendence of the planet;
- a key element and a goal of recovery strategies and programs;
- an engine that drives the economy, creating jobs;
- a desirable model for balancing development, combining economic, environmental and social aspects;
- an alternative to the brown economy;
- a concrete goal of current environmental policy and ecological transformation;
- the result of green growth.

A green economy provides the tools needed to transform an economic activity into more environmentally friendly. 12 In practice, under such conditions, income and employment growth is achieved through public and private investment in reducing CO_2 and other pollutant emissions, using energy and resources more efficiently, and protecting biodiversity and ecosystems. A green economy is based on a number of principles, e.g. sustainability, equity, dignity, inclusion, resilience, efficiency, etc. (table 2).

Table 2. Principles of a green economy

Principle	Content
Sustainable development	• is a tool to achieve sustainable development goals, not a substitute for sustainable development • balances the three pillars – environmental, social, economic • integrates cultural and ethical dimensions in relation to all three pillars
Justice	• promotes equality between and within states and between generations • respects human rights and cultural diversity, promotes gender equality • respects indigenous peoples' rights to land and resources
Dignity	• eradicates poverty • transforms existing jobs and actively develops new green jobs • ensures universal access to basic health care, education, sanitation and other basic services • respects the rights of workers and the freedom of action of labor unions • supports the right to development • supports sustainable, diverse economies and local jobs

[12] L. Georgeson, M.A. Maslin, *The global green economy a review of concepts, definitions, measurement methodologies and their interactions*, "Geography and Environment" 2017, Vol. 4, Issue 1, p. 1–24.

Earth's integrity and biological resilience (a healthy planet)	• recognizes the boundaries of ecosystems and seeks to act within them • emphasizes environmental justice • adheres to the principle of ecosystem resilience • assesses the potential impact of new unproven technologies before introducing them • demonstrates the benefits to the environment • ensures optimal use of natural resources • protects biodiversity and prevents pollution emissions • promotes the rebalancing of ecological and social relations
Integration	• is based on transparency of governance and universal access to information • supports governance at the global and local levels • supports citizens by promoting their full and effective participation at all levels of decision-making • fosters cultural values and is ethically sensitive • supports the development of public awareness through education
Responsible management	• promotes the development of common standards for measuring social development • promotes international and cooperation and accountability • promotes democracy • respects international human rights and environmental agreements
Resilience	• supports the development of social and environmental protection systems • promotes a systems approach, recognizing the interdependence and integrated nature of systems • promotes multiple models of green economy suitable for different cultural, social and environmental contexts • takes advantage of local knowledge, experiences and specificities
Efficiency	• ensures that the price includes all costs incurred, including the elimination of negative social and environmental impacts • implements the "polluter pays" principle • promotes product/service life cycle management • strives for zero emissions and waste minimization • prioritizes renewable energy and renewable raw materials • aims at absolute decoupling of production and consumption from negative environmental and social impacts • supports sustainable lifestyles • promotes social, economic and environmental innovation • fosters efficient use of resources
Intergenerational justice	• provides support for various forms of sustainable, green economy • promotes a long-term, rather than short-term perspective on decision-making • regulates the financial sector so that it reduces speculation and is more supportive of the real economy

Source: Own elaborations based upon: B. Ryszawska, *Zielona gospodarka…*, op. cit., s. 68–69; A. Łaniewska, S. Łaniewski, *Środowiskowe i ekonomiczne aspekty zielonej gospodarki…*, op. cit., s. 54; M. Michalak, K. Rosiek, P. Szyja, *Gospodarka niskoemisyjna, gospodarka cyrkularna, zielona gospodarka. Uwarunkowania i wzajemne powiązania*, Wydaw. Uniwersytetu Łódzkiego, Łódź 2020, s. 135–136.

An interest in the concept of a green economy is growing, it is becoming the subject of scientific research, the goal of local development strategies, and a reference point for all branches of business in the global economy. Despite various positions and different approaches to this concept, the common element in the thinking is the conviction that green development, green growth, or a green economy can become the engine that brings the world economy out of post-crisis stagnation, creates new jobs and added value, attracts direct and indirect investments, and creates innovations and technologies that reduce pressure on the environment. At the same time, synergistically the assumptions of a green economy can contribute to solving many environmental and social problems (inequality, exclusion, poverty) that determine the quality of life of people.[13]

1.2. Dimensions of a green economy

A green economy represents a new quality in management. It is a radical change in the approach to how people live, what they produce, how they consume. It means protecting the environment at the grassroots, through a change in public awareness and attitudes, rather than top-down bans and orders.[14] Accordingly, most definitions of a green economy emphasize the importance of its three dimensions: social, economic and environmental[15] one since its essence is the maintenance and development of social, economic and environmental well-being. Their detailed characteristics informs about the need to regulate many elements under the conditions of a green economy in order to prevent further problems, imbalances and crises. Each of them draws attention to the importance of other aspects, which together form the concept of a green economy. Thus:[16]

- **social dimension** – pays attention to: people's well-being, social inclusion and justice, reduction of inequality, quality of life, social development, an equitable access to necessary goods;
- **economic dimension** – emphasizes the importance of: income and employment growth, public and private investments, economic resilience, economic growth, a new economic activity realized in a green economy;

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13 B. Ryszawska, *Zielona gospodarka…*, op. cit., s. 54.

14 M. Ślebocka, A. Tylman, *Zielona gospodarka a finansowo-prawne dylematy…*, op. cit., s. 293–303.

15 A. Jezierska-Thöle, M. Gwiaździńska-Goraj, M. Dudzińska, *Environmental, Social…*, op. cit., p. 1–21.

16 B. Ryszawska, *Zielona gospodarka…*, op. cit., s. 58, 67.

- **environmental dimension** means: reduction of ecological risk and resource scarcity, low carbon, energy and resource efficiency, reduction of carbon emissions and pollutants, protection of biodiversity and ecosystem services, within the ecological limits of the planet, and environmental responsibility.

The social aspect of a green economy plays a very important role due to the fact that the concept focuses primarily on people, who have the right to live a healthy and creative life in harmony with nature[17] as it affects their well-being, the expansion of wealth, and the level and quality of life. It can also contribute to solving pressing social problems (e.g. hunger, poverty, exclusion). Environmental protection as one of the tasks of a "green" economy influences what air people breathe, what food and water they consume, and all this affects the state of health, morbidity, life expectancy of the population,[18] and consequently the state of entire societies and economies.

A green economy prioritizes investment and access to sustainable natural systems, infrastructure, knowledge and education needed for all people to prosper in the new conditions. It offers opportunities for green and dignified living, the creation of green businesses and new (green) jobs. It is based on a collective action for public goods, but also relates to people's individual choices.[19] The green economic model emphasizes the ability to enable all people to meet their basic needs (food, housing, employment) at an adequate level.[20]

The social dimension of a green economy also relates to the labor market as certain professions, associated with traditional sectors lose their importance, consequently disappear, and there will be a demand for new, unprecedented green jobs. Labor market policy should be aimed at supporting investments to create them.[21] All this also influences on the aspects related to education in the broadest sense, the transfer of knowledge affecting greater awareness of the assumptions of a green economy – the need (or necessity) to use resources efficiently and take action to save the planet's resources for future generations. Implementation, and especially acceleration of the implementation of the green economy assumptions also requires trainings.[22] This is

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17 M. Ślebocka, A. Tylman, *Zielona gospodarka a finansowo-prawne dylematy…*, op. cit., s. 293–303.

18 N.V. Stukalo, A. Simakhova, *Social dimension of Green Economy*, op. cit., p. 91–99

19 *The 5 Principles of Green Economy*, https://www.greeneconomycoalition.org/news-and-resources/the-5-principles-of-green-economy, (24.08.2022).

20 *Working towards a Balanced and Inclusive Green Economy: A United Nations System – wide Perspective*, United Nations, Genewa 2011, p. 13.

21 Ibidem, p. 35, 14.

22 A. Browen, B. Hancke, *The Social Dimensions of „Greening the Economy"*, Brussels 2019, p. 43.

because new conditions require new qualifications and skills, including a new way of thinking,[23] which cannot always be acquired using traditional educational pathways.

The economic dimension of a green economy refers to the benefits (or inputs) that can be achieved by entrepreneurs operating in green sectors. Economic instruments can also be the basis of an incentive system that creates favorable conditions for the implementation of green innovations, for the dissemination of environmentally friendly technologies. All countries can gain from the implementation of the green transformation of the economy by making profits through increased resource productivity and new sources of growth and green jobs. In addition to this, important benefits are manifested in human health and better well-being, higher quality of life through environmental improvements and a more responsible and sustainable approach to people.[24]

The environmental dimension of a green economy is obvious. Initiatives in this area are always aimed at implementing more ecological and greener solutions. This includes, in particular, the development of clean technologies, renewable energy sources, improving energy and material efficiency, changing consumption patterns, creating green jobs, building an economy using a diversity of natural resources based on a low-carbon energy supply, even taking into account green fiscal reform. All this should become one of the signposts that facilitate and at the same time normalize the realization of sustainable development in all its aspects.[25]

The concept of sustainability in tourism, which includes economic, ecological and socio-cultural aspects, is about making it in the long run economically viable, ecologically neutral and socially just. These three "pillars of sustainability" bind the tourism economy, the tourism participants (tourists and the host community) and the destinations to which tourists go into one coherent whole. The aforementioned aspects should be treated equivalently, as only their judicious combination is likely to result in the emergence and development of sustainable tourism, i.e. ensuring the improvement of the quality of life of individuals and societies.[26]

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23 *Working towards a Balanced and Inclusive Green Economy…*, op. cit., p. 13.

24 Ibidem, p. 9.

25 M. Ślebocka, A. Tylman, *Zielona gospodarka a finansowo-prawne dylematy…*, op. cit., s. 293–303.

26 M. Kazimierczak, *Jaką aksjologię zakłada idea zrównoważonego rozwoju w turystyce?*, [w:] *Uwarunkowania i plany turystyki*, op. cit., s. 12.

1.3. *Green economy* assumptions in different economy sectors

In the future, all entrepreneurs, doing business in various sectors of the economy, will be forced to naturally respect the requirements of the green economy and the assumptions of sustainable development.[27] They should deserve to be called green entrepreneurs implementing "green innovations" ("ecological innovations", "environmental innovations", "green technologies", "eco-innovations"[28]), solving environmental and social problems, not harming the environment, or contributing to its improvement and a higher quality of life for people.[29] They are important from the point of view of the state of the economy, but are also beneficial to entrepreneurs and their companies because the market for green innovations is a growth market with significant economic opportunities.[30] In the future, it may even be a requirement for anyone starting a business. "Green companies will then be the norm, not the exception."[31]

Until some time ago, there was a belief that the green dimension only generated costs, was a huge problem for entrepreneurs, and was a "brake on economic development". Nowadays, it is increasingly proven that, on the contrary, it can be something very positive, it can provide a new, positive impetus for sustainable development, and it can take companies to a higher level of development. This is supported by the so-called the "Potter hypothesis", which states that the environment and competition are not incompatible with each other, properly designed environmental regulations can act as an impetus for innovation, which in turn can increase competitiveness. It can mean the ability to make a profit and improve the environment at the same time. This is often referred to as a "double dividend" – a company makes a profit and protects the environment.[32]

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27 P. Demirel, Q.Ch. Li, F. Rentocchini, J.P. Pamvada, *Born to be green: new insides into the economics and management of green entrepreneurship*, "Small Business Economics" 2019, Vol. 52, p. 754–771.

28 F. Calza, A. Parmentola, I. Tutore, *Types of Green Innovations: Ways of Implementation in a Non-Green Industry*, "Sustainability" 2017, Vol. 9, p. 2301–1317.

29 M.-A. Galiano-Martin, M.-S. Castano-Martinez, M.-T. Mendez-Picazo, *The Relationship between Green Innovation, Social Entrepreneurship and Sustainable Development*, "Sustainability" 2020, Vol. 12, p. 1–19.

30 *Green innovations: industrial policy for a low-carbon future*, „Economic Report Series" 2014, p. 10, https://www.tuc.org.uk/sites/default/files/Green%20Innovation%20final%20combined.pdf, (04.08.2022).

31 *An attempt to define „Green entrepreneurship"*, op. cit.

32 F. Reuvers, *What is new about green innovation*, https://essay.utwente.nl/67437/1/Reuvers_BA_MB.pdf, (04.08.2022).

Entrepreneurs in various sectors of the economy are now attaching increasing importance to the tenets of a green economy. This is not just a fad or a fancy, but a "sign of the times", a necessity arising from the state of the environment and many serious environmental problems. This may also be due to the following reasons:[33]

- tightening of environmental standards;
- improvement of legal regulations, simplification of administrative procedures at the national and international level relating to the implementation of various types of environmental solutions;
- the emergence of financial incentives to induce entrepreneurs to conduct pro-environmental activities;
- rapid development of markets for green goods and services;
- an increased interest in receiving green products by consumers, and thus, their production by entrepreneurs (the creation of a "green" image and the introduction of green solutions is becoming an important element of the strategy of enterprises and is part of the concept of Corporate Social Responsibility).

An entrepreneur who respects the tenets of a green economy and sustainable development is a green entrepreneur, and their company is a green enterprise that:[34]

- incorporates sustainability principles into every business decision,
- provides environmentally friendly products or services that replace the need for non-environmentally friendly products and/or services,
- is greener than its traditional competitors,
- makes sustained commitments to environmental principles in its operations.

Green entrepreneurs take very risky business actions to promote sustainability and eco-development. Their results are often unpredictable, with very high risks. They are driven by intrinsic motivation ("green entrepreneurship" for them is not just an empty slogan, a signboard to attract additional customers). For them, environmental issues are important, they consider the solutions they implement as necessary for the environment, having a positive impact on the environment and the economy, positive for their businesses and customers. Most often, they are socially responsible companies with a good reputation

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33 E. Mieszajkina, *Przedsiębiorczość w koncepcji zrównoważonego rozwoju*, https://polnoreco.kig.pl/wp-content/uploads/przedsiebiorczosc-w-koncepcji-zrownowazonego-rozwoju.pdf, (11.08.2022).

34 M. Urbaniec, *Rola przedsiębiorczości w kontekście zrównoważonego rozwoju*, „Przedsiębiorczość – Edukacja" 2018, T. 14, s. 26–40.

in their environment. Green entrepreneurs consciously address environmental and social issues by identifying a specific environmental need with all its consequences (e.g. with the aforementioned risks), they want to contribute to creating a more sustainable future on many levels – e.g. technical, financial, etc.[35]

Today, more and more companies are shifting from a position of denying their negative environmental impacts to one in which they are willing and able to mitigate the harmful effects. In parallel with this, there is a growing interest in the emergence of new types of business that aim to radically change the mainstream. They are led by green entrepreneurs, i.e. those who combine environmental and business goals, and who seek to achieve social and ethical transformation not only in their businesses, but in entire sectors.

1.4. Towards green, sustainable tourism

Tourism, understood most generally as accommodation and food services activities, is a very important sector of all economies.[36] It is considered the largest "industry" of the world. It is one of the more powerfully growing branches of the economy in many countries.[37] It accounts for one-third of economic international exchange for developing countries and half for the least developed countries. International tourism ranks fourth (after fuels, chemicals and automobiles) in world exports.[38] As a multifaceted and intersectoral activity, it is linked to many industries, and covers with its influence a number of spheres of human activity – production of goods, provision of services, also their distribution, exchange and consumption.[39] It mainly results from the simple nature of the work performed and the low requirements in terms of knowledge and skills. Tourism provides an opportunity for employment for disadvantaged people in the labor market: young, unskilled or low-skilled people, also people having difficulty finding employment in other sectors and long-term unemployed,

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35 F. Farinelli, M. Bottini, S. Akkoyuniu, P. Aerni, *Green economy: the missing…*, op. cit., p. 42–49; *An attempt to define „Green entrepreneurship"*, op. cit.

36 R. Szopa, M. Szczerbowski, *Turystyka czynnikiem przemian ekonomicznych*, [w:] *Ekonomiczno-organizacyjne problemy działalności turystycznej w regionach*, pod red. S. Nowaka, Wydaw. AWF w Krakowie, Kraków 2013, s. 27–45.

37 *Innowacyjność w turystyce*, pod red. J. Krupy, Wydaw. Stowarzyszenia na Rzecz Rozwoju i Promocji Podkarpacia PRO CARPATHIA, Rzeszów 2010, s. 7.

38 *Tourism in the Green Economy. Background Report*, United Nations Environment Programme and World Tourism Organization, Madrid 2012, p. 8.

39 R. Szopa, M. Szczerbowski, *Turystyka czynnikiem przemian ekonomicznych*, op. cit., s. 27–45.

migrants and ethnic minorities, women unable to take up full-time work due to care for the dependents.[40]

The development of tourism as a whole is usually accompanied by significant infrastructure investments such as the construction of airports, roads, sewage systems and the development of telecommunications. These improvements not only generate benefits for tourists, but can also contribute to the growth of local prosperity,[41] to the reduction of the level of unemployment and social exclusion, to the improvement of economic, territorial and social cohesion.[42] This, in turn, revitalizes local entrepreneurship, drives investment,[43] influences the attraction of other industries to often disadvantaged areas, and can, therefore, be crucial to the socio-economic development of the region.[44] Tourism is also a tool for shaping local policy.[45] The economic benefits of its development are undeniable. The most important of these are:[46]

- inflow of financial resources and investment in the creation of tourism infrastructure – accommodation and accompanying facilities,
- positive impact on the balance of payments of the state, creation of national income,
- receipt of income from tourists' expenditures to meet their needs,
- development of entrepreneurship in the tourism sector or other related sectors,

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40 Of course, tourism generates not only jobs for low-skilled people. Especially under conditions of rapid development of technology and technology, digitalizing economy, also tourism employees should have certain competencies (e.g., social intelligence, adaptability, multicultural competence, analytical thinking, proficiency in new media, project attitude, virtual cooperation – sources: *Zielone miejsca pracy w turystyce…*, op. cit., s. 5–6, 14; B. Alejziak, *Kwalifikacje i kompetencje pracowników turystyki. Próba diagnozy turystycznego rynku pracy*, „Folia Turistica" 2014, nr 32, s. 119–146; A. Wartecka-Ważyńska, *Kompetencje zawodowe absolwentów kierunku turystyka i rekreacja Akademii Wychowania Fizycznego w Poznaniu na rynku pracy*, „Ekonomiczne Problemy Turystyki" 2014, nr 1 (25), s. 231–248.

41 S. Ibnou-Laaroussi, H. Rjoub, W.-K. Wong, *Sustainability of Green Tourism among International Tourists and Its Influence on the Achievement of Green Environment: Evidence from North Cyprus*, „Sustainability" 2020, Vol. 12, p. 1–24.

42 B. Gontar, *Etapy rozwoju strategii zrównoważonej turystyki*, „Europa Regionum" 2016, tom XXVI, s. 63–75.

43 *Tourism in the Green Economy…*, op. cit., p. 50.

44 I. Kapera, *Rozwój zrównoważony w turystyce. Problemy przyrodnicze, społeczne i gospodarcze na przykładzie Polski*, Wydaw. Krakowskiej Akademii im. Andrzeja Frycza Modrzewskiego, Kraków 2018, s. 113; A. Para, *Zasady zrównoważonego rozwoju turystyki – bariery i szanse dla rozwoju branży turystycznej*, Zeszyty Naukowe „Turystyka i Rekreacja", zeszyt 11 (1), pt.: *Zrównoważony rozwój turystyki w regionach Polski*, pod red. M. Kozikowskiej, Warszawa 2013, s. 7.

45 R. Szopa, M. Szczerbowski, *Turystyka czynnikiem przemian ekonomicznych*, op. cit., s. 27–45.

46 Ibidem, s. 27–45; *Tourism in the Green Economy…*, op. cit., p. 9.

- creation of new, attractive, future-oriented employment opportunities,
- reducing unemployment,
- reducing poverty,
- development of higher and specialized education,
- development of local entrepreneurship.

Bearing in mind tourism's potential as a driver of economic growth, its large contribution to GDP and employment, and its links to other sectors, even small changes toward sustainable operations can translate into improved use of natural and human resources. On the other hand, mismanagement in these industries can rapidly lead to the destruction of natural resources, including erosion, contamination of water, land and air, loss of biodiversity through the displacement of endemic species, increased fire hazards in forests and many more.[47]

The economic benefits of tourism are undeniable, but at the same time it has a significant impact on the environment, its development is strongly linked to it – on the one hand it depends on the quality and qualities of the environment, and on the other one it has a negative impact on it.[48] It is about, for instance, the huge carbon footprint that air travels leave behind, human waste and pollution, left in pristine regions. Travel can destroy local ecosystems and contribute to global climate change. Environmental degradation and climate change are capable of severely disrupting overall tourism trends and leading to the degradation of specific destinations. Rising sea levels, declining biodiversity, desertification and changing weather trends cause excessive soil erosion, extinction or disappearance of certain plant and animal species. They can, therefore, destroy the very things that attract tourists. As a result, tourism and environmental sustainability are becoming natural partners with increasingly linked agendas. No other industry needs to take a cautious approach to environmentally responsible growth, because no other industry has as much to gain and as much to lose from inappropriate use of resources.[49] Excessive and inappropriate growth of tourism and related industries can lead to shortages of water, energy and other goods. However, proper management of its development can help capitalize on natural and cultural resources, protect the environment and cultural heritage, as well as reduce poverty and increase the environmental awareness of local residents and tourists.[50]

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47 *Zielone miejsca pracy w turystyce – szansa dla Małopolski*, op. cit., s. 12.

48 J. Godlewska, *Teoretyczne i praktyczne aspekty rozwoju zrównoważonego…*, op. cit., s. 186.

49 *Cel: zielona turystyka*, https://odpowiedzialnybiznes.pl/artykuly/cel-zielona-turystyka/, (11.08.2022); A. Para, *Zasady zrównoważonego rozwoju turystyki...*, op. cit., s. 7.

50 *Zielone miejsca pracy w turystyce…*, op. cit., s. 13.

More and more environmentally conscious tourists are looking for "green destinations", i.e. destinations that are environmentally friendly[51], that proactively address the challenges of carbon emissions, biodiversity, environmental protection, waste management and water resources. Within the framework of green tourism there are distinguished:[52]

- **environmental responsibility** – this is about protecting and improving the environment to ensure the long-term positive state of the ecosystem;
- **local economic vitality** – is about supporting local economies – entrepreneurs, businesses to ensure sustainable development;
- **cultural diversity** – based on appreciating local cultures and cultural diversity to respect them and ensure development;
- **empirical diversity** – which means providing interesting and enriching research relating to various aspects of sustainable tourism.

In every sector of the economy, measures are needed to green it (even small changes towards greening can have significant effects[53]), although it is not only in Poland that the variable components of a green economy development index need improvement. Tourism plays a special role here because its development is based on environmental resources. It can (should) develop in such a way as to be sustainable, to enable contact with nature and at the same time contribute to its development. Tourism can and should be green so that it can survive and give people satisfaction from contact with it. Investments in renewable energy sources (RES) in electricity and heating are of greatest importance among the recommended measures to improve tourism. A developmental approach to sectors related to the closed-loop economy also seems important. The percentage of waste recycled in Poland is still lower than the EU average. At the same time, the sectors related to recycling, secondary circulation and repair of goods seem to have great potential providing many jobs, with a lower level of private investments than in many EU-27 countries. This indicates that there is great potential for the development of the sector, which can positively affect the goals of recycling, increase the secondary circulation of goods, and create additional green jobs.[54]

The rapid development of tourism (both in the spatial sense and in terms of growth in the size of the tourist market), in addition to its positive effects,

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51 A. Furquan, A.P.M. Som, R. Hussin, *Promoting Green tourism for future sustainability*, "Theoretical and Empirical Research in Urban Management" 2010, Vol. 5 (8) (17), p. 64–74.

52 Ibidem, p. 64–67.

53 *Tourism in the Green Economy…*, op. cit., p. 8.

54 *Green Economy – wpływ zielonej ekonomii na klimat i rozwój gospodarczy*, op. cit., s. 39.

contributes to the degradation of the natural and socio-cultural environment in the tourist reception regions.[55] Therefore, the main premise of sustainable tourism[56] is to pay attention to the need to counteract the negative consequences of increasing tourism, as well as the transition from mass tourism to quality tourism,[57] protection and development of natural, historical and cultural resources carried out not at the expense of, but in parallel with the growth of the tourism sector.[58]

Sustainable tourism is a phenomenon in which the activities undertaken by tourists do not cause losses or changes in the environment that are difficult to reverse, and at the same time benefit tourists, communities living in the visited destinations and areas, as well as people and institutions providing tourism services.[59] It emerged as a result of studying the links between tourism, the environment and development.[60] The model emphasizes social, economic and aesthetic needs, although they are not symmetrically distributed. It is intended to be a picture of harmony between the hedonistic needs of a man as an individual, the social relations of the entities that make up tourism, and the natural world, which subject, to exploration on the part of a man for the purposes of tourism products, threatening

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55 It is any fragment of space receiving tourists due to the tourist facilities and equipment located there and internal conditions. It includes: tourist destinations or its fragments, tourist regions, and even the entire country– source: I. Kapera, *Rozwój zrównoważony w turystyce…*, op. cit., s. 37; R. Szopa, M. Szczerbowski, *Turystyka czynnikiem przemian ekonomicznych*, op. cit., s. 27–45.

56 The concept of sustainable tourism refers to the general theory of equilibrium. Its main premise is the existence of a state of economic equilibrium, which means the balancing of supply and demand. Since the equilibrium theory is static, some propose a dynamic approach to it, which is called the concept of growth, or sustainable development understood as development without disturbing natural resources, in harmony with nature and the surrounding world. This term fully describes the concept of sustainable development in relation to the natural environment – source: A. Kowalczyk, *Turystyka zrównoważona – aspekty kulturowe*, [w:] *Uwarunkowania i plany turystyki*, pod red. Z. Młynarczyka, I. Potockiej, A. Zajadacz, tom VI, „Turystyka zrównoważona", Bogucki Wydawnictwo Naukowe, Poznań 2010, s. 20.

57 In the literature, various terms opposed to mass tourism are identified with sustainable tourism, such as: "green tourism", "gentle tourism", "responsible tourism", "environmentally friendly tourism", "agrotourism", "rural tourism", "alternative tourism, "ecotourism". However, sustainable tourism is not anti-mass in its essence and does not seek to reduce the number of tourists. On the contrary, assuming a growing demand for tourism services, it provides a framework for any type of environmentally friendly tourism that ensures sustainable socio-economic development, sources: I. Kapera, *Rozwój zrównoważony w turystyce…*, op. cit., s. 46; A. Hadzik, *Wybrane aspekty turystyki zrównoważonej na wiejskich obszarach uzdrowiskowych*, „Infrastruktura i Ekologia Terenów Wiejskich" 2008, Nr 2, s. 287–296; B. Gontar, *Etapy rozwoju strategii zrównoważonej turystyki*, op. cit., s. 63–75.

58 *Zielone miejsca pracy w turystyce – szansa dla Małopolski*, op. cit., s. 13.

59 I. Kapera, *Rozwój zrównoważony w turystyce…*, op. cit., s. 46.

60 A. Niezgoda, *Zastosowanie analizy strategicznej dla rozwoju turystyki zrównoważonej*, [w:] *Uwarunkowania i plany turystyki*, op. cit., s. 51.

the well-being of the natural world, and consequently a man themselves, who explores nature by the very fact of their existence.[61] Sustainable tourism affects:[62]

- foreign direct investment,
- employment,
- economic development of less developed areas,
- poverty reduction,
- improvement of the environment,
- sustaining cultural heritage.

Sustainable tourism is based on three interrelated dimensions: economic growth, social justice and environmental protection.[63] It is, therefore, more environmentally friendly, culturally sensitive and socially responsible.[64] It seeks to be more energy-efficient and less damaging to the climate (for example, through: the use of renewable energy), the use of less water, waste minimization, biodiversity protection, cultural heritage and traditional values, promotion of intercultural understanding and tolerance, generation of local income and integration of local communities to improve living conditions and reduce poverty.[65] It does not refer to a specific form of tourism, but is a concept that creates a framework for the development of those forms of tourism that foster economic, social and environmental objectives appropriate to the area.[66] Sustainable tourism means:[67]

- a systemic and holistic view of economic, social and natural phenomena, perceiving their interdependence, the relationship between various uses of the environment and its condition and the quality of life of society;
- optimal use of environmental resources, which are a key element in its development, preserving basic ecological processes and helping to protect natural heritage and biodiversity;

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61 J. Mosz, *Pragmatyczne i ideowe aspekty turystyki zrównoważonej*, „Studia Ecologiae et Bioethicae" 2018, Vol. 16 (2), s. 17–28.

62 J. Phillips, J. Faulkner, *Tourism investment and finance. Accessing sustainable funding and social impact capital*, George Washington University, p. 19–20; https://www.usaid.gov/sites/default/files/documents/2151/InvestmentWorkbook_4%5B2%5D.pdf, (03.09.2022).

63 M. Meler, M. Ham, *Green marketing for green tourism*, "Tourism & Hospitality Management", Conference Proceedings, 2012, p. 130–139.

64 *Tourism in the Green Economy…*, op. cit., p. 76.

65 Ibidem, p. 13.

66 A. Niezgoda, E. Markiewicz, *Turystyka biznesowa a turystyka zrównoważona – przykład hotelu w aglomeracji*, „Zeszyty Naukowe Wyższej Szkoły Bankowej w Poznaniu", t. 63, nr 6, s. 221–237.

67 I. Kapera, *Rozwój zrównoważony w turystyce…*, op. cit., s. 47; A. Kowalczyk, *Turystyka zrównoważona – aspekty kulturowe*, op. cit., s. 20; E. Panfiluk, *Problemy zrównoważonego rozwoju w turystyce*, "Economy and Management" 2011, Vol. 2, s. 66–67; A. Niezgoda, *Uwarunkowania wdrażania koncepcji rozwoju zrównoważonego na obszarach recepcji turystycznej*, „Prace Naukowe UE we Wrocławiu", nr 259, Wrocław 2012, s. 264–273.

- tourist activities that do not cause losses or changes in the natural environment that are difficult to reverse, while at the same time benefiting tourists, the communities living in the destinations they visit, as well as people and institutions providing tourist services;
- respecting the socio-cultural authenticity of host communities, preserving cultural heritage and traditional values, and contributing to intercultural development, understanding and tolerance;
- selecting development, production and consumption priorities using a set of economic, environmental and social criteria;
- balancing benefits and losses with respect to the economy, society and the environment;
- treating the environment as a limited whole, which is the subject, like the economy, to constant development processes of an evolutionary nature and occasional transformations of a revolutionary type.

Among the tools for the implementation of sustainable tourism development are: legal regulations, the creation of protected areas, the study of the impact of projects on the environment, environmental management systems, environmental reports and tourism management techniques.[68] Sustainable tourism development should:[69]

- take into account the environmental aspect in planning the development of infrastructure (transportation, sports, water, energy, accommodation, trade and other tourism and recreation related);
- influence the improvement of air quality;
- enable the development of the competencies of tourism sector employees (including foreign language skills);
- promote non-mass forms of tourism and attract such tourists who will be ready to generate income that exceeds the financial and social costs incurred by the region and its residents.

Sustainable tourism should be based on a number of principles, adherence to which contributes to the main objective of the concept, and in particular[70] to:

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[68] I. Kapera, *Rozwój zrównoważony w turystyce…*, op. cit., s. 44; A. Kowalczyk, *Turystyka zrównoważona – aspekty kulturowe*, op. cit., s. 20.

[69] *Zielone miejsca pracy w turystyce – szansa dla Małopolski*, op. cit., s. 16.

[70] D. Puciato, M. Winiarz, B. Woś, *Rola gospodarstw agroturystycznych w realizacji koncepcji turystyki zrównoważonej w gminie Głuchołazy*, [w:] *Uwarunkowania i plany turystyki*, op. cit., s. 62; A. Para, *Zasady zrównoważonego rozwoju turystyki…*, op. cit., s. 10; R. Szopa, M. Szczerbowski, *Turystyka czynnikiem przemian ekonomicznych*, op. cit., s. 27–45; *Tourism in the Green Economy…*, op. cit., p. 12; A. Hadzik, *Wybrane aspekty turystyki zrównoważonej…*, op. cit., s. 287–296; J. Godlewska, *Teoretyczne i praktyczne aspekty rozwoju zrównoważonego turystyki…*, op. cit., s. 187.

- promote a pro-healthy lifestyle in harmony with nature and bring people of different nations together in a spirit of openness and tolerance;
- make optimal use of environmental resources that are a key element in the development of tourism;
- focus on the development and maintenance of necessary ecological processes and help preserve natural resources and biodiversity;
- contribute to the preservation of nature's resources and diversity, and to the protection of indigenous culture of local communities;
- promote participation in the implementation of a green economy of local people for whom tourism can be a source of income;
- promote at the global level the idea of a free market and free exchange of tourism services, while maintaining environmental protection standards;
- respect the socio-cultural authenticity of local communities receiving tourists, protect their cultural heritage and traditional values, and contribute to intercultural understanding and tolerance;
- ensure viable, long-term economic activity with socio-economic benefits for all, including stable employment and earnings;
- reduce waste generation, conserve utilities, eliminate environmentally harmful substances from use, and motivate all market participants to behave in an environmentally friendly manner;
- promote free market policies in tourism, reduce barriers to international exchange, adhere to the principles of sustainable development, and respect legal norms related to nature conservation.

The presumed goal of sustainable tourism, in a given tourist reception area, is to achieve a state of equilibrium in meeting the needs (reaping the benefits) of the two main stakeholder groups – tourists and the community living and/or working for tourism in the area – while achieving an acceptable level of environmental and socio-cultural degradation. Sustainable tourism should also ensure a high level of tourist satisfaction and guarantee the tourist experience by raising awareness of sustainability issues and promoting sustainable tourism practices.

At the same time, sustainable tourism development requires the informed participation of all stakeholders, as well as strong political leadership to be able to ensure their broad participation in tourism.[71]

The lack of access to capital[72] is a very important factor limiting efforts to green tourism. However, the most serious problem in the process of

[71] I. Kapera, *Rozwój zrównoważony w turystyce…*, op. cit., s. 48.

[72] *Tourism in the Green Economy…*, op. cit., p. 9.

implementing solutions conducive to the development of green, sustainable tourism is the lack of environmental awareness and the need to implement such measures, both on the part of tourism entrepreneurs and tourists themselves. Sustainable development is a challenge for society, and entrepreneurs. It is one of the proposed ways to prevent the overexploitation of all elements of the natural environment through the rational use of environmental resources and values and the creation of conditions that allow the preservation of biological and landscape diversity.[73]

Sustainable green tourism can (should) become a universally accepted way of doing business, not just an alternative for socially conscious entrepreneurs.[74] To promote sustainable tourism in a green economy, national, regional and local economies should first ensure a good investment climate, including security and stability, also regulations, taxes, finance, adequate infrastructure necessary for its development. There is also a need for policy coherence, which can include economic issues, instruments and fiscal policy to reward sustainable investments and practices, and discourage those who do not see the need to stop excessive, or the destructive use of the environment.[75]

The transition to a green economy is an inevitable development direction that requires increased efforts to improve the development of a green economy in all countries of the world.

It should take into account national interests and the capabilities of individual economies. Green protectionism and green standards should not become an obstacle to solving current socio-economic problems, but contribute to, rather than counteract, the achievement of the goals of sustainable development of the global economy.[76] Investments made in the tourism sector should take into account the assumptions of sustainable development, respect ecological, social, cultural values, prefer green technologies, use renewable energy sources to produce "clean" green energy.

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73 E. Panfiluk, *Problemy zrównoważonego rozwoju w turystyce*, op. cit., s. 62.

74 *Zielone miejsca pracy w turystyce…*, op. cit., s. 14.

75 *Tourism in the Green Economy…*, op. cit., p. 138.

76 A. Łaniewska, S. Łaniewski, *Środowiskowe i ekonomiczne aspekty zielonej gospodarki…*, op. cit., s. 7.

Chapter 2.
TOURISM INVESTMENTS IN THE NATIONAL ECONOMY SYSTEM

2.1. The place of the tourism sector in the national economy

The national economy in the simplest terms is divided into sectors: agriculture, industry and services.[1] This classification, when more detailed, can be a division that takes into account five or more elements[2]. This refers to the object the entities activities comprising the sector, although this is not the only division in force in the system of national accounts. When applying the above to tourism, it should be noted that the very concept of "tourism" poses some classification difficulties due to its interdisciplinarity and complexity, since it is simultaneously a psychological, social, economic, spatial or cultural phenomenon.[3] Thus, when talking about tourism, it is possible to frame it as a tourism economy (a broad view) and as a tourism industry (a narrow view). The tourism economy is based on services, information and flexible structure.[4] The tourism economy will, therefore, include all entities related to tourism or affected by tourism (such as transportation or public services). It is estimated that the impact of tourism on the global economy approaches about 10% of global GDP, which shows the scale of tourism understood in this way. This broad view of tourism

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1 Today, this division is already informal and not used arbitrarily, due to the great variety of forms and ways of functioning of the economy, but it can be an introduction to help understand how broad a perspective should be taken when analyzing the various sectors.

2 This division includes: (1) Sector one – agriculture, forestry, fishing; (2) Sector two – mining, quarrying and processing, construction; (3) Sector three – transportation, communications, utilities and housing, trade; (4) Sector four – finance, insurance, marketing and advertising, real estate; (5) Sector five – health care, welfare, education, research, government, justice, police and military, and tourism and recreation.

3 W. Alejziak, *Przemysł turystyczny przyczynek do dyskusji na temat zasadności używania, definicji oraz zakresu znaczeniowego pojęcia*, [w:] *Przemysł turystyczny*, pod red. A. Schwichtenberg, E. Dziegieć, Wydaw. Politechnika Koszalińska, Koszalin 2000, s. 13–58.

4 Ł. Nawrot, *Biomas energy investment in rural areas – possible application in tourism industry*, "Actual Problems of Economics" 2012, No 7, Vol. 2; Ł. Nawrot, M. Bednarska, P. Zmyślony, *Odnawialne źródła energii w gospodarce turystycznej…*, op. cit., p. 85–98.

is used, among other things: in tourism satellite accounts.[5] In the second approach, the so-called narrow one, tourism is treated as an industry. It is worth pointing out that this approach is related to the need to estimate various economic quantities connected with tourism, and the easiest way to do this is to classify tourism according to a specific division, for example, related to an economic activity. This is reflected in the use of concepts which involve the European System of Accounts in parts of official statistics and in research. In this sense, the economy is divided into institutional sectors, whose specification has been standardized for EU countries in the just-mentioned European System of Accounts (ESA).[6] It is "an international methodological and accounting standard for the detailed and systematic description of the total economy (i.e. regions, countries, groups of countries), its components and its relations with other total economies."[7] ESA distinguishes:[8]

- non-financial companies;
- financial institutions;
- state and local government institutions;
- households;
- non-commercial institutions operating for the benefit of households.

This division enables to build a detailed classification of types of activity (so-called JRD – one type of activity), based on the fact that the classification by institutional sectors makes it possible to distinguish economic entities that have "the power to own products and assets, incur liabilities, engage in economic activities and transact with other entities on their own behalf."[9] One type of activity as a secondary division in Poland took the form of the Polish Classification of Activities (PAC), which distinguishes 21 sections understood as detailed categories of economic sectors.[10] The inclusion of tourism as a tourist industry results in the activities carried out under this classification in Section "I" – *Accommodation and Food Service* activities:

- **Division 55** – comprising *Accommodation*,
- **Division 56** – covering *Food Service activities*.

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5 A presentation of the assumptions of satellite accounts for tourism can be found later in the text.

6 Regulation of the European Parliament and of the Council (EU), No. 549/2013 of May 21, 2013 on *the European system of national and regional accounts in the European Union*, 26.6.2013, p. 1–727.

7 Ibidem.

8 Ibidem.

9 Ibidem.

10 Ordinance of the Council of Ministers of 24.12.2007 on the Polish Classification of Activities (PAC), (Journal of Laws of 2007 No. 251, item 1885, of 2009 No. 59, item 489, of 2017 No. 2440, and of 2020, No. 1249.

Thus, it is possible to indicate very precisely which entities will be considered as operating in the so-called tourism industry. Section "I" includes: provision of a short-term stay, including food for immediate consumption.[11] It does not specify activities related to food services alone (Section C) or the retail and wholesale sale of foodstuffs (Section G) and the provision of so-called long-term stay, treated as the main place of residence (Section L).[12] The main components of both sections are the following Groups:[13]

- **55.1 – Hotels and similar accommodation** – accommodation in: hotels, motels, boarding houses, other hotel facilities (e.g. wotels, botels. novotels, airtel houses, inns, castles);
- **55.2 – Tourist accommodations and short-stay accommodation** – accommodation in: colony resorts and other holiday accommodation (e.g. holiday resorts, training and recreation centers), guest quarters and bungalows, cottages or chalets, without service, rural farms (agritourism), hostels;
- **55.3 – Campgrounds** – accommodation in: campsites (e.g. recreational, fishing, hunting), caravans and provision of sites for RVs and setting up of tents;
- **55.9 – Other accommodation** in: students dormitories and school dormitories, workers' hotels, apartment blocks, and provision of space in sleeping cars and other means of transportation;
- **56.1 – Restaurants and other food service facilities** – restaurants, cafes, *fast food restaurants*, milk bars, fast food bars, ice cream parlors, pizzerias, places with take-out food, restaurants or bars operated in means of transportation, itinerant ice cream vendors, food carts, food trailers, food preparation at stalls;
- **56.2 – Preparation of food for external customers** – preparation and delivery of food provided on the basis of a contract, for specific celebrations to places designated by the customer, preparation and delivery of food for external customers, preparation and delivery of food on the basis of a contract (e.g. for transport companies), catering services provided in sports and similar facilities, operation of canteens and cafeterias (e.g. in industrial plants, offices, schools);
- **56.3 – Preparation and serving of beverages** – activities of: bars, taverns, cocktail bars, discos (serving mainly beverages), beer and pubs, coffee

11 Ibidem.

12 Ibidem.

13 Due to the subject of the report, detailed classes and subclasses within the group are not listed.

shops, fruit juice stores, sellers of beverages at mobile points, preparation and serving of beverages in means of transport.

The classification is broad and allows a detailed description of the activities of entities included in the tourism and recreation sector. However, in accordance with ESA provisions, a separate compilation, which is a dedicated satellite account, is necessary to precisely define this sector. The document establishing the principles of the aforementioned European System of Accounts (ESA 2010) indicates that "due to the needs of a specific type of data, separate satellite accounts should be compiled."[14] The satellite account for the role of tourism in the national economy is listed as the second among those proposed. Its structure proposed by ESA includes five of the eight characteristics of satellite accounts, i.e.:[15]

- functional satellite accounts,
- special sector accounts – links to branches or products,
- inclusion of non-monetary data,
- additional details,
- supplementary concepts.

The tourism satellite account, according to ESA 2010, "provides an overview of the supply and use of goods and services for the different types of tourism and their importance for national employment, the balance of payments, government finances, and private and corporate income."[16] Tourism itself, as defined in ESA 2010, "includes the activities of persons traveling to places outside their usual environment and remaining there for less than one year, for a principal purpose other than employment by a resident entity in the place visited."[17] Such activities do not include only traditional travel or leisure, but a range of activities undertaken by visitors. The indications contained in ESA 2010 influenced the development of the proposal of the *Tourism Satellite Account for Poland*.[18] So far, this is the only document covering this topic. This account includes various activities that are related to tourism, including:[19] Group 55. Accommodation, 56. Food and beverage service activities, 49.1. Intercity passenger rail transport, 49.3. Other passenger land transport, 50.1. Sea and coastal

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14 Regulation (EU), No. 549/2013 of the European Parliament and of the Council of May 21, 2013 on the European System of Accounts..., op. cit., p. 41.

15 Ibidem, s. 491.

16 Ibidem, s. 531.

17 Ibidem, s. 531.

18 *Rachunek satelitarny turystyki dla Polski za rok 2013 i oszacowania za rok 2015*, pod red. E. Dziedzic, Stowarzyszenie na Rzecz Badania, Rozwoju i Promocji Turystyki, Warszawa 2017, s. 15.

19 Ibidem, s. 10.

passenger transport, 50.3. Inland passenger water transport, 51.1. Passenger air transport, 77.11. Rental and leasing of cars and vans, 79. Activities of tour operators, travel agents and brokers and other reservation service and related activities, 91. Activities of libraries, archives, museums and other cultural activities, 93. Sports, entertainment and recreational activities, 68. Real estate services. It attempts to estimate the amount of investment in tourism using information on capital expenditures on property, plant and equipment and the net value of fixed assets from the following reports:[20]

- SP – the annual enterprise survey – part III. Fixed assets and investments – prepared by entities with more than 9 employees – classified according to PAC 2007 to sections H, I, N, R;
- F-03 – the report on the state and movement of fixed assets and investment activities prepared by units of the government and local government sector classified in sections H, I, N, R – regardless of the number of employees,
- SG-01 – the municipal statistics – part 4 – Investments and fixed assets – prepared by municipal offices,
- SP-3 – the report on economic activity of an enterprise with up to 9 employees.

Thus, *the Satellite Account* indicated investments made under three categories of purpose: buildings and structures, means of transportation and other fixed assets (including in particular: machinery, technical equipment and tools). The data on capital expenditures included information on land improvements, which, however, were not reflected in the information on the value of fixed assets, due to their incomplete inclusion in the accounting records resulting from the lack of regulations related to their valuation.

2.2. Investments in tourism – a multi-sectoral approach

Tourism is an important tool for socio-economic development. Investing in this sector plays a very important role, as it increases the development potential of a region. Tourism investment is any investment that helps develop the supply of tourism products and services provided to tourists. It is, therefore, the incurring of expenses to attract tourists and meet their needs.[21] Sustainable investments

[20] Ibidem, s. 15.

[21] Ł. Nawrot, P. Zmyślony, *Wpływ inwestycji na konkurencyjność regionu turystycznego*, [w:] *Międzynarodowa konkurencyjność regionu turystycznego*, pod red. Ł. Nawrot, P. Zmyślony, Wydaw. PROKSEMIA, Kraków 2009.

in tourism are largely responsible for achieving all elements of sustainable development involving economic, environmental and social aspects. They contribute not only to the development of tourism, but also to other sectors of the economy, and help solve pressing social problems (e.g. by generating new jobs).[22]

Tourism investments have an extremely wide scope in terms of subject matter and entities. They cover the activities of private and public sector institutions, are profit-oriented, but they are also non-profit ventures, and are both tangible and intangible in nature.[23] In particular, systemic solutions, decisions made at the central level on the determinants of tourism development are very important – they stimulate both economic and sectoral growth by increasing the productivity of current resources, as well as adding more new resources. It influences the creation of a legal framework and appropriate policy approaches to tourism development in a region, provides tools to encourage attractive investors (e.g. tax incentives, subsidies, etc.).[24] It is also important that some elements of tourism infrastructure (e.g. beaches, parks, attractive landscapes) are treated as national assets, as unique cultural heritage, and therefore, cannot be overseen by the private sector – hence the large role of the public sector in proper development, in overseeing and controlling tourism activities.[25]

In research on investment in tourism, there is a tendency to specialize and focus on selected aspects, such as, for example, investment programming, evaluation of efficiency and determinants of development, international capital flows, or their impact on regional development. The issue of investment in renewable energy sources in the tourism economy is not very often addressed in the literature, and the existing positions focus on indicating the range of possibilities of this sector and technical aspects. There is a lack of research results on the level of investment, its structure, motives for undertaking investment activities in the field of renewable energy sources, also the determinants of these activities of stimulants and destimulants.[26]

In order entrepreneurs were able to make various types of investments, they need capital. Cash and funds for tourism investments can come:[27]

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22 Y.S. Elzek, H.A. Gaafar, H. Abdelsamie, *Evaluation of Sustainable Tourism Investment in Tourism Business: Evidence from Egypt*, „Journal of the Faculty of Tourism and Hotels" 2020, Vol. 23, No. 1, p. 42–58.

23 Ł. Nawrot, M. Bednarska, P. Zmyślony, *Odnawialne źródła energii…*, op. cit., s. 85–98.

24 J. Phillips, J. Faulkner, *Tourism investment and finance…*, op. cit., p. 22.

25 M.A. Nawaz, *Investment and Tourism. Insights from the Literature*, „International Journal of Economic Perspectives" 2016, Vol. 10, Issue 4, p. 581–590.

26 Ł. Nawrot, M. Bednarska, P. Zmyślony, *Odnawialne źródła energii…*, op. cit., s. 85–98.

27 D. Szostak, *Finansowanie inwestycji turystycznych – wybrane zagadnienia*, op. cit., s. 247–257.

- **from private investors** – they are mainly related to investments in strictly tourist services, and primarily hotel (accommodation facilities and related infrastructure), food services (facilities of different scope and standard), as well as investments in service and service-related infrastructure. Private investors invest funds in investments that guarantee revenues in excess of costs. The lack of clear profitability usually results in a lack of interest in making such an investment. Evaluation of profitability and efficiency is an important element of the financial plan (as a component of the feasibility study or business plan);
- **from the state budget** – public funds and resources are earmarked for, among other things, the protection of national cultural assets, the development of certain types of tourist infrastructure and paratourist investments whose purpose is to encourage future private investors to engage funds in the development of local areas with a tourist character. Funds from the state budget and local governments are also the necessary own contribution to the implementation of projects financed from external sources (primarily EU);
- **from European Union aid funds** – a significant portion of these funds were or are concentrated, for example, in regional operational programs for individual provinces. Funds for the implementation of projects of a tourist nature can also be found in European territorial cooperation programs (a continuation of the INTERREG III Community Initiative).

Tourism investments are related to the creation of a material base for the provision of tourism services. Bearing in mind the heterogeneity of the tourism economy, when dividing investments of this sector, it is necessary to keep in mind the function they play in it. Therefore, it is possible to distinguish such investments that are inseparably connected with the tourist function of an area and those that, in relation to tourism, play an auxiliary role. Thus, one can distinguish (fig. 1):[28]

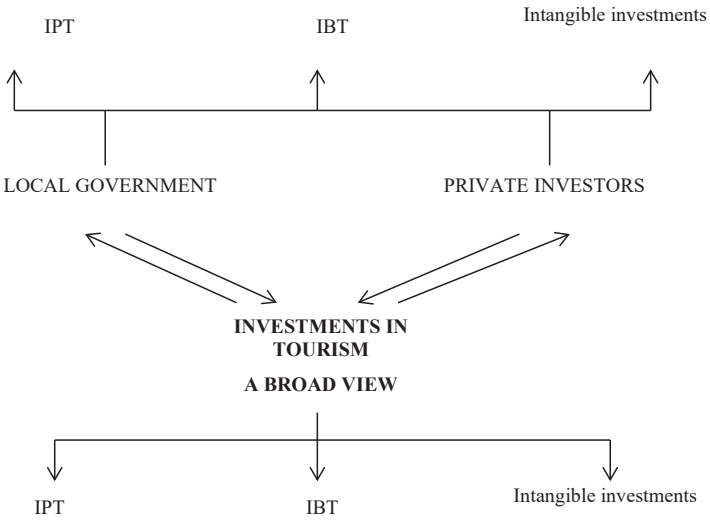
- **investments directly related to tourism**, so-called IBT – refer to facilities through which the needs of a potential tourist are met, i.e. accommodation, food, transportation, entertainment, or whose existence may be an attraction, such as: (1) construction of new accommodation facilities, expansion of existing facilities; (2) purchase of transportation facilities (planes, ferries, coaches), as well as construction of the necessary

[28] Ibidem, s. 247–257; M. Bordun, *Znaczenie inwestycji turystycznych w stymulowaniu popytu turystycznego na przykładzie gminy Biały Bór*, „Ekonomiczne Problemy Usług" 2012, nr 85, s. 139–150; Ł. Nawrot, P. Zmyślony, *Wpływ inwestycji na konkurencyjność…*, op. cit.

infrastructure for their use (airports, ports, parking lots); (3) construction of facilities constituting tourist infrastructure (sports facilities – ski lifts, ski trails, swimming pools, tennis courts, tourist information points, recreational facilities such as hiking trails, bicycle paths, educational paths); (4) restoration and renovation of national cultural assets (for example, parks, palaces, castles, manor houses, churches, open-air museums, old towns, monuments, post-industrial facilities);

- **paratourist investments** (the so-called IPT – investments indirectly related to tourism) – refer to facilities and equipment that are an important complement to strictly tourist investments, and thus are part of the tourist product. These include: (1) service infrastructure (stores, gas stations, medical care buildings); (2) technical infrastructure (gas pipelines, sewerage, water supply, electrification); (3) communications and telecommunications network; (4) environmental protection investments (water and sewage treatment plants, facilities and infrastructure to reduce dust and gas pollution, waste disposal, landfill development and revitalization).
- **intangible investments** – refer to the intangible sphere of tourism and these include: (1) people (investment in human capital); (2) investment in research and development; (3) investment in culture; and (4) investment in environmental protection.

Fig. 1. Investments in tourism – a broad view



Source: Ł. Nawrot, P. Zmyślony, *Wpływ inwestycji na konkurencyjność regionu turystycznego*, [w:] *Międzynarodowa konkurencyjność regionu turystycznego*, pod red. Ł. Nawrot, P. Zmyślony, Wydaw. PROKSEMIA, Kraków 2009.

It is worth noting at this point that these investments are made by various entities operating in the tourism market, not only entrepreneurs operating in this field, but also local government units or, both directly and indirectly, market environment institutions.[29]

When planning investment activities from the point of view of building a competitive tourism product at the level of a municipality or a region, it is necessary to analyze and pay attention to such elements as:[30]

- a widely understood, reliable and comprehensive assessment of the natural, environmental, and anthropogenic assets of the municipality or region;
- conditions for the development of tourist investments in the municipality and the region, both those of a general and specific nature, and the elimination of the most onerous barriers, which should be preceded by studies of tourist supply in the region – an assessment of infrastructural and socio-economic resources;
- a detailed analysis of tourist demand carried out on a regular and methodical basis, allowing an identification of needs, an assessment of the existing state and proper programming of the tourist product – planned activities at the regional level to increase it;
- cooperation of entities in the region for tourism development,
- a comprehensive tourism product of the region, whose assumptions should be included in planning documents, such as municipal development strategies, or tourism development for the municipality or region, which is the basis to determine investment needs in the study area;
- economic viability for private investment, without which it is not possible to create the core of the tourism economy in the municipality or the region, which is made up of private service providers.

Tourism investments are most often carried out by private entrepreneurs in the micro, small and medium-sized business sector, while para tourism is mainly the domain of the public sector, whose actions and decisions serve not only tourists, but also local communities.[31] In a green economy, an economic growth should be driven by investments that reduce carbon emissions and

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29 Market environment institutions can directly invest their resources in tourism, but it seems that their main role in terms of investment activities is to stimulate enterprises and local government units to a more active investment policy for the development of the region – see. Ł. Nawrot, P. Zmyślony, *Wpływ inwestycji na konkurencyjność…*, op. cit.

30 Ibidem.

31 J. Phillips, J. Faulkner, *Tourism investment and finance…*, op. cit., p. 16–19.

other pollutants, increase energy and resource efficiency, reduce biodiversity and excessive interference with the ecosystem.[32]

2.3. Investment in tourism in the system of national accounts according to the CSO data

Investment in tourism is part of the total investment in the national economy. Between 2017 and 2020, the value of investments in the overall economy increased from PLN 257.8 billion. in 2017 to PLN 309.5 billion. in 2020. However, it is worth noting that 2020 was the time of the COVID-19 pandemic and a number of restrictions on the functioning of economies around the world. This is also confirmed by the data on investments, as it was in 2019 that their value was the highest, at PLN 320.9 billion. Thus, the decline of more than PLN 10 billion was largely due to pandemic restrictions, which negatively affected the functioning of the economy.

The main source of investment in the economy is investors' private own funds (table 3). However, their share was declining over the past thirteen years, from 71.5% in 2008 to 69.4% in 2020. Budgetary funds are becoming a slightly more important source of financing, whose share in the last year for which data was available for (i.e. 2020) was 5.1%. However, the share of loans and credits has declined. In 2020, they accounted for 7.4% of all sources of financing. It is worth noting that the share of funds coming directly from abroad, including bank loans, which accounted for almost 1/10 of all sources of financing in 2019, increased steadily. In 2020, this percentage decreased to 8.8%.

Table 3. Selected sources of investment financing in the economy

Financial sources	2008	2017	2018	2019	2020
Own funds	71.5%	73.5%	72.8%	68.1%	69.4%
Budgetary funds	2.5%	3.5%	3.6%	3.1%	5.1%
Domestic loans and credits	12.8%	10.5%	10.1%	9.0%	7.4%
Financial leasing	–	–	–	4.5%	4.0%
Total funds directly from abroad	6.4%	4.7%	6.6%	9.6%	8.8%
Unfunded expenditures	3.8%	3.5%	3.0%	2.5%	2.7%

Source: Own study based on data from the Local Data Bank.

[32] *Green Innovation in Tourism Services*, „OECD Tourism Papers" 2013, Vol. 1, p. 7.

A major role in investing in tourism is played by the state, local authorities, which through their resources, can effectively support the activities of local investors. Through infrastructure investments, local authorities not only support entrepreneurship, but also promote the development of municipalities or counties in general (for instance, unemployment is reduced, the environment is improved). This development depends to a large extent on the peculiarities of individual municipalities, in which the tourist function occupies a very important place.[33]

The tourism investment data presented within this chapter is based on information from the only Tourism Satellite Account study to date, which was conducted for 2013 data along with an estimate of 2015 data, and information on investment and fixed assets in the economy. The Tourism Satellite Account study has been of a pilot nature so far, although it contains valuable information on the estimation of all investments. The lack of further studies of this nature and in this methodology makes it difficult to properly estimate the value of investments in tourism. The presentation of further data, in addition to the information from *the Tourism Satellite Account for Poland for 2013 and the estimate for 2015*, will be based on information on investments made within Section I of the Polish Classification of Activities – Accommodation and Food Services, which is consistent with the methodology used in the project's own research.

The tourism satellite account showed that in 2013 investment expenditures on: "buildings and structures, means of transportation and other fixed assets, including expenditures on land improvements" amounted to nearly PL PLN 14.4 billion (6.2% of total capital expenditures).[34] Two years later, in 2015, the same outlays already amounted to PLN 15.8 billion, although their share in total capital expenditures decreased and accounted for 5.8% of the total.[35]

As part of the research on capital expenditures carried out by entities of the national economy, it is possible to extract information for section I of the PAC – *Accommodation and Food Service*. The information contained in the report published annually by the CSO concerns investment outlays on fixed assets and so-called other outlays.[36] Investments in fixed assets are made in

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33 Ibidem, p. 247–257.

34 *Rachunek satelitarny turystyki dla Polski za rok 2013 i oszacowania za rok 2015…*, op. cit., s. 37.

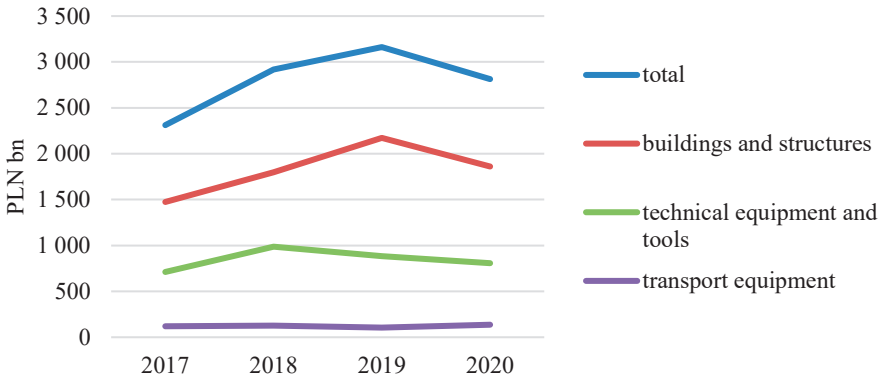
35 Ibidem, s. 61.

36 **Capital expenditures** include financial or in-kind expenditures to create new fixed assets or to improve (reconstruct, expand, reconstruct or modernize) existing fixed assets, as well as expenditures for the so-called first equipment of the investment – See: pojęcie „Nakłady

four categories: (1) buildings and structures, (2) machinery, technical equipment and tools, (3) means of transportation, and (4) other (e.g., land improvements, etc.).[37]

Based on the data from 2017–2020, it can be concluded that the COVID-19 pandemic clearly slowed down and reduced capital expenditures in accommodation and food service. With respect to 2019, this was a total decrease of 3.57%. Investment in buildings and structures accounted for the largest share in the value of outlays – 60% of outlays in each year (fig. 2).

Fig. 2. Investment expenditures within the Accommodation and Food services section



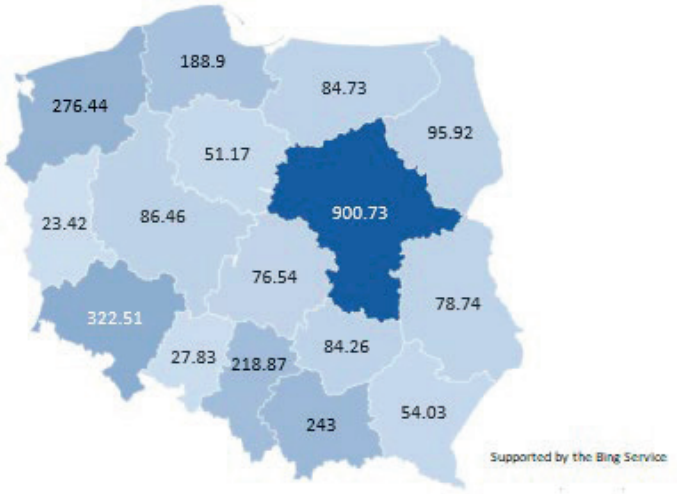
Source: *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, Wydaw. GUS, Warszawa 2022.

It is worth noting that the largest expenditures were made in the private sector. Every year (with the exception of 2018) they exceeded 90% of the total outlays realized in both ownership sectors (public and private). Regionally, the largest investment outlays were realized in the Mazowieckie Province (fig. 3).

inwestycyjne", https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/223,pojecie.html, (08.10.2022).

37 *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, op. cit., s. 13.

Fig. 3. Value of total capital expenditures in the Accommodation and Food Service section by province (in million PLN) in 2020



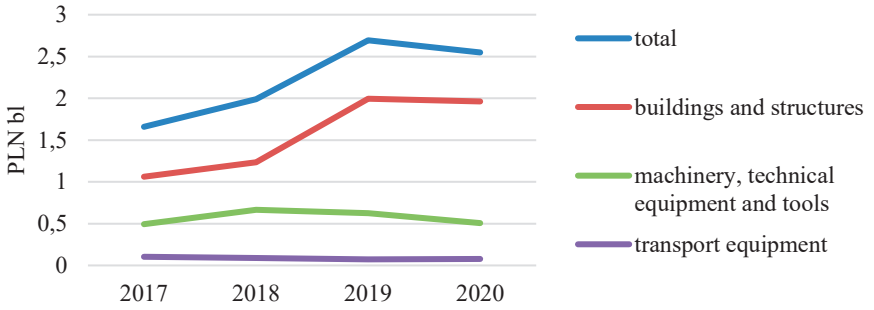
Source: Own study based on data from the Local Data Bank.

The share of investment in buildings in 2017–2020 is more than half of all investment, while in the last year of the analysis (2020) it accounted for almost two-thirds of investment. Almost 30% of investments in tourism were those in machinery, technical equipment and tools. This value exceeded 1/3 of outlays only in 2018, when investments in buildings and structures decreased (table 4).

The gross value of fixed assets in the Accommodation and Food Service section was PLN 4N 46.3 billion in 2n 2020, which was more than double of their value compared to 2008.[38] Their value represents more than 1% of the value of all fixed assets in the entire national economy. Each year, the value of fixed assets at the end of the reporting period exceeded their value at the beginning of the period, which is due to the lower value of liquidated assets and the higher value of those obtained from investment activities (fig. 4).

[38] **Gross fixed capital expenditures** represents acquisitions less disposals of fixed assets by resident producers during a given period, plus certain values resulting from the enhancement of non-produced assets realized as a result of the production activities of producers or institutional units. Gross fixed capital expenditures do not include expenditures that are first equipment of investments and interest on investment loans and credits for the period of investment. See: Pojęcie „Nakłady brutto na środki trwałe" https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/222,pojecie.html, (09.10.2022).

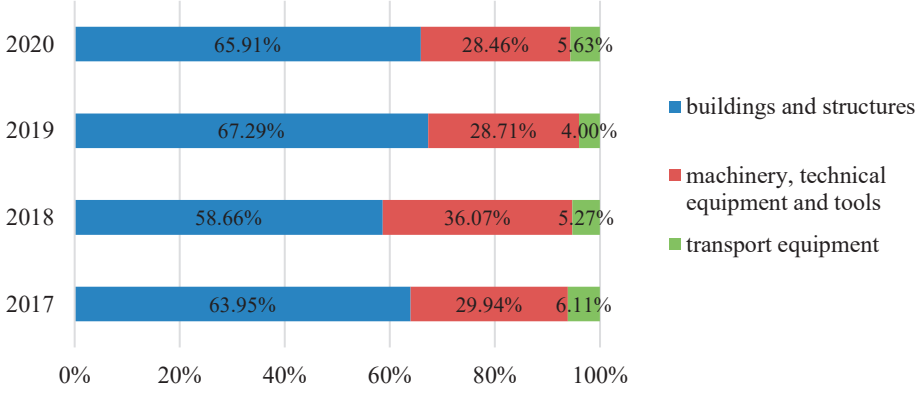
Fig. 4. Difference between the value of fixed assets in the Accommodation and Food Service section as of December 31 and January 1 of a given year



Source: *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, op. cit.

Investments in fixed assets in tourism included primarily buildings and structures. As with their monetary value, this group was also subject to the highest investments among all groups of fixed assets (fig. 5).

Fig. 5. Gross value of fixed assets from investment activities by group of fixed assets within the Accommodation and Food Service section



Source: *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, op. cit.

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Table 4. Gross value of fixed assets by province in 2017–2020 in the Accommodation and Food Service section

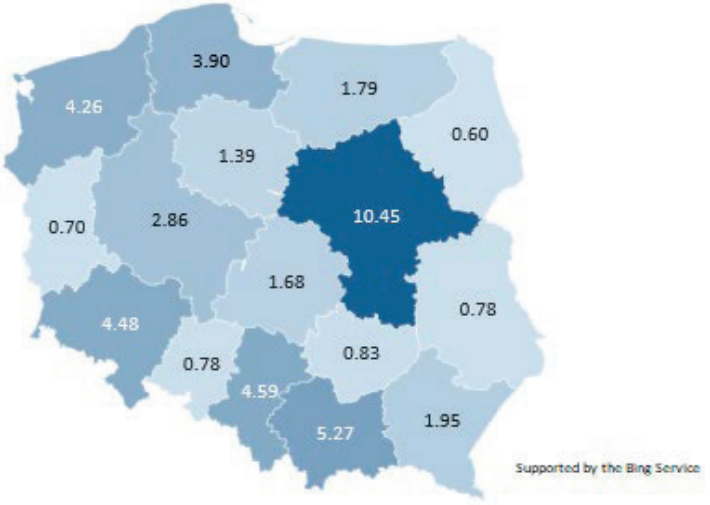
Province	2017	2018	2019	2020
dolnośląskie	3.86	4.13	4.12	4.48
kujawsko-pomorskie	1.32	1.35	1.33	1.39
lubelskie	0.79	0.80	0.73	0.78
lubuskie	0.61	0.64	0.65	0.70
łódzkie	1.60	1.62	1.72	1.68
małopolskie	4.91	4.96	5.27	5.27
mazowieckie	7.34	8.12	8.52	1.,45
opolskie	0.70	0.74	0.82	0.78
podkarpackie	1.33	1.40	1.40	1.95
podlaskie	0.69	0.64	0.63	0.60
pomorskie	3.61	3.76	3.69	3.90
śląskie	3.91	4.18	4.35	4.59
świętokrzyskie	0.85	0.88	0.84	0.83
warmińsko-mazurskie	1.64	1.70	1.75	1.79
wielkopolskie	2.58	2.72	2.87	2.86
zachodniopomorskie	3.69	3.77	3.97	4.26

Key:
– 0–2 PLN bn
– 3–5 PLN bn
– 6–8 PLN bn
– 9–11PLN bn

Source: Own study based on *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, op. cit.

The gross values of fixed assets in the Accommodation and Food Service section in 2017–2020 did not change much except in the Mazowieckie Province, where there was an increase in the gross value of fixed assets by more than PLN 3 billion. It is worth noting that three provinces – Lubelskie, Podlaskie, Świętokrzyskie – saw a decrease in the gross value of fixed assets during the analyzed period. Three provinces besides Mazowieckie also saw a significant increase in the gross value of fixed assets of more than half a billion PLN; these were Dolnośląskie, Śląskie and Zachodniopomorskie (fig. 6).

Fig. 6. Gross value of fixed assets by province in 2020, Accommodation and Food Services section

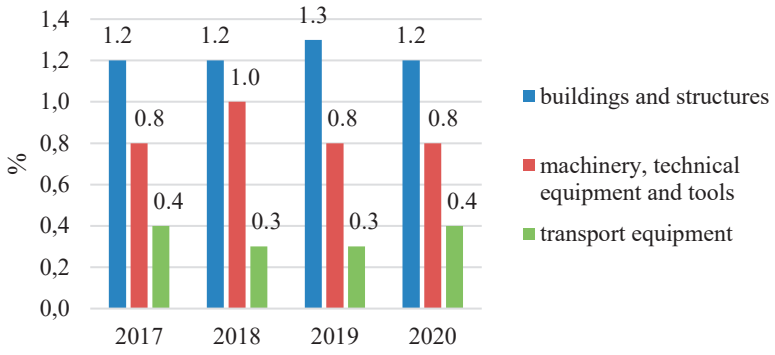


Source: Own study based on: *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, op. cit.

When analyzing the territorial distribution of fixed assets in Section I of the PAC Accommodation and Food Services, it is worth noting the significant relationship with the economic development of the area. In the group of provinces with a high value of fixed assets in the Accommodation and Food Services section, there are not only the provinces based in their strategies on emphasizing tourist values (Warmińsko-Mazurskie, Podlaskie, Podkarpackie), but above all those with a long tourist history (Małopolskie, Pomorskie) and the so-called richer ones, where industry was located (Mazowieckie, Dolnośląskie, Śląskie, Zachodniopomorskie). The existing infrastructural base and the superstructure (modernization) of new investments on its basis can be a significant factor influencing the development of tourism in the country and the value of new investments, especially green ones.

The investments in buildings and structures in tourism averages 1.2% of all capital expenditures in the entire economy, in machinery, technical equipment and tools, and they do not exceed 1% of all expenditures, and in means of transportation used for tourism averages between 0.3% and 0.4%. The gross value of capital expenditures on fixed assets incurred within the entire *Accommodation and Food Service* section does not exceed 0.9%-1%. Thus, it can be concluded that investments in tourism infrastructure account for one-hundredth of all investments (fig. 7).

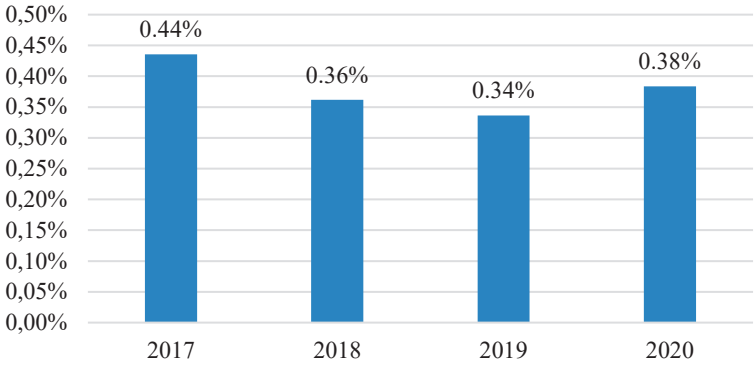
Fig. 7. Percentage of investment in fixed assets in the Accommodation and Food Services section in the investment expenditures of the total economy



Source: *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, op. cit.

The used fixed assets accounts for a small percentage of all capital expenditures in the economy in 2017 accounted for only 0.44% of the value of all fixed assets in the *Accommodation and Food Service* section, while their share steadily declined until 2019. In the last year the data was available for (2020), the share of used fixed assets increased slightly and amounted to 0.38% of total fixed assets in this section of the PAC (fig. 8).

Fig. 8. Share of used fixed assets in the Accommodation and Food Service section in total fixed assets in this section

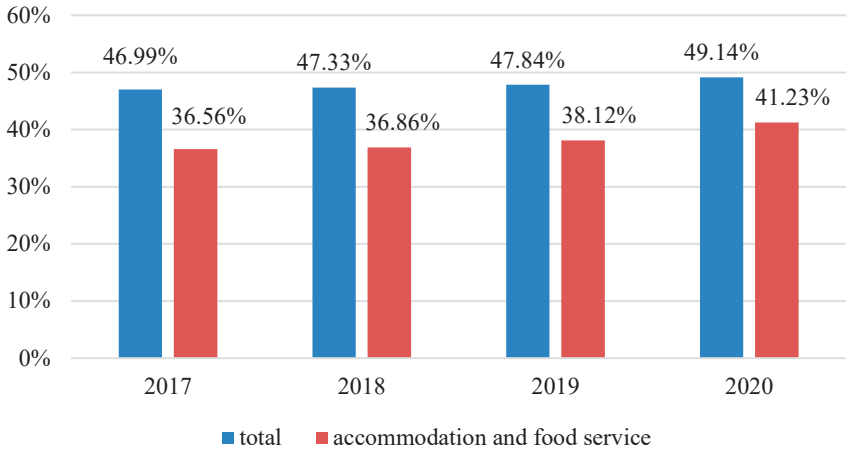


Source: *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, op. cit.

The data provided by the CSO allows an analysis of the degree of use of fixed assets. It is defined as the percentage ratio of the value of wear and tear to the

gross value of fixed assets.[39] In tourism, this ratio is lower than in the economy as a whole (fig. 9).

Fig. 9. Degree of consumption of fixed assets in the economy and in the Accommodation and Food Service section

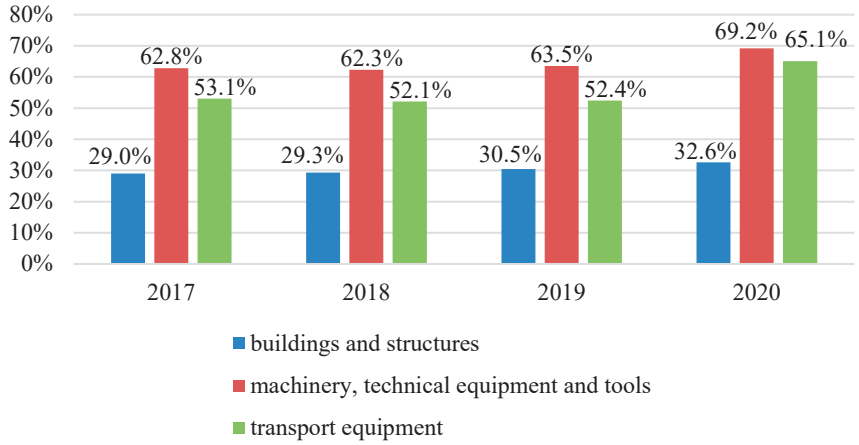


Source: *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, op. cit.

In the Polish economy as a whole, on average over the analyzed years 2017–2020, the rate of consumption of fixed assets was 47.8%, while in tourism it was almost 10% lower at 38.1%. It is noteworthy, however, that in the last two years which the data were available for, this difference decreased by 9.7% in 2019 and by 7.9% in 2020. This means that the consumption rate of fixed assets in tourism is increasing and its dynamics was higher (108% in 2020) than the dynamics of their consumption in the national economy as a whole (103%). Broken down into the three groups of fixed assets already mentioned, the highest rate of consumption was for machinery, technical equipment and tools. It exceeded 60%, while in the last year which the data was available for, it reached almost 70% (fig. 10).

[39] Ibidem, s. 57.

Fig. 10. Degree of wear and tear of three groups of fixed assets in the Accommodation and Food Service section



Source: *Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020*, op. cit.

It is worth noting that, at the same time, the consumption rate of means of transportation used in tourism was also increasing, and from more than half (53.1% in 2017), it reached almost two-thirds of their value (65.1% in 2020).

2.4. Green investments in tourism

Green investments are expenditures necessary to minimize emissions of greenhouse gases and air pollutants without significantly affecting the production and consumption of non-energy products. They involve, among other things: implementing green innovations that result in a reduction of negative environmental impact, optimize the use of natural resources, reduce waste. The examples include the solutions to improve energy efficiency in hotels, farms (including refrigerators, washing machines, air conditioning and heating equipment, etc.). Their implementation is often forced by rising energy prices, customer expectations, the development of advanced low-carbon technologies, and sometimes government initiatives.[40]

Green investments are not the same as green innovations. By some authors they are treated as a component of a separate category of green development.[41]

[40] J. Godlewska, *Teoretyczne i praktyczne aspekty rozwoju zrównoważonego…*, op. cit., s. 189.

[41] These categories include Green Investment, Green Fiscal Policy, and Technological Development, in which green innovation is positioned. See: J. Stankevičienė, M. Nikanorova, G. Çera,

Indeed, not all investments that positively affect the environment will have the degree of novelty required for innovation. The innovations can mean a real world-first, or a subjective novelty from the point of view of an entity.[42] According to *the Oslo Manual*,[43] an innovation is a new or improved product or process (or a combination thereof) that differs significantly from an entity's previous products or processes and that has been made available to potential users (product) or put into use by an entity (process).[44] Tourism companies can implement:[45]

- **product (service) innovations** – relating to changes perceived by consumers as new, i.e. unprecedented or novel for a given company or a tourist destination;
- **process innovations** – relating to the functioning of the so-called back office of the company, i.e. the production side of the services provided, invisible to the customer; their basis, as in the case of product innovations, is often innovative technological solutions;
- **management innovations** – i.e., in the forms of organizing cooperation within the company, personnel management, delegation of duties and tasks, career development, and construction of the remuneration and motivation system;
- **marketing innovations** – involving the implementation of a new marketing strategy, including significant changes in a product design, distribution, promotion and pricing policies;
- **institutional innovations** – related to new organizational or legal structures that effectively change the conditions under which a company operates.

Green innovation is the creation of new competitive products, services, processes, procedures and systems designed to use natural resources at

Analysis of green economy dimension in the context of circular economy: the case of Baltic Sea region, "E&M Economics and Management" 2020, Vol. 23(1), p. 4–18.

42 S. Pastoors, U. Scholz, J.H. Becker, R. van Dun, *Towards Sustainable Innovation*, Tectum Verlag, Baden-Baden 2017, p. 64.

43 In 1991, the first agreement was signed in Oslo within the global community of practitioners active in the OECD Working Party of National Experts on Science and Technology Indicators on how to define and measure innovation in enterprises. These guidelines became known as the Oslo Manual, which was published and tested with the support of the European Union – Source: *Podręcznik Oslo 2018, Zalecenia dotyczące pozyskiwania, prezentowania i wykorzystywania danych z zakresu innowacji*, Wydaw. GUS, Warszawa, Szczecin 2020, s. 3.

44 Ibidem, p. 22.

45 R. Seweryn, A. Niemczyk, *Innowacje w przedsiębiorstwach turystycznych w opinii klientów (na przykładzie Kopalni Soli w Wieliczce)*, „Rozprawy Naukowe AWF we Wrocławiu" 2015, nr 50, s. 136–145.

a minimum level and provide a better quality of life for local communities.[46] They contribute to the achievement of sustainable development and conservation of natural resources (more optimal use of them) through the development of greener products and services using environmentally friendly raw materials.[47] A tourism enterprise is considered innovative when its owner creates new items, produces them efficiently and promotes them effectively.[48] If they additionally have a positive impact on the environment while bringing business benefits, they are considered green innovations.

For both tourism and other service-oriented sectors, innovations do not mean introducing mainly new technologies. They usually involve continuous transformation, improvement and adaptation of their offerings to the needs of customers.[49] Non-technological innovations play a much greater role in the service sector. For instance, these can be environmental management systems, new business models, changes in marketing and organizational methods, innovations in social and institutional structures, in innovative interactions with the environment. National governments should support such innovations, including whether their tourism policies are sufficient to implement them.[50] At the national level, green innovations can be supported by changes in a tax policy, a reform and a reduction of environmentally harmful subsidies, the use of new market instruments, targeting public investment in "green" key sectors (including renewable energy sources, waste recycling, sustainable production and consumption, organic agriculture, sustainable transportation), greening public procurement, improving environmental regulations, as well as their enforcement. The use of green innovations in tourism can help solve problems such as excessive energy consumption and greenhouse gas emissions, water consumption, loss of biodiversity, as well as problems related to the effective management of cultural heritage.[51]

For research purposes, the work adopts the recommendations of the Oslo Manual, which divides innovations into product, process, organizational and marketing innovations.

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46 https://www.igi-global.com/dictionary/green-innovation/74603, (30.10.2022).

47 J. Guinot, Z. Barghouti, R. Chiva, *Understanding Green Innovation. A Conceptual Framework*, "Sustainability" 2022, Vol. 14, p. 1–14.

48 M. Roman, *Teoria innowacji i jej zastosowania w turystyce*, [w:] *Innowacje w rozwoju turystyki*, pod red. K. Nuszkiewicza, M. Romana, Wydaw. Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie, Warszawa 2013, s. 23.

49 E. Dziedzic, E. Szymańska, H. Zawistowski, W. Heliński, M. Migdał, *Poradnik innowacyjności w turystyce*, Wydaw. Ministerstwa Sportu i Turystyki, Warszawa 2016, s. 27.

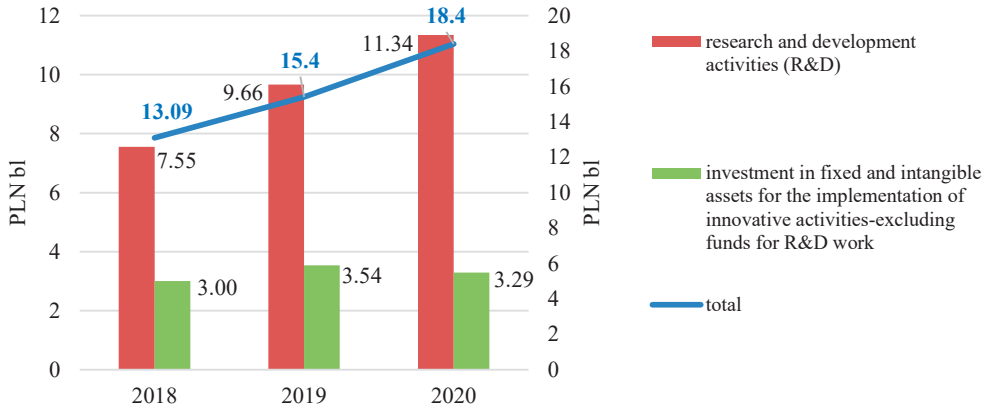
50 *Green Innovation in Tourism…*, op. cit., p. 189.

51 Ibidem, p. 189.

According to the CSO's data, among the service enterprises that can be classified as innovative, in the years 2018–2020 the enterprises related to tourism in the broadest sense, including those operating within the *Accommodation and Food Services* section, are not listed. It is worth noting that they are classified in the so-called Less Knowledge-Intensive Services.[52] Estimation what the share of innovation is, including green innovation, in the activities carried out by such enterprises is extremely difficult. Therefore, it is only possible to estimate these figures to some extent on the basis of general data on innovation activity itself, as well as expenditures and sources of funding for certain elements of it. Expenditures on innovation activities in service enterprises in 2020 amounted to more than PLN 18.4 billion (fig. 11).

Investments in fixed and intangible assets for the purpose of carrying out innovative activities, excluding funds for R&D work are a fairly important category according to the breakdown presented in Figure 10. This category can include any fixed assets for carrying out innovative activities at the stage of their use and not their creation (R&D work). The value of this type of fixed assets exceeded PLN 3 billion annually over the past three years.

Fig. 11. Expenditures on innovation activities in service companies in 2018–2020 by selected categories



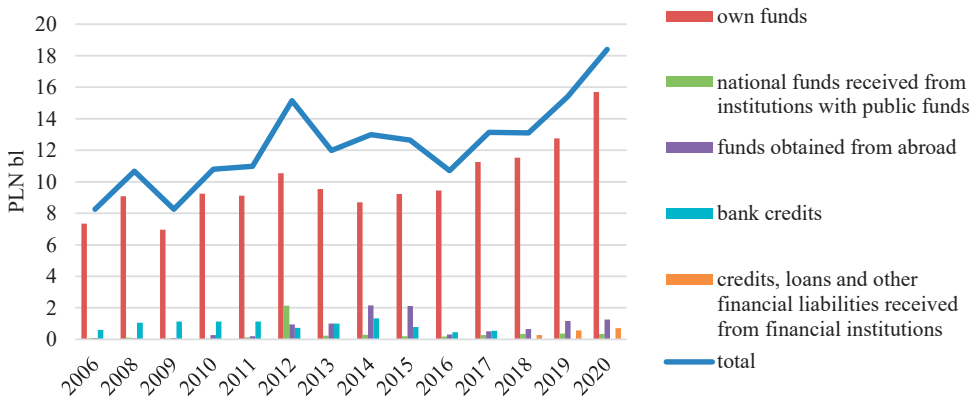
Source: Own study based on data from the Local Data Bank.

The main source of funding for innovation activities in 2018–2020 in service companies were own funds (Figure 12; Table 5). Their value fluctuated, which

[52] *Działalność innowacyjna przedsiębiorstw w latach 2018–2020*, Wydaw. GUS, Warszawa 2022.

probably depended on the availability of funds not only from enterprises, but also from public sources (such as projects). This is because it was necessary to involve the so-called "own contribution" in the implementation of the project, while the availability of the latter depended on the phase of implementation of the operational program (seven-year cycle) and the number of announced competitions for funding. The highest value of involvement of own funds in innovation activities was reached in 2020 and amounted to PLN 15.7 billion. This was a more than twofold increase counting from 2006.

Fig. 12. Expenditures on innovation activities in service enterprises by source of financing



Source: Own study based on data from the Local Data Bank.

Table 5. Expenditures on innovation activities in service companies by source of financing in selected years [in %]

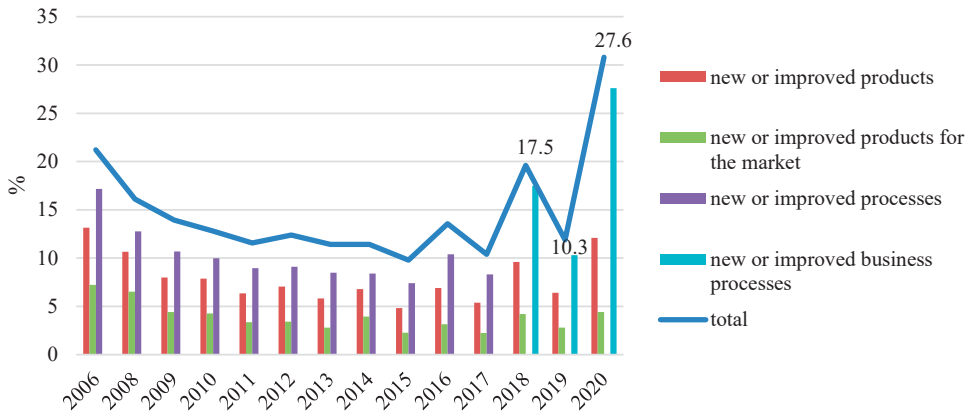
Specification	2006	2010	2014	2017	2018	2019	2020
Own funds	89.0	85.7	67.0	85.7	88.1	82.8	85.3
National funds received from institutions with public funds	0.8	0.5	2.2	2.1	2.6	2.4	1.9
Funds obtained from abroad	1.1	2.5	16.6	3.9	5.1	7.6	6.8
Bank credits	7.2	10.5	10.2	4.1	–	–	–
Credits, loans and other financial liabilities received from financial institutions	–	–	–	–	2.1	3.7	3.8

Source: Own study based on data from the Local Data Bank.

In addition to own funds, the funds obtained from abroad (6.8% in 2020) and loans and credits from various financial institutions (3.8% in 2020) played an important role in innovation activity expenditures in service enterprises.

The purpose of expenditures on innovation activities are specific innovations, which can be divided into two main categories: innovations in products and in the way services are provided. In the most recent year, which the innovation data are available for, (i.e., 2020), more than 30% of enterprises in the service industry could be considered innovative (fig. 13). Most of the innovations introduced were process-based and were either new or improved processes, including business processes relating to its very conduct.

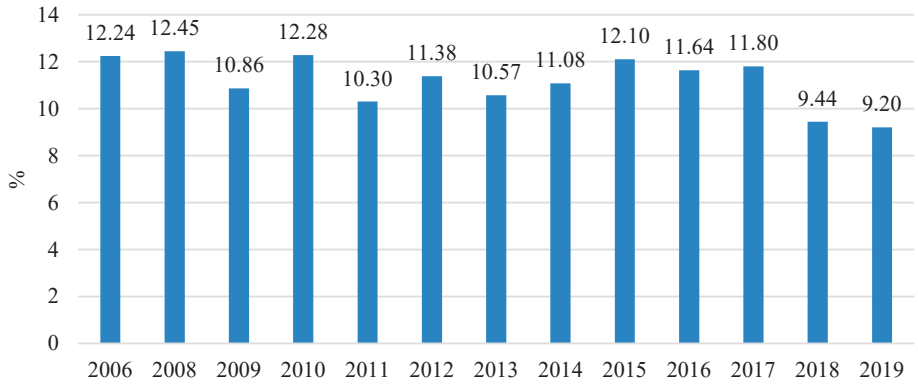
Fig. 13. Percentage of innovative enterprises in the service sector by types of innovations introduced



Source: Own study based on data from the Local Data Bank.

In 2020, 27.6% of service enterprises were implementing new or improved business processes. It is worth noting that expenditures on innovation activities in all enterprises in general, both manufacturing and service enterprises in relation to gross fixed capital formation have declined in recent years. The CSO's data shows that in the last two years (which data were available for, i.e. 2018–2019), this share did not exceed 10%, while in earlier years it reached more than 12% (fig. 14).

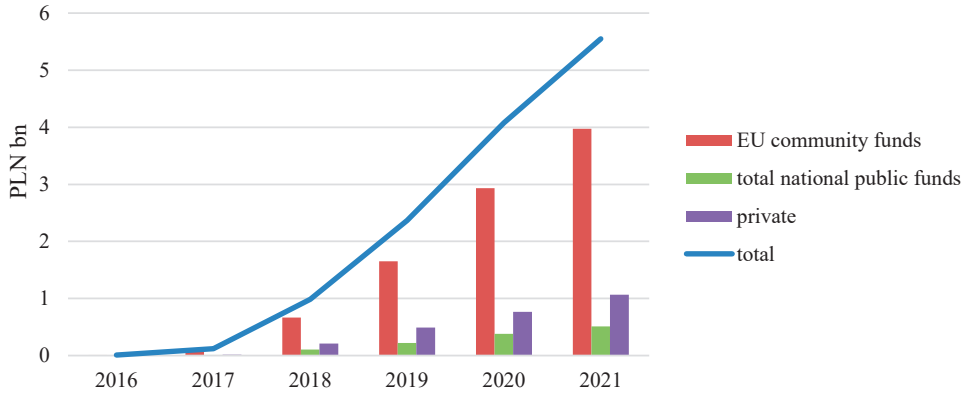
Fig. 14. Expenditures on innovative activities in relation to gross fixed capital expenditures [%]



Source: Own study based on data from the Local Data Bank.

The estimation of green investments in tourism based on publicly available data is difficult due to the lack of breakdown of available information by the section of PAC. Nevertheless, it is possible to deduce from an analysis of information on the financing of certain types of projects within the framework of nationwide operational programs in what direction investments can be made, including tourism. Within the framework of the main Environmental Operational Program (Operational Program Infrastructure and Environment), the value of projects carried out in the area of decarbonization has been increasing over the past few years (fig. 15). In 2021, their value amounted to more than PLN 5.5 billion, most of which were subsidized by Community funds.

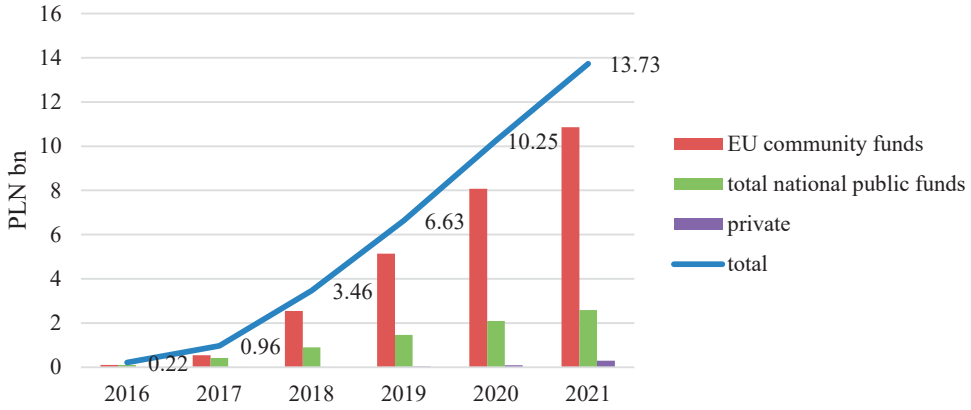
Fig. 15. Decarbonization of the economy under the Infrastructure and Environment Operational Program



Source: Own study based on data from the Local Data Bank.

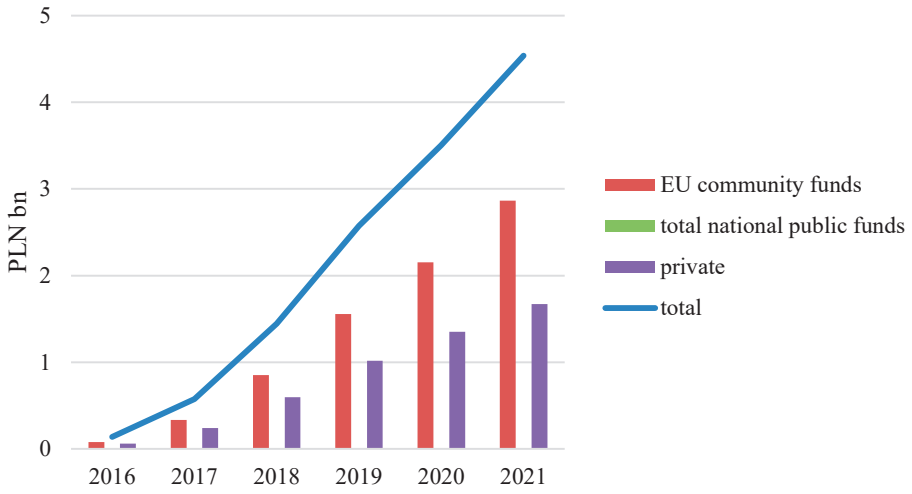
The value of projects carried out in the framework of environmental protection, including adaptation to climate change, also increased steadily, and in 2021 reached a maximum value of more than PLN 13 billion (fig. 16).

Fig. 16. Environmental protection, including adaptation to climate change under the Operational Program Infrastructure and Environment



Source: Own study based on data from the Local Data Bank.

Fig. 17. Improving energy security under the Infrastructure and Environment Operational Program

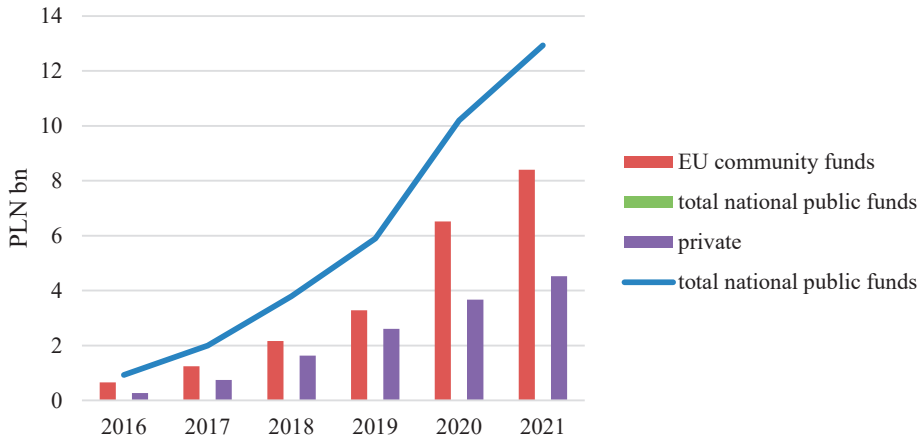


Source: Own study based on data from the Local Data Bank.

Energy security improvement projects in 2021 reached more than PLN 4.5 billion. (fig.17). This indicates an increase in funding for ecological investments, which are part of green investments.

Looking from the side of innovation processes, one can see increasing subsidization of environmental projects (fig. 18).

Fig. 18. Support for innovation under the Intelligent Development Operational Program



Source: Own study based on data from the Local Data Bank.

Within the framework of the main innovation operational program (Operational Program Smart Development), the value of ongoing innovation projects in the last year (i.e. 2021) amounted to nearly PLN 13 billion. More than PLN 8 billion. allocated for this purpose came from Community funds, while more than PLN 4 billion were private funds. These values indicate interest in the implementation of innovative investments and making efforts to obtain funding. It is expected that these trends will be maintained in the 2021–2027 programming period.

Chapter 3.
THE CHARACTERISTICS OF RENEWABLE ENERGY SOURCES MARKET

3.1. The essence of renewable energy sources

Renewable energy sources (RES) provide an alternative to fossil fuels and help curb global climate change. Especially those based on the forces of nature, can meet the growing needs of the population for electricity. They are not depleting, their use does not burden the environment, some of them allow the production of energy close to the consumer (which does not require the transmission of energy over long distances) and allow efficient development of rural areas with limited access to the electricity grid. Thanks to new solutions and technologies, energy production using RES is becoming cheaper and more accessible.[1] It has ceased to be a privilege of the state, and has become an affordable technology for individuals and small businesses, which on the roof of the house or in their own garden or a short distance from their premises can build an installation and produce energy for themselves and sell the surplus for use by the public.[2]

The use of RES depends on many conditions, which can be divided into: economic and social, legislative and technological[3]. RES investment activities have for many years been supported by the European Union, which in policies[4] and

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1 *Polska energetyka na fali megatrendów*, Forum Analiz Energetycznych, Warszawa, Styczeń 2016, https://forum-energii.eu/pl/analizy/1–2, (10.09.2022).

2 P. Devine-Wright, *Community versus local energy in a context of climate emergency*, „Nature Energy" 2019, vol. 4, p. 894–896; E. Sidorczuk-Pietraszko, *Wpływ instalacji odnawialnych źródeł energii na tworzenie miejsc pracy w wymiarze lokalnym*, „Ekonomia i Środowisko" 2025, nr 3 (54), s. 26–41; M. Woźniak, *Zrównoważona gospodarka energetyczna na obszarach wiejskich w Polsce*, „Polityka Energetyczna" 2018, tom 21, zeszyt 1, s. 69–84.

3 K. Tomaszewski, A. Sekściński, *Odnawialne źródła energii w Polsce – perspektywa lokalna i regionalna*, „Rynek Energii" 2020, nr 4 (149), s.11–15.

4 *Energia 2020. Strategia na rzecz konkurencyjnego, zrównoważonego i bezpiecznego sektora energetycznego*, Komisja Europejska 639, Bruksela 2010; *Zielona Księga: Ramy polityki w zakresie klimatu i energii do roku 2030*, Komisja Europejska 169, Bruksela 2013; *Europejski Zielony Ład*,

primary[5] and secondary legislation encourages member states to use this type of technology. This is reflected in the following initiatives undertaken by the European Commission:[6]

- **in 2009** – it was established that by 2020 20% of the EU's total energy consumption must come from renewable sources, and in the transport sector, member states committed to achieving a 10% share of fuels from these sources; it also set out the mechanisms that can be used to achieve the targets set (support schemes, joint projects and cooperation between countries, and sustainability criteria); each EU country also determined how it intended to achieve its individual targets and developed an overall action plan;
- **in 2016** – the European Commission published a legislative package entitled "Clean Energy for All Europeans".
- **in 2018** – the revised Renewable Energy Directive came into force as part of the "Clean Energy for All Europeans" package; its goal was to maintain the EU's position as a global leader in renewable energy and help the Union meet its emissions reduction commitments under the Paris Agreement; set a binding target that by 2030, final energy consumed in the EU should be sourced at least 32% from renewable sources; member states are to propose a national energy target and establish 10-year energy and climate plans under Horizon 2030;
- **in 2019** – the European Commission presented a communication on the European Green Deal; it gives a detailed vision on how to make Europe a climate-neutral continent by 2050 by providing clean, affordable and secure energy;
- **in 2021** – in the European Green Deal package, the European Commission proposed a revision of the Renewable Energy Directive to align its

Komisja Europejska 640, Bruksela 2019; T. Młynarski, *Unia Europejska w procesie transformacji energetycznej*, „Krakowskie Studia Międzynarodowe" 2019, tom 16, z. 1, s. 31–44.

5 *Traktat o funkcjonowaniu Unii Europejskiej*, „Dziennik Urzędowy Unii Europejskiej" 2016, C 202.

6 https://ec.europa.eu/info/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en#documents, (16.09.2022); https://www.eumonitor.eu/9353000/1/j4nvke1fm2yd1u0_j9vvik7m1c3gyxp/ vkcwedk9layr/v=s7z/f=/com(2016)860_en.pdf, (16.09.2022); https://eur-lex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN, (16.09.2022); *United Nations Climate Change*, https://unfccc.int/sites/default/files/ english_paris_agreement.pdf, (16.09.2022); https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/ DOC_1&format=PDF, (16.09.2022); https://eur-lex.europa.eu/resource.html?uri=cellar:dbb7eb9c-e575-11eb-a1a5-01aa75ed71a1.0001.02/DOC_1&format=PDF, (16.09.2022); https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0550&from=PL, (16.09.2022)

renewable energy targets with the new climate goals; discussions are currently underway on a post-2030 energy policy framework; in 2021, a new energy legislative package was published entitled: *Fit for 55': Delivering the EU's 2030 Climate Target* on the way to climate neutrality; it proposes raising the binding target for the share of renewable energy in the EU's energy mix to 40%.[7]

In order to implement the EU's energy and climate policy from 2021 to 2030, as part of the so-called "winter package", member states were required to prepare their own national strategies in this regard (*National Energy and Climate Plans*, NECPs). Poland has prepared such a document called: "National Energy and Climate Plan for 2021–2030", which outlines the development of the internal energy market. As part of this, Poland will strive to increase the availability and capacity of current cross-border electricity connections and integrate the national natural gas transmission system with the systems of Central and Eastern European and Baltic Sea countries. In this context, further investment in internal gas and electricity networks will be needed to ensure security of energy supply. With regard to energy production from renewable sources, measures will be taken to ensure an adequate level of flexibility in the energy system. One of the most important documents adopted by the Council of Ministers on November 10, 2010, relating to RES is the document *Energy Policy of Poland until 2030*. One of the most important assumptions contained therein is to increase the share of renewable energy sources in final energy consumption to at least 15% in 2020, and to further increase this rate in subsequent years. From the point of view of the tourism economy, other assumptions included in this document are also important:[8]

- support for investments in energy savings using preferential loans and subsidies from national and European funds,
- an application of mandatory energy performance certificates for buildings and housing when marketing and renting them,
- marking the energy intensity of energy-consuming equipment and products and introducing minimum standards for energy-consuming products,
- supporting scientific and research work on new solutions and technologies to reduce energy consumption,

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[7] K. Chudy-Laskowska, T. Pisula, *An Analysis of the Use of Energy from Conventional Fossil Fuels and Green Renewable Energy in the Context of the European Union's Planned Energy Transformation*, "Energies" 2022, Vol. 15, 7369.

[8] Ł. Nawrot, E. Bąk-Filipek, *Działalność B+R w gospodarce turystycznej na tle uwarunkowań rozwoju odnawialnych źródeł energii*, „Folia Turistica" 2017, Vol. 42, s. 9–30.

- information and education campaigns to promote the rational use of energy.

In order to enable the development of the RES market, in addition to a number of necessary regulations, it is also necessary to increase the knowledge of consumers on the subject and encourage them to play a more active role in the energy market, while reducing energy poverty with the protection of vulnerable social groups.[9]

3.2. The characteristics of renewable energy sources

Renewable sources of energy are an increasingly important element of the energy market, fitting into the issue of sustainable development, as well as innovation (green innovation) and investment. These elements are important economic categories, for which the tourism economy can be a research plane.[10]

In the market for renewable energy sources, there are many opportunities that investors can take advantage of. Depending on the location of the investment, the needs and the amount of money needed to finance it, geographical and climatic conditions (sunshine, wind, water sources), the most cost-effective method of obtaining energy can be matched. Currently, renewable energy sources are primarily associated with solar and wind power, these are the most common technologies used by prosumers (producer and consumer). However, there are more sources of renewable energy, they include solar, wind, water, geothermal and biomass. Solar radiation makes it possible to produce thermal energy as well as electricity. To produce thermal energy, solar collectors are applied, which heat water using a heating medium and heat exchanger in a tank. Solar energy can also be converted by photovoltaic (PV) cells, which are the main component of photovoltaic panels. As a result of their operation, solar radiation is converted into electricity.

The involvement of tourism economy players in the RES market is influenced by a wide variety of factors, which are worthy of a detailed analysis. These are not easy decisions, nevertheless, entities operating in the tourism economy, even if they do not want to, but will be forced now or in the near future to take up the subject of investment in RES. Although the nature of the

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9 *Krajowy Plan na rzecz Energii i Klimatu na lata 2021–2030*, wersja 4.1. z 18.12.2019 r., https://www.gov.pl/web/klimat/krajowy-plan-na-rzecz-energii-i-klimatu, (16.09.2022).

10 Ł. Nawrot, M. Bednarska, P. Zmyślony, *Odnawialne źródła energii…*, op. cit., s. 85–98.

involvement, and the level and structure of the investment will differ, but it may be necessary.[11]

On the basis of our own survey of tourism and hospitality operators conducted for the study, it was shown that the most commonly used renewable-based investments were solar panels, photovoltaics, shallow geothermal energy, heat pumps, solid biomass, and domestic wind turbines. The following subsections, therefore, characterize in detail the technologies that were used by the respondents included in the survey.

3.2.1. Solar collectors

Solar collectors are modern devices for converting solar energy into heat, which can be used, among other things, to heat domestic water, pool water or support central heating.[12] Solar installations today can be found on many buildings – both residential and public buildings. They are also used on farms, agritourism farms and small businesses. A solar collector is one of the components of a solar heating system, which includes: a solar collector or a battery of solar collectors, a solar hot water tank or an external tank, a control system, a pump unit (connection and protection).

The installation in solar collectors is used to convert solar energy into useful heat. This is possible thanks to the absorber, where the heat is transported thanks to the solar fluid (also called the working medium) to the exchanger.[13] This transport is possible thanks to a pump unit. When the temperature of the water in the tank is lower than the temperature of the solar fluid, then the control system turns on the pump unit. Solar energy is given back to the domestic water through an exchanger inside the tank. It is then transported through hydraulic fittings to the various consumption points. If the heat generated by the collectors exceeds the storage capacity of the tank, the temperature controller switches off the circulation pump. Then appropriate safety devices, installed in the pump unit, will prevent damage to the system (fig. 19). Thanks to the modular design, it is possible to expand the system with additional devices, such as central heating buffer tanks or pool heat exchangers. If there is a shortage of

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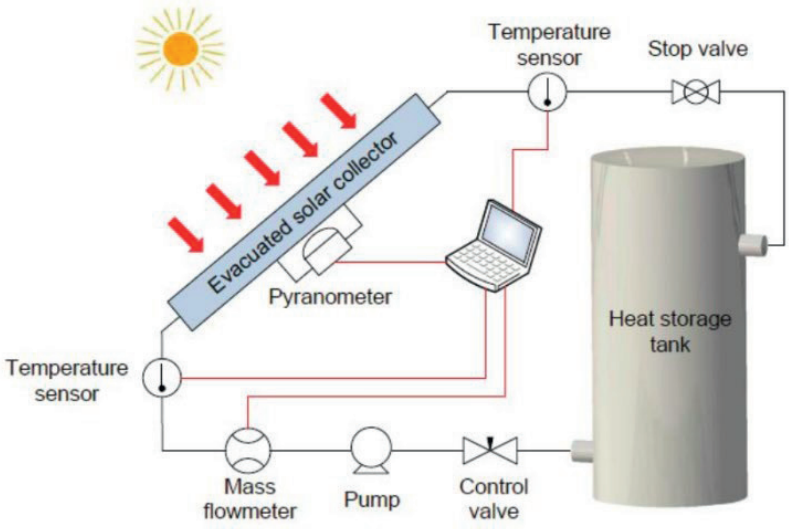
11 Ł. Nawrot, E. Bąk-Filipek, *Działalność B+R w gospodarce turystycznej…*, op. cit., s. 9–30.

12 J. Dąbrowski, *Kolektory słoneczne do podgrzewania wody użytkowej. Efektywność i opłacalność instalacji*, Wydaw. Uniwersytetu Przyrodniczego we Wrocławiu, Wrocław 2009, s. 11.

13 W. Nowak, A. Stachel, *Kolektory słoneczne i panele fotowoltaiczne jako źródło energii w małych instalacjach cieplnych i elektroenergetycznych*, „Automatyka, Elektryka, Zakłócenia" 2011, Vol 2, Nr 2 (4).

solar energy, the installation can be combined with traditional heating equipment to provide water heating.[14] The performance of solar collectors is largely influenced by the technology used and the quality of the materials used during production.[15]

Fig. 19. Schematic example of the solar collector system



Source: K. Jong-Soo, H. Soo-Jung, L. Sang Il, J., Bang Ho, *The study of evacuated solar collector using pulsating heat pipe*, "Frontiers in Heat Pipes" 2013, Vol. 3(4), p.1–5.

Solar collectors are relatively simple devices in construction. An absorber receives radiation and converts it into heat, which is then transferred to a fluid that flows through a system of tubes contained in the solar panels. The tubes are usually made of copper, and the back plate is painted black to help absorb solar radiation. The heated fluid circulating in the system flows through the storage coil, where the heat is transferred to the domestic water. The cooled fluid then returns to the collector, and the whole process is repeated. Positioning the collectors in the optimal direction ensures the most efficient operation of the system. The greatest efficiency can be hoped for by pointing them

[14] E. Różycka, *Analiza opłacalności zastosowania niekonwencjonalnych źródeł energii w projektowanym budynku jednorodzinnym. Kolektory słoneczne, pompy ciepła*, Środkowo-Pomorskie Towarzystwo Naukowe Ochrony Środowiska, Tom 11, Koszalin 2009, s. 1354–1371.

[15] https://kospel.pl/blog/jak-dzialaja-kolektory-sloneczne-b59.html, (10.09.2022).

in a southerly direction. The collectors are designed to cover 80 to 100% of hot water demand[16] in the summer half-year.

Solar collectors have a number of advantages, but also disadvantages (table 6), they can be successfully used on single-family houses, and public buildings.

Table 6. Advantages and disadvantages of solar collectors

ADVANTAGES	DISADVANTAGES
• low operating costs • easy installation • ecological way of obtaining heat • energy efficiency • convenience of use, trouble-free, failure-free • rapid return on investment • service life of more than 20 years	• performance dependent on the weather • low efficiency in winter • relatively high investment cost • technical problems – unused power results in obtaining very high temperatures in the collector, thus degrading the solar fluid; if the collector is not able to transfer heat, it overheats

Source: Own study based on: https://www.biawar.com.pl/blog/kolektory-sloneczne-wady-i-zalety/, (15.09.2022) and https://swatt.pl/pl/SWATT_WIEDZY/energia-odnawialna/czy-kolektory-sloneczne-sa-oplacalne, (15.09.2022).

The use of heat collectors in tourist areas is not insignificant. They can reduce operating costs. Their role in the aspect of enriching the tourist space with new components cannot be overlooked either. The presence of such devices can affect the so-called ecological prestige of an area. It builds the image of the place, and, creating a kind of quality certificate, constitutes an advertisement of the area. Nowadays in the competition gain those places that are in some way characteristic, distinctive and symptomatic, have a developed brand that testifies, among other things, to the high quality of life.[17] Such a role can be played by solar panels as a pro-environmental element that is part of the idea of "green economy".

3.2.2. Photovoltaic panels

Photovoltaic panels convert solar energy into electricity. In order to do this, it is necessary to build a system consisting of a PV generator (a panel or set of photovoltaic panels), an energy storage unit with a controller, and an inverter

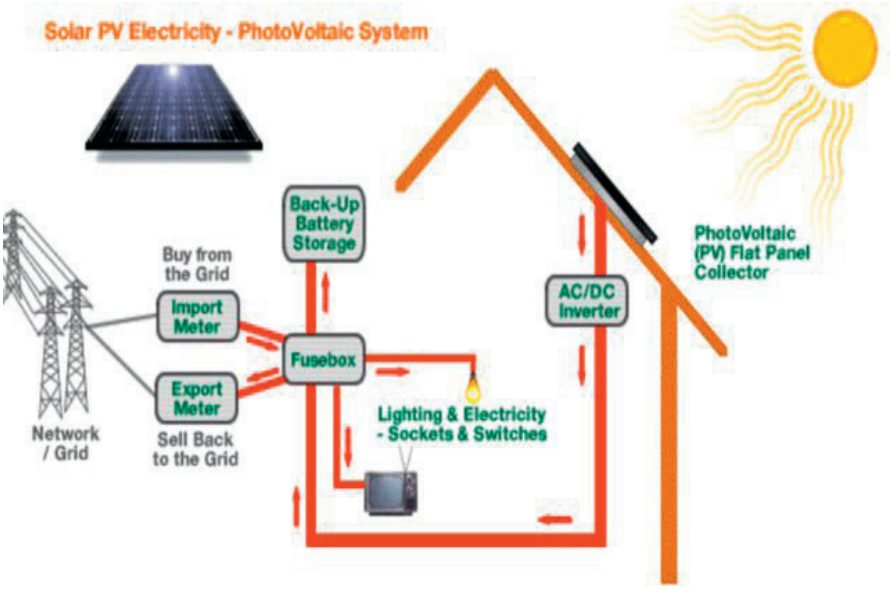
16 Ibidem.

17 J. Chodkowska-Miszczak, *Obszar turystyczny Dolina Zielawy w kontekście wykorzystania energii słonecznej*, „Studia Ekonomiczne i Regionalne" 2012, Nr 2, s. 112–119.

(a DC to AC converter with the parameters of the power grid supplying the building).[18]

The photovoltaic system is connected to the electrical system. It is used to heat water and light the house. The resulting electricity can be used for current needs or stored. It all depends on the type and power of the installation. The principle of photovoltaic cells is that a photon (the minimum unit of light), falling on a single photovoltaic cell is absorbed by silicon. This then occurs knocking the electron out of its position and forcing it to move, which means an electric current flows (fig. 20).

Fig. 20. Schematic example of a solar Photovoltaic system



Source: E. Flood, K. McDonnell, F. Murphy, G. Devlin, *A Feasibility Analysis of Photovoltaic Solar Power for Small Communities*, "The Open Renewable Energy Journal" 2011, Vol. 4, 78–92.

There are two possible applications for photovoltaic systems – as on-grid and off-grid systems. On-grid systems are connected to existing power grids. Regardless of the energy demand of the facility, the energy generated by the panels is fed into the power grid. In such a system, the power line acts as a buffer with almost infinite capacity. This creates the possibility of selling surplus energy,

[18] W. Jaskółowski, J. Wiatr, *Instalacje fotowoltaiczne. Podstawy fizyczne działania. Ochrona odgromowa. Zasady neutralizacji zagrożeń porażenia prądem elektrycznym w czasie pożaru*, „Zeszyty Naukowe Szkoły Głównej Służby Pożarniczej w Warszawie", nr 59/3, Warszawa 2016, s. 71–100.

which is the essence of prosumer systems. Off-grids work as completely autonomous energy sources, not requiring connection to the power line for operation. In this type of case, additional energy buffers – batteries – are used, which significantly increase the efficiency of the entire system by storing surplus energy generated.[19]

Photovoltaics has a number of advantages, but also disadvantages (table 7). The most important advantage is that it is a free, fully ecological, clean energy source.

Table 7. Advantages and disadvantages of photovoltaics

ADVANTAGES	DISADVANTAGES
Financial: • free electricity from the sun • savings for at least 30 years • independence from electricity price increases • increase in property value • require no maintenance and are virtually trouble-free • easy, quick installation, without a building permit • at first the cost of the installation may seem high, but it pays for itself in a relatively short time, and then generates large savings **Ecological:** • solar energy is renewable and sustainable, which means it can't be scarce • clean energy source – the installation does not emit pollution • quiet – electricity from the sun is generated silently, so it is an ideal solution for urban areas • accessible – sunlight is available anywhere on the globe, so virtually everyone has the opportunity to get electricity from the sun	• dependence on solar radiation on a cloudy day and in winter energy production lower • investment costs • generation of energy only during the day • even slight shading can affect the efficiency of the installation • required free space for installation • roof windows, chimneys, roof structure can be an obstacle • production of photovoltaic panels is associated with greenhouse gas emissions • already used installation components should be properly recycled • prosumer energy industry is dependent on regulations

Source: W. Bouaguel, T. Alsulimani, *Understanding the Factors Influencing Consumers' Intention toward Shifting to Solar Energy Technology for Residential Use in Saudi Arabia Using the Technology Acceptance Model*, „Sustainability" 2022, Vol. 14; K. Papis-Frączek; K.A. Sornek, *Review on Heat Extraction Devices for CPVT Systems with Active Liquid Cooling*, „Energies" 2022, Vol. 15; https://columbusenergy.pl/blog/fotowoltaika-wady-i-zalety/?zrodlo=google-ads&medium=search&IDkampanii=1509955182&kampania=fotowoltaika-search-1&gclid=Cj0KCQjwxb2XBhDBARIsAOjDZ36sTXAgQtP4Py3hwZNAgCVrk42xi5keW_if1PbHXLkX4dfB25oVwfYaAozFEALw_wcB, (10.09.2022).

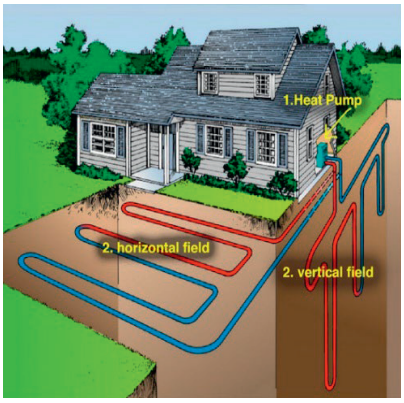
[19] T. Mirowski, K. Sornek, *Potencjał energetyki prosumenckiej w Polsce na przykładzie mikroinstalacji fotowoltaicznych w budownictwie indywidualnym*, „POLITYKA ENERGETYCZNA – ENERGY POLICY JOURNAL" 2015, Z 2, Tom 18, s. 73–84.

Photovoltaic panels can be placed both on the ground and on the roof of a building. The advantages of placing on the ground are the development of unused land, the ability to optimize the positioning of the modules in relation to the sun, easier access in case of servicing, better ventilation increasing efficiency, especially in summer. The advantages of placing the panels on the roof are: less risk of theft or damage to the installation, aesthetic value (the installation is less visible) and lower investment cost (no additional scaffolding required).

3.2.3. Gheotermal energy in individual facilities

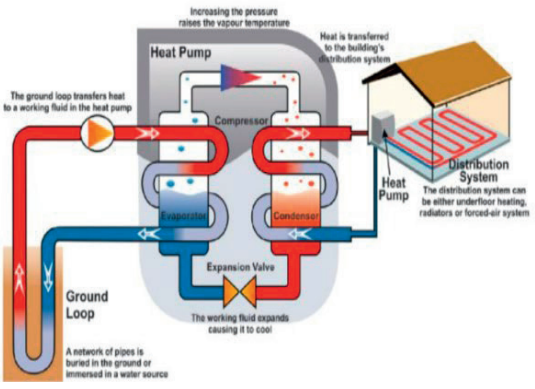
Geothermal energy is the most difficult type of renewable energy source to obtain. It involves the use of water, rock and ground energy to produce heat and electricity. The total amount of the installation depends on geological conditions and can range from tens to hundreds of thousands of PLN.[20] A schematic example of geothermal operation is included in fig. 21 and fig. 22.

Fig. 21. Schematic example of shallow geothermal operation



Source: https://www.24hplans.com/site-plans-for-geothermal-heating-and-cooling/, (12.09.2022).

Fig. 22. Geothermal heat pump schematic



Source: M. Climo, L. Lind, B. Carey, S. Bendall, *The rise and rise of geothermal heat pumps in New Zealand*, New Zealand Geothermal Workshop, Proceedings, Auckland, New Zealand 2019.

[20] M. Vicidomini, D. D'Agostino, *Geothermal Source Exploitation for Energy Saving and Environmental Energy Production*, "Energies" 2022, Vol. 15.

Geothermal energy sources used for household needs are called shallow geothermal. It is designed to introduce long-term savings in heating. A ground source heat pump can be used to heat hot water and heat rooms regardless of external weather conditions. The extracted heat comes from groundwater or brine, which requires additional drilling, so the price of a ground source system can be higher compared to simple air pumps. However, this is compensated by the high efficiency of operation and the possibility of economical reheating of rooms.[21] Table 8 gives the advantages and disadvantages of shallow geothermal installation.

Table 8. Advantages and disadvantages of shallow geothermal energy

ADVANTAGES	DISADVANTAGES
• environmental friendliness – heat pumps use renewable energy without generating any pollution • low cost of heat energy • very long life of the device – about 50 years • the use of energy from the Earth's interior • cooperation with other devices, such as fireplaces	• heat pump pays off the most when the whole building is energy efficient, which increases the expected results • high investment cost depending on the type of pump, the building and its floor area

Source: https://artemida.org.pl/2022/03/10/elektrownia-geotermalna-jak-dziala-wady-i-zalety/?gclid=Cj0KCQjworiXBhDJARIsAMuzAuw6pLu7s2jIkMjbMDJu_x9sUb_Edn-uRr7-vQjG-4mxA6nF70mfrzC0aAo4YEALw_wcB, (11.09.2022).

The geothermal installations currently in use, the environmental, economic and social benefits associated with them, also the increase in the number of investments carried out in recent years, the interest in possible further investments and market demand entitle us to conclude that the use of geothermal energy can be expected to increase in the coming years. In selected locations, it will also be possible to work towards the commissioning of binary installations for cogeneration of electricity and heat. It is important, however, that this growing economic interest in geothermal and investment projects be succored as soon as possible by appropriate legal regulations, economic instruments and faster administrative procedures to favor the implementation of these projects and encourage the initiation of further ones. It is also necessary to increase funding for geothermal research and development, with, among other things, greater commitment from ministries, government.[22] Only then is there a chance to reduce the cost of this type of investment, and thus increase demand for geothermal.

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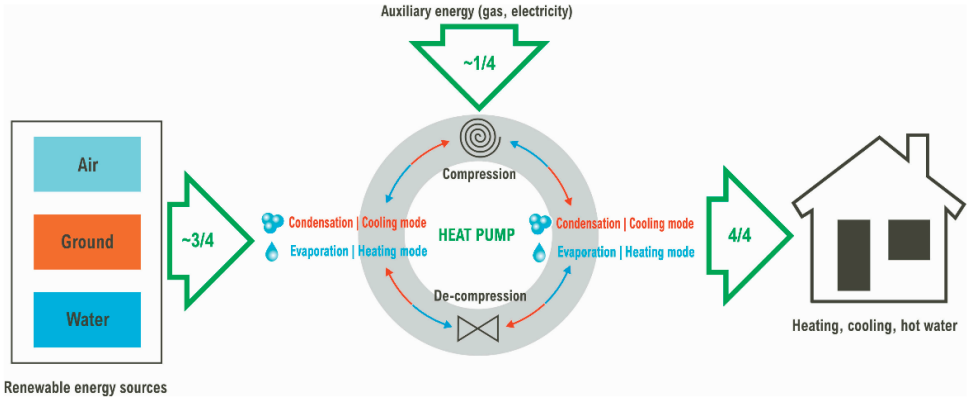
21 https://kb.pl/porady/cennik-pomp-ciepla-porownanie-producentow-i-technologii/, (11.09.2022).

22 B. Kępińska, *Energia geotermalna w Polsce – stan wykorzystania, perspektywy rozwoju*, „Technika Poszukiwań Geologicznych. Geotermia. Zrównoważony Rozwój" 2011, nr 1, s. 7–19.

3.2.4. Heat pumps

A heat pump is a device that extracts energy from the environment surrounding the object which it feeds that energy to. It functions on a similar principle to a home refrigerator.[23] It forces heat to flow from an area of lower to an area of higher temperature. This process goes against the natural direction of heat flow and occurs due to externally supplied mechanical or thermal energy. The most important components of a heat pump are the compressor, condenser, expansion valve, and evaporator. The device would not perform its function without the working medium, or liquid, which circulates inside the system, boiling at low pressure and extracting heat at low temperature. In the system, the pressure and temperature increase, and thanks to the compressor, the refrigerant changes to a gaseous form, going then to the condenser, where it gives up heat to the system. After that, the liquid refrigerant passes through the expansion valve, where the pressure and temperature drop and the cycle begins again.[24] The principles of heat pump operation are included in fig. 23.

Fig. 23. The principle of the heat pump operation



Source: R. Valancius, R.M. Singh, A. Jurelionis, J. Vaiciunas, *A Review of Heat Pump Systems and Applications in Cold Climates: Evidence from Lithuania*, "Energies" 2019, Vol. 12, (13.09.2022).

Air-to-water heat pumps can be connected to the existing heating system. The receivers are, for example, radiators, or an underfloor system. The most effective

[23] W. Leśniak, M. Janczar-Smuga, W. Podgórski, M. Klimkowski, *Pompy ciepła – ekologiczne źródło energii odnawialnej*, „Nauki Inżynierskie i Techniczne" 2012, Vol. 3 (6), s. 78–90.

[24] https://columbusenergy.pl/blog/pompa-ciepla-powietrze-woda-jak-dziala/, (11.09.2022).

is the use of low-temperature receivers like floor or wall heating. The advantage of surface heating is that the transfer of heat is through a very large area, so that high temperatures are not needed as in the case of point heat sources. The heating medium can also transfer heat energy to the hot water cylinder.[25] Selected advantages and disadvantages of heat pumps are included in table 9.

Table 9. Advantages and disadvantages of a heat pump

ADVANTAGES	DISADVANTAGES
• energy efficiency – low electricity consumption • safety – no risk of explosion or blackout • ecology – no exhaust emissions, "clean energy" • convenience – virtually maintenance-free system	• high price • rather complicated construction of the device • failure rate with lower and medium class pumps • dependence on electricity • high noise level • the maximum temperature of heated water in most pumps does not exceed 60 degrees

Source: https://top-oze.pl/wady-i-zalety-pompy-ciepla/, (12,09.2022); https://www.naswoim.com.pl/pompa-ciepla-dzialanie-plusy-i-minusy/, (15.09.2022).

Due to the type of drive and the principle of operation are distinguished:[26]

- **absorption pumps** (heat-driven) – used in large industrial plants to increase the energy potential of waste heat,
- **thermoelectric pumps** (electrically driven) – used for continuous and efficient removal of large amounts of heat from small objects, such as cooling of semiconductors in modern electronics,
- **compressor pumps** (mechanically driven, the compressor motor is usually powered by electricity) – used in heating and cooling technology; this is an alternative to organic fuel boilers and electric heaters.

From the perspective of heat pump efficiency, it is clear that the less heat loss a building has, the better. However, this does not change the fact that thermal upgrading is often not a prerequisite for installing a heat pump-based heating system. The required temperatures of the heating system are the decisive aspect in deciding on such heating. It should be remembered that in many cases older heating systems, especially radiators, are oversized (such used to be the tendency). This provides an opportunity to lower the supply temperature when replacing the heating source, and thus increase the efficiency of the heat pump. Another issue is

[25] Ibidem.

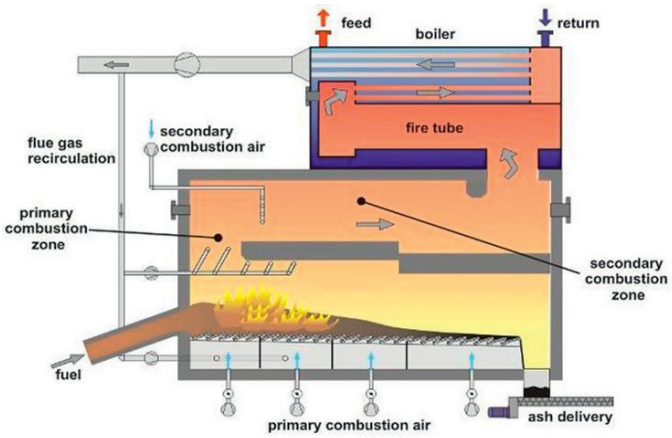
[26] E. Różycka, *Analiza opłacalności zastosowania niekonwencjonalnych źródeł energii…*, op. cit., s. 1356–1357.

possibly smaller or larger thermal upgrading measures, such as replacing window frames. Often these are sufficient to ensure proper operation of the heat pump.[27]

3.2.5. Biomass

Biomass is an organic material derived from plants, animals, and microorganisms which is non-fossilized and biodegradable. Biomass also comes in the form of products, byproducts, residues and waste from agriculture, forestry and related industries, as well as the non-fossilized and biodegradable organic fractions of industrial and municipal solid wastes. Gases and liquids recovered from the decomposition of non-fossilized and biodegradable.[28] Biomass is the oldest source of energy. Wood was used to power the first steam engines. Final energy production is also mostly based on solid biomass. Nowadays it is extracted from high-yielding plants and is intended for electricity and heat generation.[29]

Fig. 24. Schematic example of the biomass combustion plant and operating parameters



Source: K.H. Schulze, G. Hofmeister, M. Joeller, R. Scharler, I. Obernberger, R. Korbee, M.K. Cieplik, *Development and evaluation of a flexible model for CFD simulation of ash deposit formation in biomass fired boilers*, https://obnizenie.pl/development/and/evaluation/of/a/flexible/model/for/cfd/simulation/of/ash/deposit/formation/in/biomass/fired/boilers/24235.html, (15.09.2022).

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27 *Pompy ciepła w istniejących budynkach – fakty i mity*, „Chłodnictwo. Klimatyzacja" 2021/2022, s. 15–17.

28 A. Demirbas, *Fuels from biomass*, [in:] "Biorefineries. Green energy and technology", Springer, London 2010, p. 33–73.

29 A. Roszkowski, *Energia z biomasy – efektywność, sprawność i przydatność energetyczna*, Cz. 1, „Problemy Inżynierii Rolniczej" 2013, Vol. 1(79), s. 56–68, 97–124.

All types of solid biomass differ in their physical and chemical properties, of which the suitability for energy purposes is determined primarily by calorific value and moisture content. These properties affect the choice of combustion technology, the transportation, storage and feeding method to the boiler, and the efficiency of thermal conversion.[30] A schematic example of biomass combustion is included in fig. 24.

Biomass for energy purposes can be classified by:[31]

- **origin** – one distinguishes then: forest biomass (dendromass), biomass of agricultural origin (agromass), animal waste (zoomass);
- **state of aggregation** – a distinction is then made between: solid biomass (forest and plant biomass), gaseous biomass (biogas), and liquid biomass (biofuels);
- **the degree of processing** – a distinction is then made between: primary waste (wood, straw, energy crops), secondary waste (slurry, liquid sludge, manure), processed waste (biogas, bioethanol, rapeseed oil esters).

The advantages and disadvantages of biomass are included in Table 10. Solid biomass is obtained primarily from trees and energy crops. After harvesting, they are either used in the form of raw biomass or treated.

Table 10. Advantages and disadvantages of biomass

ADVANTAGES	DISADVANTAGES
• harmless to the environment – has low emissions of carbon monoxide, nitrogen oxide and sulfur dioxide • biomass combustion leaves a small amount of ash • low cost – high and uniform frequency of biomass on the globe • utilization of wasteland, reduction of current waste, both organic and industrial • reliability – biomass is available at all times • can be easily stored during periods of low demand and used when needed	• low energy value compared to fossil fuels • low density – this makes storage and transportation difficult • moisture content range is wide – in some conditions it is difficult to process

Source: Own study based on: A. Ociepa-Kubicka, *Wykorzystanie biomasy w przedsiębiorstwach energetycznych*, Proceedings of ECOpole'14 Conference, Vol. 9(1), Opole 2015, s. 279–286; Z. Zbytek, F. Adamczyk, *Możliwości wykorzystania biomasy stałej…*, op. cit., s. 27; D. Rogowska, *Wykorzystanie OZE w energetyce a zrównoważony rozwój*, „NAFTA-GAZ" 2017, Rok LXXIII, Nr 8, s. 616; https://domynowoczesne.info.pl/biomasa.html, (13.09.2022).

[30] L. Kowalewski, *Amerykańskie piece kominkowe na pelety i granulki z trocin*, „Magazyn Instalatora" 2007, Vol. 5, s. 36–37.

[31] Z. Zbytek, F. Adamczyk, *Możliwości wykorzystania biomasy stałej*. *Uwarunkowania prawne i podział biomasy stałej*, „TECHNIKA ROLNICZA, OGRODNICZA, LEŚNA" 2017, NR 2, s.27.

Often their waste is used, and so: extracting wood from trees, it can be used as firewood or go to industrial processing, such as furniture or paper factories. They can be further used as biomass used for energy production.

An important and popular form of biomass created from processing industrial residues is briquette. This is a biofuel that can be made from any type of phytomass, however, straw and shredded wood waste are most commonly used for this purpose. Another form is pellet. This is a pellet produced from wood residues, such as sawdust and shavings.

3.2.6. Home wind power plant

Small wind power plants are increasingly used as an additional source of energy to support the energy system of a single-family home. They can be used to heat water in the central heating system or give electricity directly to the grid.[32] They are installed on masts about a dozen meters high and generally operate at low wind speeds. Wind turbines with multi-bladed turbines work best in such conditions.[33] A home wind power plant uses wind turbines to convert the kinetic energy of the air into electrical energy: the air moves the rotor blades in the turbine which causes the windmills to move, which is then transferred to a generator that generates electricity.

The advantages and disadvantages of wind power plants are included in table 11.

[32] T. Boczar, *Energetyka wiatrowa. Aktualne możliwości wykorzystania*, Wydaw. PAK, Warszawa 2008; J. Czuczman, M. Czerepanjak, I. Sczur, P. Golubowski, *Generatory synchroniczne do autonomicznych, bezprzekładniowych elektrowni wiatrowych*, XII Konferencja nt.: „Problemy eksploatacji maszyn i napędów elektrycznych", Ustroń, 18–20.05.2005; A. Polak, A. Bežański, *Małe elektrownie wiatrowe – przykłady praktycznego zastosowania*, XII Konferencja nt.: „Problemy eksploatacji maszyn i napędów elektrycznych", Ustroń, 18–20.05.2005.

[33] Z. Goryca, *Przydomowa elektrownia z wielołopatową turbiną wiatrową*, „Napędy i Sterowanie" 2017, Nr 19 (2), s. 67–70.

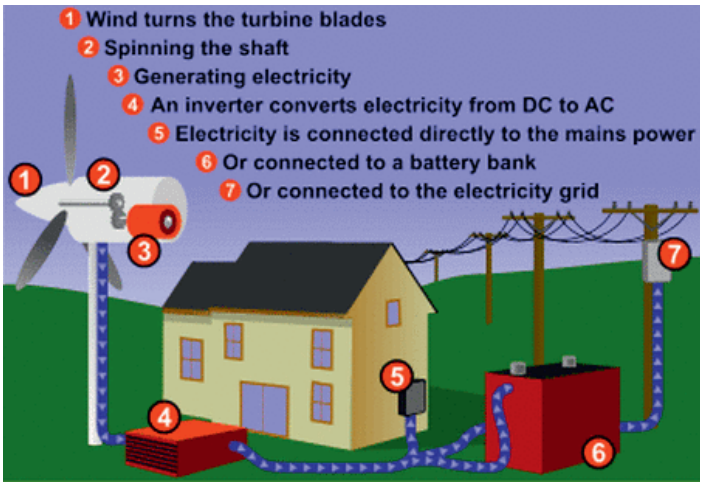
Table 11. Advantages and disadvantages of domestic wind power plants

ADVANTAGES	DISADVANTAGES
• free energy from wind • versatile application – energy can be used in many ways • variety of solutions – a wide range of design variants • possibility to sell surplus energy • the possibility of accumulating excess energy – a solution proven in facilities that have frequent power outages • pro-environmental activity – do not emit carbon dioxide, smog and other pollutants • the possibility of installation in a place where mains electricity cannot be supplied • the operation process is quite simple • installation time is short • operation and maintenance costs low	• high initial cost, higher start-up fees • varying payback time • downtime in energy production due to lack of wind • lower efficiency in areas with lower wind intensity • the need to sign a contract and additional formalities – in Poland in the case of on-grid installations – connected to the power plant • high costs of energy storage • threat to birds

Source: Own study based on: G. Kalda, *Wykorzystywanie w Polsce energii wiatru do oświetlania i ogrzewania*, Zeszyty Naukowe Politechniki Rzeszowskiej, Budownictwo i Inżynieria Środowiska, Nr 283, z. 59, Rzeszów 2012, s. 56; P. Urbańska, *Exploatation of Selected Res Instalation on the Example of Small Wind Power Station with Vertical Axis Wind Turbine*, "Energia-Ekologia-Etyka" 2016, Tom 1, s.70; W. Radzikowska-Juś, S. Owczarek, *Czy warto inwestować w małe przydomowe elektrownie wiatrowe? — studium przypadku*, „Biuletyn WAT" 2016, Vol. LXV, Nr 3, s. 28.

A home wind power plant is a set of interconnected devices that generate and store electricity. Unlike windmills operating on wind farms – the devices included in a home power plant produce energy on a smaller scale, exclusively for the needs of a single household. A major advantage of such a solution is that a small home wind turbine is not as heavily regulated as large windmills, which must stand at a distance many times their height (among other things, due to the noise generated). A diagram of how a wind turbine works is included in fig. 25.

Fig. 25. Schematic example of a domestic wind power plant operation



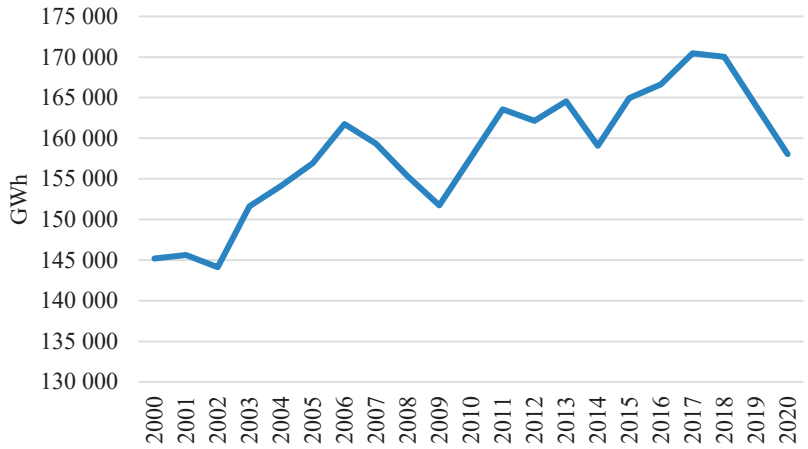
Source: https://1898242ae2014.weebly.com/how-it-works.html, (16.09.2022).

The installation of a domestic wind power plant can be a future-oriented investment that, in these times when electricity prices are constantly rising, allows partial independence from power utilities. It carries a number of benefits (not only environmental), but the disadvantages (e.g., quite high costs) should be taken into account when deciding on installation.

3.3. The use of renewable energy sources in Poland

Total electricity production in Poland has been increasing over the past 21 years (fig. 26). Between 2000 and 2020, it increased by 12,859 GWh. It reached its highest level in 2017, when its total production from all sources exceeded 170,465 GWh.

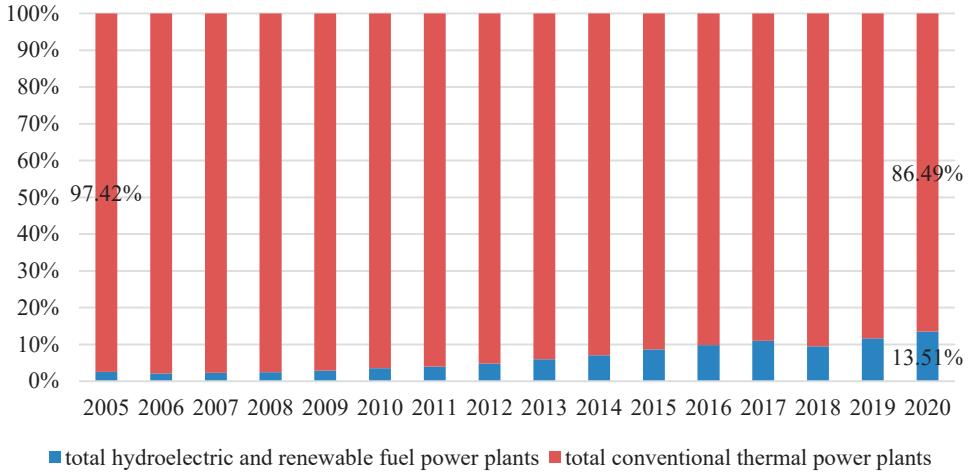
Fig. 26. Total electricity production in Poland (in GWh)



Source: own study based on data from the Local Data Bank.

The main source, which the produced energy comes from, are invariably conventional power plants (primarily utility power plants), which in 2000 produced more than 97% of all electricity in Poland. In recent years, the share of this source has declined to 86.5%. On the other hand, the share of electricity production from hydroelectric and renewable fuel power plants has increased (fig. 27).

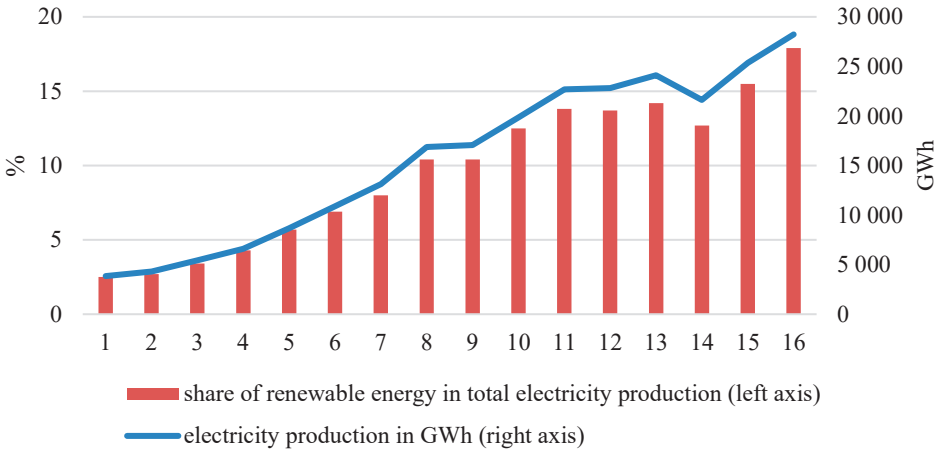
Fig. 27. Electricity production in Poland by conventional and renewable sources



Source: own study based on data from the Local Data Bank.

Electricity production from renewable energy carriers has been recorded in statistics since 2005. Since then, its share has increased from 2.5% in 2005 to almost 18% in 2020 (fig. 28 – 1 as 2005).

Fig. 28. Share (in %) and electricity generation (in GWh) from renewable energy carriers

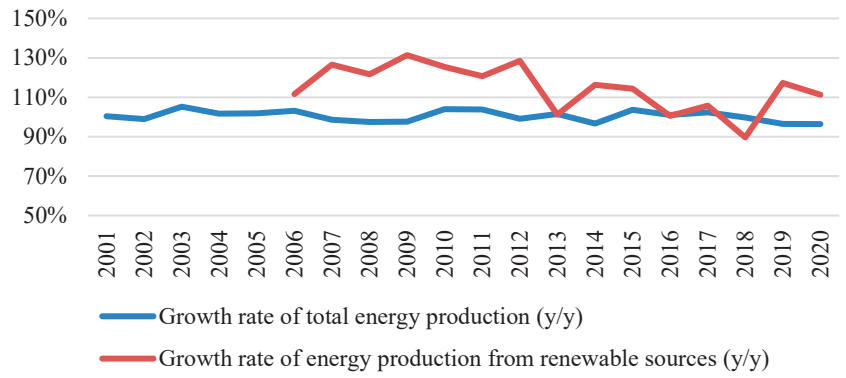


Source: own study based on data from the Local Data Bank.

Changes in the national electric power industry are resulting in an increase in the share of RES in the structure of the power of systems installed in the National Power System (NPS) and in electricity production. Over the 2010–2018 period, there was a 4-fold increase in capacity from RES and a doubling of electricity production. Poland in 2018 surpassed 16 EU countries in the volume of capacity installed in RES.[34] Nominally, the production of electricity from renewable sources increased from 3,847.3 GWh in 2005 to 28,226.6 GWh in 2020. At the same time, total energy production increased by the previously mentioned 12,859 GWh, hence it follows that the rate of growth of energy production from renewable sources is higher than from conventional sources (fig. 29).

[34] *Renewable Energy Statistics*, IRENA, 2019.

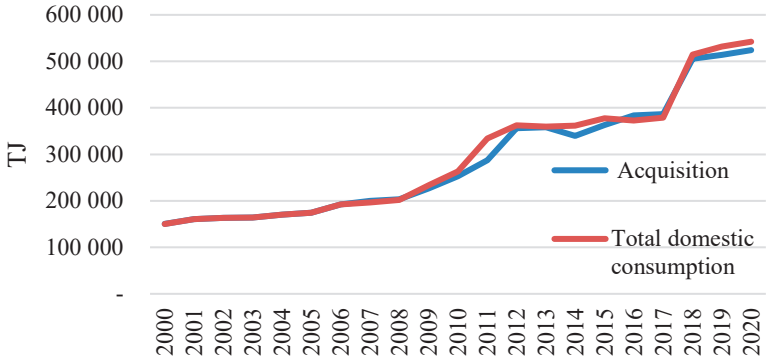
Fig. 29. Growth rate of total and renewable electricity generation (y/y)



Source: own study based on data from the Local Data Bank.

The value of renewable energy is steadily increasing, and in 2020 it reached 524,000 terajoules (TJ), an almost three-and-a-half-fold increase in value over 2000 (fig. 30).

Fig. 30. Acquisition and domestic consumption of energy from renewable sources (in TJ)

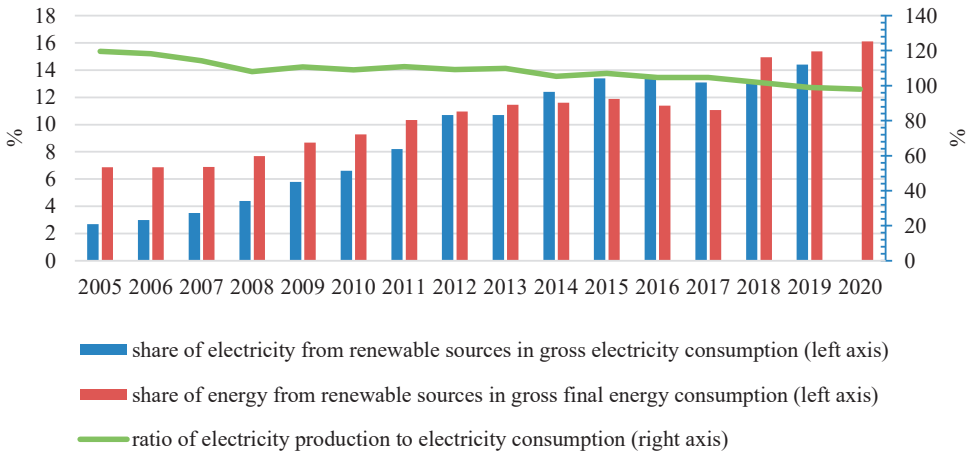


Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, Wydaw. GUS, Warszawa (the years under study).

When analyzing the data on electricity production and consumption, it is worth noting that, as of 2019, its production does not meet the needs arising from consumption (fig. 31). Nominally, the volume of final consumption is the difference between total domestic consumption and the volume

of consumption per transformation input and the energy sector's own consumption.[35] The remainder after subtracting these two volumes represents final the consumption. Despite the increase in the volume of energy production, including the one from renewable energy in Poland, the demand for electricity continues to increase. With regard to renewable sources, this trend can be seen as early as 2010, when consumption was higher by more than 9,000 TJ in relation to the volume of energy acquisition. The following year, the difference increased as much as 46 thousand TJ.

Fig. 31. Share of energy from renewable sources in energy consumption in Poland



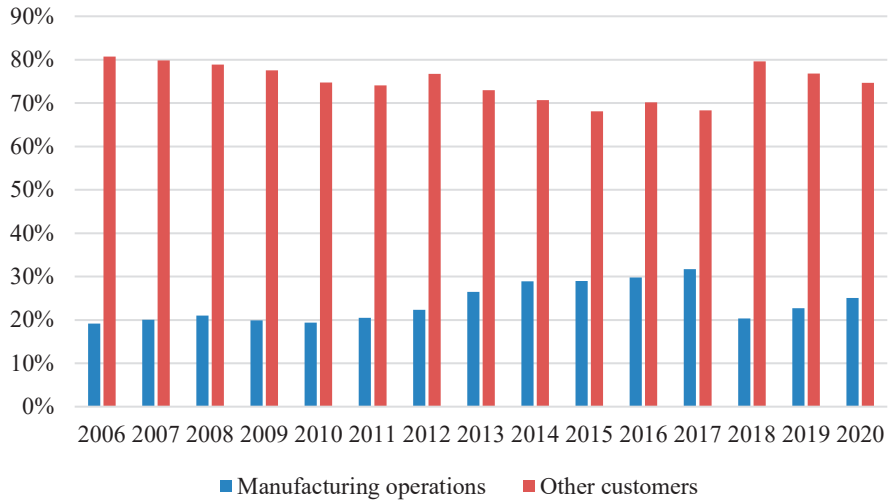
Source: own study based on data from the Local Data Bank.

Only in 2016–2017 there was an excess of acquisition over consumption of energy from renewable sources. Consumption of energy from RES in gross final energy consumption increased from 6.9% in 2005 to more than 16% in 2020. These figures indicate an increasing demand for this source, so in the process of creating it, it is important to use the various renewable resources from which it can come.

[35] Final consumption of energy carriers for technological, production and domestic needs without further conversion to other energy carriers. Inputs and needs for energy transformation, as well as losses arising at producers and distributors, are excluded from final consumption. However, fuel consumption for the production of heat, consumed entirely by its producer, is included – source: https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/3802,pojecie.html, (15.10.2022).

The main purpose of the energy from RES is to serve the so-called other consumers. In addition to manufacturing activities, construction and transportation, they are its main end users. Their share of consumption is about 80% on average (fig. 32).

Fig. 32. Final consumption of renewable energy by customer

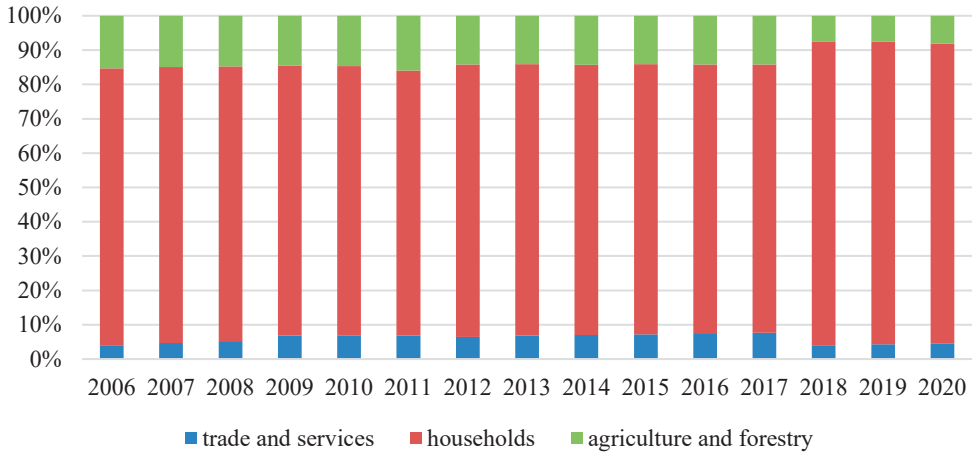


Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, op. cit.

The largest share of final energy consumption from RES is held by other consumers, which include trade and services, households, and agriculture and forestry. The second target in terms of consumption are manufacturing activities, which consumes on average about 25% of the total energy used. Construction and transportation together use about 1% of energy. Among other users, households are the key consumers (fig. 33). The volume of consumption in this case is more than 85% of the total use of electricity in the group of other users. It is worth noting that in the last three years the share of households in energy consumption has increased from 78% to 88%. At the same time, the share of agriculture and forestry in the use of energy from RES has fallen from a dozen to about 7–8%. Energy use by the trade and service sector, which includes tourism-related entities, fell from more than 7% in 2015–2017 to about 4% in the last three years. This trend indicates that households are the main consumers of renewable energy. In the two other groups (agriculture and forestry, and trade and services), their share fell by about half. This may indicate an unmet and growing need for electricity use on the part of households, but at the same

time may indicate a market niche and demand on the part of the very groups where consumption has declined. Meeting the needs of households is a priority, but trade and services and others can and are also able to use energy from these sources.

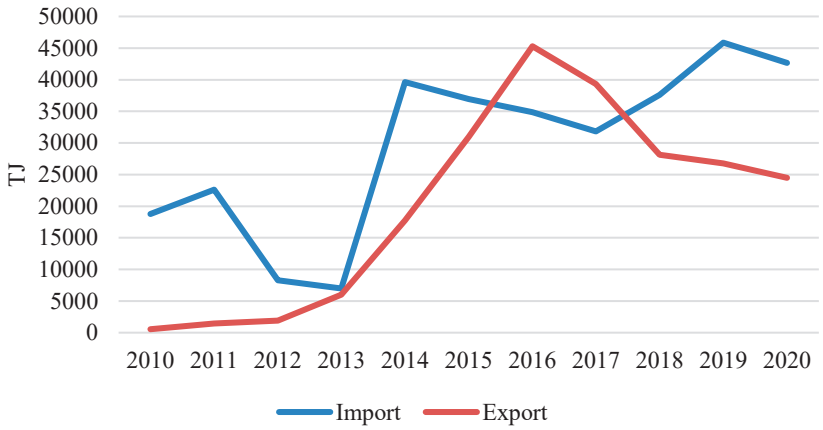
Fig. 33. Final consumption of renewable energy among other consumers



Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, op. cit.

When characterizing the situation in terms of the use of renewable energy in Poland, it should be noted that globally the demand for renewable energy is increasing, as evidenced by the growth in the value of imports of this energy and its predominance over exports of that generated domestically. Thus, the volume of energy from domestic acquisition plus imports and minus exports, and the negative difference in the change in its inventory is at the disposal of the country. From 2010 to 2015, imports of energy from RES outweighed exports. This was due to the expanding domestic infrastructure for obtaining energy from these sources. Only in 2016–2017 was the volume of RES exports higher than its imports. In the five-year period (2016–2020), the proportions of exports and imports reversed (fig. 34). As of 2018, imports increased by more than 5,800 TJ while the volume of exports decreased by more than 11,100 TJ compared to 2017. These data, together with information on the growth of total energy demand and consumption, indicate that obtaining energy from RES is not just a choice, but becomes a necessity in the proper functioning of the economic system. Also, in the face of the energy crisis related to the sanctions imposed on the Russian Federation by the EU and possible shortages in meeting energy needs, it seems crucial to obtain it from various cost-effective sources.

Fig. 34. Export and import volume of renewable energy in Poland (in TJ)



Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, op. cit.

The origin of renewable energy sources is of great importance in the production and use. An analysis of their structure shows that solid and liquid biofuels are key, and in recent years also wind energy (table 12). These sources together yield more than 90% of energy. The others, including the recently popular solar-related sources, have only a few percent share (together they do not exceed 10%).

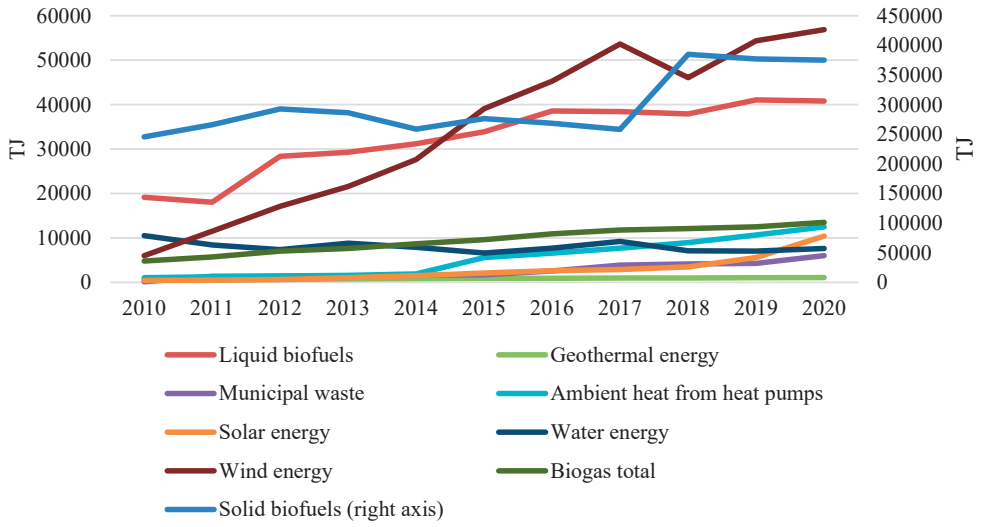
Table 12. Structure of obtaining energy from RES by type of source (in %)

Type	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Solid biofuels	85.23	84.89	82.07	79.88	76.13	73.54	69.98	66.76	76.13	73.41	71.61
Total liquid biofuels	6.64	5.76	7.96	8.18	9.18	9.02	10.06	9.94	7.50	7.99	7.79
Geothermal energy	0.20	0.17	0.19	0.22	0.25	0.24	0.24	0.24	0.20	0.20	0.20
Municipal waste	0.04	0.43	0.38	0.39	0.45	0.45	0.67	1.00	0.81	0.83	1.15
Ambient heat from heat pumps	0.36	0.39	0.41	0.44	0.55	1.48	1.71	1.99	1.77	2.08	2.38
Solar energy	0.15	0.17	0.17	0.29	0.44	0.56	0.69	0.74	0.69	1.08	1.99
Water energy	3.65	2.68	2.06	2.45	2.31	1.76	2.01	2.38	1.40	1.37	1.46
Wind energy	2.08	3.68	4.79	6.03	8.13	10.41	11.81	13.89	9.11	10.59	10.85
Biogas total	1.66	1.83	1.97	2.12	2.56	2.55	2.85	3.04	2.39	2.43	2.58

Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, op. cit.

An analysis of the structure of renewable energy sources shows that there is a decline in the share of solid biofuels (from 85.2% in 2010 to 71.6% in 2020). However, the share of wind energy is increasing (from 2% in 2010 to 10.8% in 2020). Similarly, although with periodic fluctuations, the share of liquid biofuels is also increasing. The maximum share of renewable energy generation from this source was recorded in 2016, when it was 10%. It is worth noting that nominally, renewable energy production from sources such as water, solar, municipal waste, ambient heat and geothermal energy does not exceed 10,000 TJ each per year. Wind energy and biofuels, both solid and liquid, serve to produce energy volumes more than 25 times larger (fig. 35).

Fig. 35. Volume of renewable energy obtained from renewable sources in Poland



Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, op. cit.

In the case of liquid biofuels, energy extraction from biodiesel is crucial. It is on average more than five times higher than the energy yield from bioethanol. In 2020, the volume of energy from biodiesel was 35254 TJ, while that from bioethanol was 5489 TJ. In the final (final) consumption of renewable energy, solid biofuels are of key importance. They account for more than 92% of the energy used (table 13).

The second element in the structure of consumption is ambient heat from heat pumps. Its use accounts for 3.75% of the total energy consumed.

Table 13. Structure of final energy consumption from RES by type of source (in %)

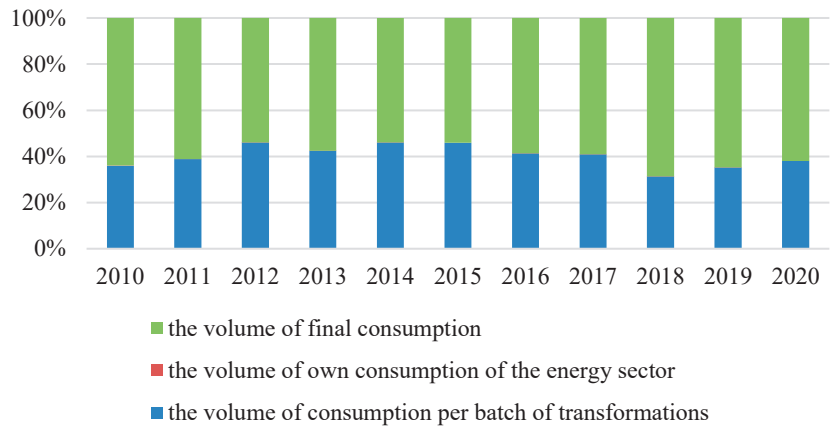
Type	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Solid biofuels	92.10	91.62	95.58	95.86	95.37	93.52	92.79	92.45	94.78	93.46	92.84
Total liquid biofuels	5.77	5.43	0.88	0.51	0.19	0.03	0.09	0.02	0.02	0.50	0.25
Geothermal energy	0.29	0.26	0.34	0.38	0.43	0.44	0.42	0.42	0.28	0.30	0.32
Municipal waste	0.06	0.66	0.70	0.67	0.78	0.81	1.02	1.09	0.73	0.64	0.72
Ambient heat from heat pumps	0.53	0.60	0.74	0.77	0.96	2.70	3.00	3.43	2.53	3.10	3.72
Solar energy	0.21	0.26	0.32	0.50	0.75	0.92	1.00	1.02	0.67	0.87	1.00
Water energy	–	–	–	–	–	–	–	–	–	–	–
Wind energy	–	–	–	–	–	–	–	–	–	–	–
Biogas total	1.03	1.18	1.44	1.31	1.52	1.59	1.68	1.57	0.98	1.12	1.15

Remark: (–) – no data

Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, op. cit.

It is worth noting that final consumption accounts for more than 60% of all renewable energy consumption. Nearly 40% is related to the so-called consumption per transformation input[36] (fig. 36, fig. 37).

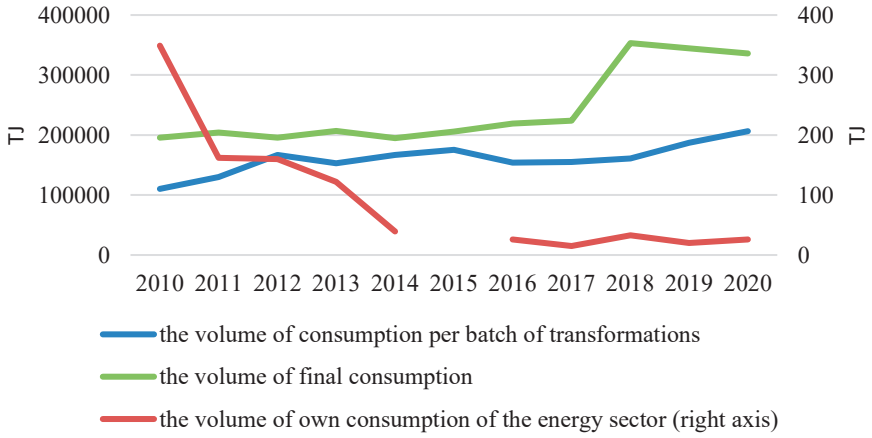
Fig. 36. Domestic consumption by purpose



Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, op. cit.

[36] This is the use of energy as a feedstock, i.e. processed into other energy carriers in technological processes recognized as energy transformations, excluding the consumption of energy carriers intended for energy service of this process – source: https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/580,pojecie.html, (11.09.2022).

Fig. 37. Volume of domestic renewable energy consumption by purpose



Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, op. cit.

Nominally, final consumption increased by 35% in 2018 (compared to 2017) and exceeded half a million TJ. At the same time, the volume of energy used in technological processes (for transformations) increased by over 50,000 tonnes over the same period. T.J. Finally, in 2020, domestic consumption amounted to over 542,000. TJ, of which final consumption – 335 thousand. T.J. Solid biofuels play a major role in the final consumption of renewable energy in the trade and services sector. The share of their consumption in the final consumption of this sector is over 60% (table 14).

Table 14. Structure of RES final consumption by sources in the trade and services sector

Specification	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Solid biofuels	79.02	76.04	70.18	72.20	68.13	67.39	66.18	68.33	66.44	63.93	64.29
Total liquid biofuels	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.16	0.21	0.39	0.36
Geothermal energy	1.23	0.98	1.55	2.11	2.48	2.25	1.93	2.00	2.18	2.30	2.32
Municipal waste	0.00	0.00	0.00	0.00	0.00	0.00	1.12	0.34	0.17	0.02	0.09
Ambient heat from heat pumps	8.85	2.59	3.16	3.29	5.29	5.57	5.36	5.70	6.19	6.75	7.26
Solar energy	1.00	1.30	1.68	1.74	2.08	2.20	2.11	2.11	2.24	2.14	2.03
Water energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wind energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biogas total	9.91	19.08	23.42	20.65	22.01	22.59	23.16	21.36	22.58	24.47	23.66

Source: Own study based on data from the publication: *Energia ze źródeł odnawialnych*, op. cit.

Biogas is of great importance for the trade and services sector, its share in consumption is almost 25% of the total consumption of RES. It is worth noting that it has increased its importance abruptly since 2011, when it increased by 10%. The third source in terms of share in energy consumption were heat pumps.

This type of infrastructure allows the consumption of over 7% of energy. Geothermal energy and solar energy also have a 2% share in final consumption. Other sources play a marginal role in this sector.

The above analysis shows the specificity of RES use in the trade and service sector, including tourism. In the service sector as a whole, it is not only the main (classical) sources of energy acquisition that are important, but one can also see an increased share of the slightly less efficient ones.

While solar energy can be said to be proportionally used (2% in total acquisition, 1% in total consumption to 2% use in trade and services), geothermal energy is slightly more important for this sector than for the economy as a whole as a source of renewable energy (0.2% in total acquisition, 0.3% in total consumption to more than 2% use in trade and services).

Likewise for heat pumps (2.3% in total acquisition, 3.72% in total consumption to more than 7.2% use in trade and services), or biogas (2.6% in total acquisition, 1.2% in total consumption to 23.7% use in trade and services). Thus, it can be seen that certain energy sources are preferred in the trade and services sector, which will translate into interest and opportunities for their use by entities operating in this sphere. In the case of tourism, this will involve investment and development of specific infrastructure for the acquisition and use of renewable energy.

Chapter 4.
INVESTMENTS IN RENEWABLE ENERGY SOURCES ON THE GROUND OF TOURISM ECONOMY – AN EMPIRICAL APPROACH

4.1. The characteristics of own research

4.1.1. Methodological approach of the study

As M. Porter points out, increasing competitiveness at various levels (both micro-, meso- and macro-economic) depends on the continuous creation and implementation of innovations.[1] This applies to all sectors of the economy, including the tourism economy, and the result of these processes is investment and focus on the long term without succumbing to short-term trends, which is part of the broad meaning of sustainable development.[2] Thus, relating this process to the tourism economy, it results in the use and implementation of "green" technologies and the use of renewable energy sources. The level of uptake of innovations in the field of RES is directly linked to the investment activity of tourism economy entities. Therefore, it can be assumed that the level of investment is a measure of the ability of business entities and sectors to absorb innovations. It should be emphasized that although the tourism economy is considered a low-productivity and innovative activity, it is one of the least burdensome economic activities for the social and natural system, which gives it a character that fits perfectly with the requirements of sustainable economic development.[3]

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1 M. Porter, *Porter o konkurencji*, PWE, Warszawa 2001.

2 A. Steer, W. Wade-Gery, *Sustainable Development: Theory and practice for a sustainable future*, "Sustainable Development" 1993, No. 1(3), p. 23–35; A. Niezgoda, *Obszar recepcji turystycznej w warunkach zrównoważonego rozwoju*, Wyd. AE w Poznaniu, Poznań 2006; *Agenda dla zrównoważonej i konkurencyjnej turystyki europejskiej*, Komunikat Komisji Wspólnot Europejskich, 19.10.2007, KOM 621, Bruksela 2007.

3 E. Smeral, *Beyond the myth of growth in tourism*, [in:] *Tourism Growth and Global Competition*, P. Keller, T. Bieger (ed.), AIEST, St. Gallen 2001; P. Keller, *Towards Innovation-oriented Tourism Policy: A New Agenda?*, [in:] *Innovation and Product Development in Tourism: Creating Sustainable Competitive Advantage*, B. Walder, K. Waiermair, A. Sancho Pérez (ed.), Erich Schmidt Verlag, Berlin 2006, p. 55–70; K. Waiermair, *Prospects for Innovations in Tourism: Analyzing*

Unfortunately, despite such potential of this sector, one notices an information gap in the form of the lack of studies and research that would indicate the level of capacity to absorb innovations in the tourism economy in the field of RES. The situation is similar in the case of knowledge of the level, structure and conditions for the development of investments in renewable energy sources in tourism.

Such data are not collected within the framework of the system of public statistics and also a comprehensive study has not been realized so far. However, such a thesis needs to be developed and justified in order to constructively and objectively determine the scope of the research gap and give appropriate shape to future scientific research. In an attempt to fill this information gap, the basic research problem adopted in this thesis was formulated and posed in the form of the following question: what is the capacity of the tourism economy to absorb RES innovations, and what are the determinants of this capacity and related investment demand?

The research problem thus adopted involves linking two areas related to investment and innovation in RES. Subsequently, for the purposes of the research, specific research questions and hypotheses were formulated in an attempt to answer the questions indicated above (table 15).[4]

the Innovation Potential Throughout the Tourism Value Chain, [in:] *Innovation in Hospitality and Tourism*, M. Peters, B. Pikkemaat (ed.), Haworth Press, Binghamton 2005, p. 59–72; *Konkurencyjność małych i średnich przedsiębiorstw na polskim rynku turystycznym*, pod red. M. Bednarczyk, Wyd. Uniwersytetu Jagiellońskiego, Kraków 2006; B. Bramwell, B. Lane, *Sustainable tourism: An evolving global approach*, „Journal of Sustainable Tourism" 1993, No. 1(1), p. 1–5; C. Southgate, R. Sharpley, *Tourism, Development and the Environment*, [in:] *Tourism and development: Concepts and Issues*, R. Sharpley, D.J. Telfer (ed.), Channel View Publications, Clevedon 2002.

4 The assumptions of the NCN-funded research project were initially described in: Ł. Nawrot, M. Bednarska, P. Zmyślony, *Odnawialne źródła energii w gospodarce turystycznej jako obszar badań naukowych*, [w:] *Przeszłość, teraźniejszość i przyszłość turystyki*, pod red. B. Krakowiak, J. Latosińska, Wydaw. Uniwersytetu Łódzkiego, Łódź 2014, s. 85–98.

Table 15. Research assumptions made

Research assumptions	Description
Main research problem	What is the capacity of the tourism economy to absorb renewable energy innovations, and what are the determinants of this capacity and related investment demand?
Research objective	Identification and classification of the determinants of the ability to absorb renewable energy innovations by tourism economy entities. ⇩ Creating an index of the innovation potential of the tourism economy in the field of RES
Main hypothesis	In contrast to the low level of innovation of the tourism economy, the capacity to absorb RES innovations and related investment demand is continuously increasing, mainly due to the dependence on local resources and the existence of heterogeneous inter-entity relations.
Research questions in detail	1. What are the determinants of RES investment in tourism economy entities? 2. to what extent is the ability to absorb innovations related to the investment attractiveness of the tourism economy, understood as the ability to compete for capital? 3. what is the nature and extent of diffusion of RES innovations in the tourism economy?
Hypotheses in detail	1. The determinants of RES investment in the tourism economy are endogenous and exogenous, with the dominant role to be attributed to exogenous determinants, especially regulatory factors. 2. The degree to which the ability to absorb innovations influences capital allocation decisions in the tourism economy varies and depends mainly on the size of the entity and the type of business. 3. The diffusion of RES innovations is determined by the open nature of the tourism economy on the one hand, and is subject to spatial concentration on the other.

Source: Own study.

The implementation of such a research intention required the definition of specific, detailed steps necessary to obtain the necessary information to verify the formulated hypotheses (table 16).

Table 16. Research tasks defined on the basis of the assumptions made

Elements of research assumptions	Research tasks
Main objective To identify and classify the determinants of the ability to absorb innovations in the field of renewable energy sources by entities of the tourism economy. ⇩ Creation of an index of the innovative potential of the tourism economy in the field of RES	1. To conceptualize and operationalize the capacity to absorb innovations in the tourism economy, including renewable energy sources. 2. To compile a catalog of factors influencing the innovation potential of RES. 3. To measure the strength of the impact of the identified factors on the innovation potential of tourism economy entities. 4. To isolate the main groups of determinants and identify their hidden dimensions. 5. Identification of the main stimulants and destimulants of RES innovation implementation in the tourism economy. 6. Construction of a model explaining the relationship between the ability to absorb RES innovations in the tourism economy and the determinants of this ability, taking into account the differentiation of the strength of the determinants by the type and location of the entities that make up the tourism economy, which is the direct basis for determining the innovative potential of the tourism economy in terms of RES.
Specific research question 1 What are the determinants of RES investments in tourism economy entities?	1. To investigate the level and structure of RES investment in the tourism economy. 2. To identify and prioritize motives for RES investment decisions by tourism economy entities. 3. To measure the extent of the innovation effects of RES investments in tourism.
Specific research question 2 To what extent is the ability to absorb innovation related to the investment attractiveness of the tourism economy, understood as the ability to compete for capital?	1. Identification of factors determining the ability to compete for capital in the tourism economy. 2. Determination and prioritization of motives for capital allocation in the tourism economy. 3. Determination of the rank of innovation potential in the set of determinants of investment attractiveness of the tourism economy.
Specific research question 3 What is the nature and extent of diffusion of RES innovations in the tourism economy?	1. To determine and measure the strength of the impact of RES innovation diffusion factors in the tourism economy. 2. To measure the strength of direct internal linkages among tourism economy entities and international economic linkages in the diffusion of RES innovations. 3. To identify possible ways of diffusion of RES innovations in the tourism economy.

Source: Own study.

The realization of the assumptions made required the use of a variety of methods and techniques (table 17), which made it possible to achieve the objectives of the study and verify the hypotheses.

Table 17. Methods and tools used in the different stages of the research implementation

Stage	Research task	Sources	Methods and tools
1.	Conceptualizing and operationalizing the capacity to absorb innovation in the tourism economy.	**Secondary:** • literature on the subject, • reports of research institutes, • data bases.	A critical analysis of the literature of the subject, searches of documents and databases.
2.	Drawing up a catalog of factors influencing RES innovation potential.		
3a)	Measuring the degree of RES utilization and its determinants.	**Primary:** • entities of the tourism economy.	Internet survey, postal survey; questionnaire, stratified random sampling; min. sample = 1067.
3b)	Determining the direction and measuring the strength of the determinants.	**Primary:** • entities of the tourism economy.	Statistical analysis methods: descriptive statistics, regression analysis.
4.	Identifying the main groups of determinants.		Statistical analysis methods: factor analysis, cluster analysis.
5.	Model structure.	**Primary:** • entities of the tourism economy.	**Logical inference:** Statistical analysis methods: ANOVA, multiple regression analysis.
6.	Creation of a synthetic index of the innovative potential of the tourism economy in terms of RES.	**Primary:** • entities of the tourism economy.	**Logical inference:** methods of statistical analysis: Descriptive statistics.

Source: Own study.

The data used in the study to conduct the analysis came from the author's own survey conducted in cooperation with a professional research firm on a random sample of 1,200 entities operating in Section I of the Polish Classification of Activities (divisions 55 and 56). A random stratified sampling by place (province) and type of business was used. This allowed the survey to be conducted with a maximum error of 3.97% for the accommodation industry and 3.99% for the food service industry (table 18).

Table 18. Detailed sample selection

Province	Number of surveys	
	Section I division 55	Section I division 56
Dolnośląskie	47	47
Kujawsko-pomorskie	13	25
Lubelskie	15	21
Lubuskie	12	14
Łódzkie	14	32
Małopolskie	82	58
Mazowieckie	51	107
Opolskie	6	17
Podkarpackie	18	23
Podlaskie	10	10
Pomorskie	129	44
Śląskie	34	80
Świętokrzyskie	9	15
Warmińsko-mazurskie	21	14
Wielkopolskie	31	50
Zachodniopomorskie	113	38
Poland	605	595

Source: Own study.

The research in question was conducted between December 2017 and February 2018 using the *Computer Assisted Telephone Interview* (CATI) technique, using a survey questionnaire with 33 questions. Various statistical methods were used to analyze the source material and verify the hypotheses, including: descriptive statistics, statistical tests (Chi^2 test of independence, Mann-Whitney U test, Kruskal-Wallis ANOVA), etc. $\alpha=0.05$ was used as the level of significance for the study. To determine it, the study assumed that if: $p < 0.05$ – significance is present (*), $p < 0.01$ – significance is high (**), $p < 0.001$ – significance is very high (***). All calculations and graphs were performed using STATISTICA software (version 13.3).

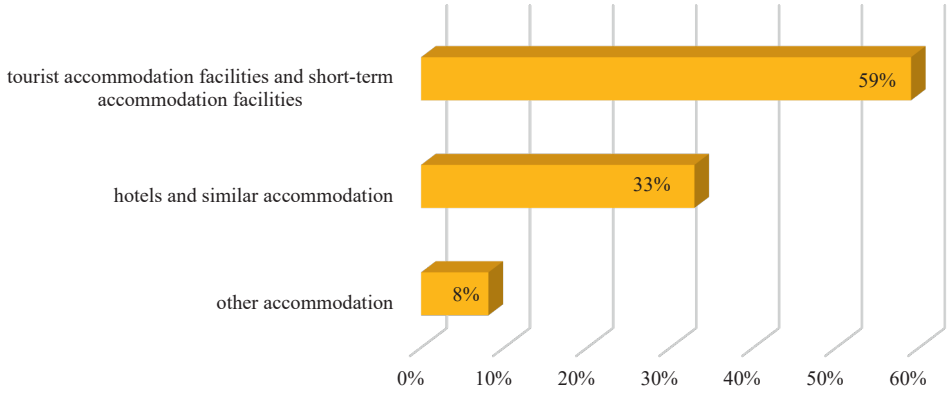
A total of 1,200 entities participated in the study on the use of renewable energy sources in the Polish tourism industry (section I of PAC). The surveyed group was divided into two categories – the first included the facilities operating in tourist accommodation and there were 605 of them, which accounted for 50.4% of the surveyed group, and food establishments – there were

595 of them, which accounted for 49.6% of the surveyed group. This corresponds to the statistical division of Section I, in which classes 55 and 56 were distinguished. The following subsections provide a detailed description of the surveyed facilities included in the two categories indicated above.

4.1.2. Subject of the study – accommodation

In the area of accommodation, respondents indicated one by far predominant activity – tourist accommodations and short-stay accommodation – 59% of indications (fig. 38).

Fig. 38. Scope of activity conducted in the accommodation category (percentage share)



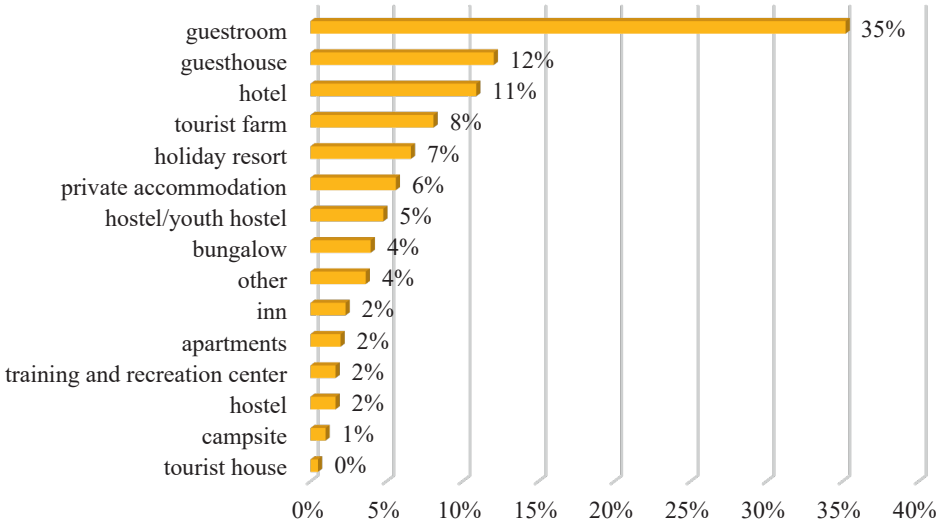
Source: Own study based on own research.

While analyzing the scope of respondents' companies in more detail, it can be seen that it was the largest share of guest room type establishments (35%), a large percentage were guesthouses (12%) and hotels (11%). The smallest share was accounted for by tour homes (0.5%) and campgrounds (1%). The "other" category included school dormitory, boarding house, students house, wedding house, motel, workers' hotel, workers' accommodation and rest home (fig. 39).

Depending on their facilities and the scope of their service program, hotel facilities are given the following categories:

- hotels, motels and boarding houses – five categories marked with stars;
- campgrounds – four categories marked with stars;
- tour homes and youth hostels – three categories marked with Roman numerals.

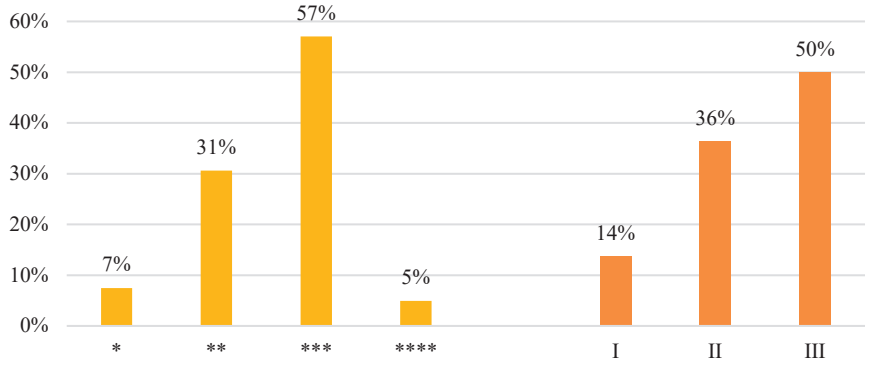
Fig. 39. Detailed scope of activities carried out in the accommodation category (percentage share)



Source: Own study based on own research.

Some of the surveyed entities (143 in total, 24% of the total surveyed) reported their categories (fig. 40 – separately for categories marked with asterisks and Roman numerals).

Fig. 40. Categories of facilities surveyed (percentage share)



Source: Own study based on own research.

In the category of hotels, motels, guesthouses and campgrounds, facilities with three stars prevailed (there were 57% of them), a large percentage – 31% – were

facilities with two stars while only 5% of entities had four stars. In the case of hostels and tour homes, half of them had category III, and 36% had category II.

Representatives of the surveyed entities were also asked what number of beds they had. This question was answered by 89% of them. Basic descriptive statistics were calculated for the number of beds (table 19).

Table 19. Basic descriptive statistics of the number of beds in the categories studied

Specification	N	Mean	Me	Min.	Max.	Std. dev.	Vz
Others	22	49.3	18,5	4	620	128.1	259.7%
Training and recreation center	10	31.5	26	15	65	16.9	53.6%
Tourist home	2	27.5	27,5	25	30	3.5	12.9%
Guesthouse	73	23.4	22	5	80	13.3	57.0%
Inn	14	22.9	20,5	14	40	8.1	35.6%
Hostel	10	21.3	18,5	4	60	15.5	72.7%
Holiday resort	39	21.0	18	4	50	9.5	45.1%
Hotel	7	20.4	14	8	50	14.9	72.9%
Apartments	12	19.0	5,5	1	130	36.8	193.6%
Hostel/youth hostel	29	18.6	11	4	86	19.2	102.9%
Holiday home	24	17.3	11,5	2	100	21.3	122.7%
Camp site	1	12.0	12	12	12	0.0	0.0%
Guest room	213	11.1	10	2	80	6.7	60.6%
Agritourism farm	49	8.9	7	3	70	9.8	109.8%
Private accommodation	34	8.1	7	2	21	4.6	56.8%

Source: Own study based on own research.

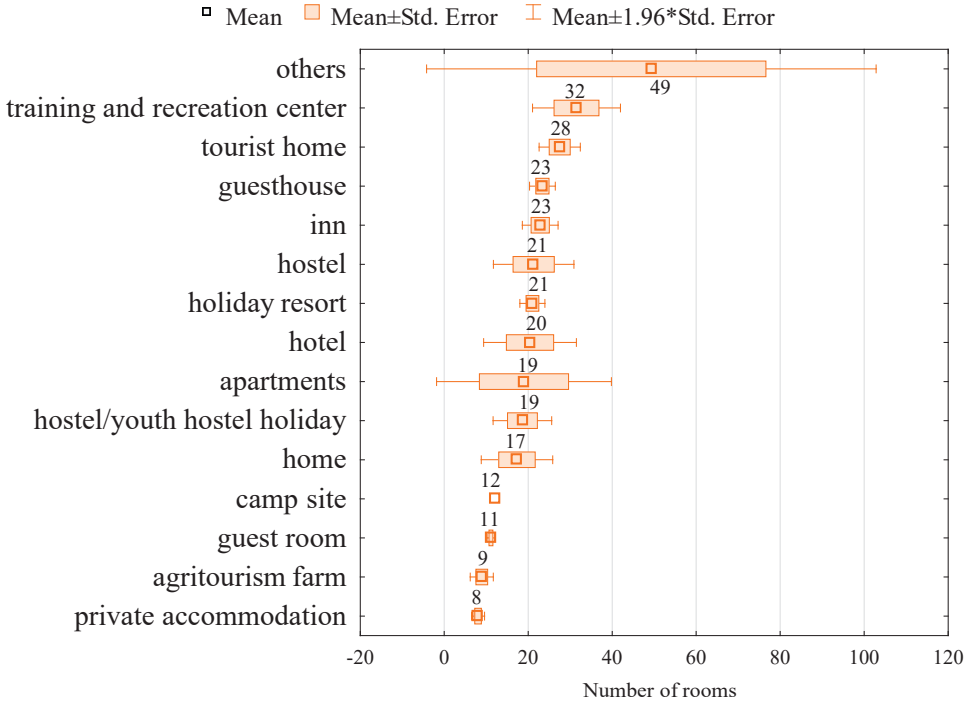
On average, the largest number of beds was in the "other" category, i.e.: school dormitory, boarding house, student house, wedding house, motel, workers' hotel, workers' accommodation and rest home (the average number of beds in this category was 49) (fig. 41).

The facility with the largest number of places, 620, was the student house. Training and recreation centers (an average of 31.5) and tourist homes (an average of 27.5) also had a large number of places. Also apartments (the maximum number of rooms in this category was 130) and holiday homes (maximum 100 rooms).

The analysis of the data obtained in the course of the conducted research shows that there is a large variation in the number of rooms in the surveyed accommodation categories, as indicated by the coefficient of variation. The largest variation occurred in the "other" category – as much as 260%, due to the

fact that it included both school dormitories, dormitories, student dormitories, as well as motels and workers' hotels.

Fig. 41. Average number of rooms in different types of tourist facilities



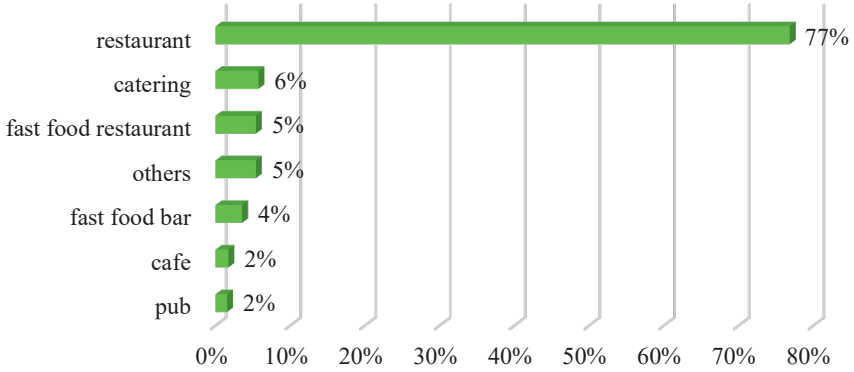
Source: Own study based on own research.

The analysis shows that the lodging category is very diverse in nature. The most homogeneous in terms of the number of rooms turned out to be tour homes and inns.

4.1.3. Subject of the study – food services

In the area of food services, restaurants were the most represented – 77%. Other establishments were engaged in catering – 6%, and 5% were fast-food restaurants. The smallest number of pubs and cafes occurred in the group dealing with food services – 2% each. The "other" category in figure 42 included, for example: restaurant and catering, pizzeria, canteen, music club, party house (party hall), bistro, tavern, tea house.

Fig. 42. Detailed scope of activity conducted in the food category (percentage share)



Source: Own study based on own research.

On average, the facilities in the "other" category had the largest number of eating places – about 161, because this group included, among others: canteens, party houses, banquet halls, which are oriented to receive a large number of customers at the same time. Fast food bars also had a large number of consumption seats, with an average of 82, and restaurants came in third place with 70 seats. The smallest number of consumption seats was offered by cafes (52) and catering establishments (an average of 12 seats) (fig. 43).

Fig. 43. Average number of eating places in facilities with food operations

Source: Own study based on own research.

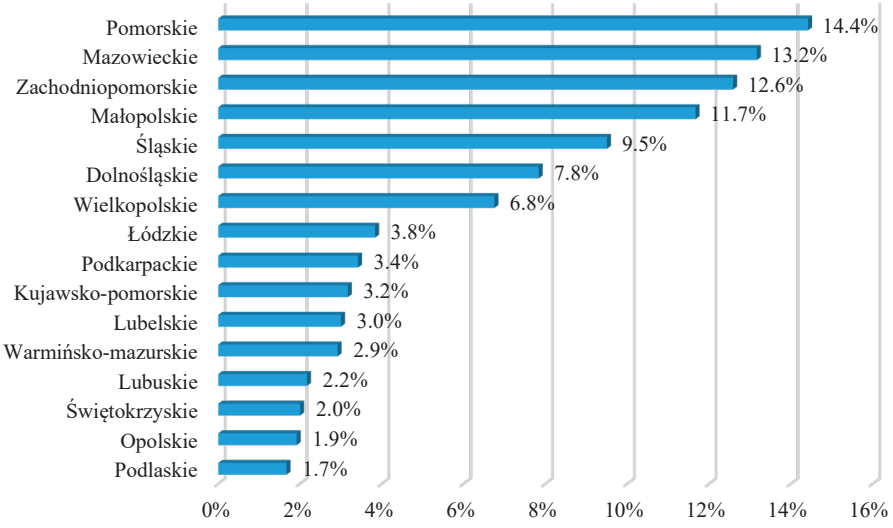
When analyzing the basic descriptive statistics of the surveyed facilities in terms of the number of consumption places, it can be said that the greatest variation occurs in the group of catering facilities – the coefficient of variation here was as high as 223%. The minimum value in this group is 0, i.e. some facility had no consumption seats at all, but there were in this category and those that had 120 of them. High variation also occurred in restaurants – coefficient of variation of 122%. In the surveyed group there were restaurants with only 15 seats for customers, but also some that had as many as 1,600 consumption seats (table 20).

Table 20. Basic descriptive statistics of the number of eating places in the surveyed facilities

Specification	N	Mean	Median	Min.	Max.	Std.dev.	Vz
Catering	34	11.9	1	0	120	26	223%
Cafe	10	52.2	30	22	200	53	101%
Fast food restaurant	32	57.5	60	20	200	30	53%
Pub	9	58.9	70	40	80	16	27%
Restaurant	456	69.6	60	15	1600	85	122%
Fast food bar	21	82.4	80	20	250	52	64%
Others	32	160.8	100	25	1000	192	119%

Source: Own study based on own research.

Fig. 44. Percentage distribution of surveyed facilities in accommodation and food services by province



Source: Own study based on own research.

The tourist facilities surveyed were distributed throughout Poland (fig. 44). The most represented provinces were Pomorskie (14.4%) Mazowieckie (13.2%) Zachodniopomorskie (12.6%) and Małopolskie (11.7%). The smallest number of entities came from Podlaskie (1.7%), Opolskie (1.9%) and Świętokrzyskie (2.0%) provinces.

The length of operation of tourist facilities varied greatly. The surveyed group included those that had been operating for a short time, i.e. for six months, but also those that had started operations as long as 73 years ago. There was a boarding school operating in Podkarpacie, while a hostel in the Śląskie Province had been operating for 61 years. The average operation of a tourist facility on the Polish market is 13 years. The most frequent facilities in the surveyed group had been operating for 9 years and there were 130 of them, accounting for about 11% of the total group. Half of the facilities operated 12 years or less, and half 12 years or more, as indicated by the median. The coefficient of variation indicates a fairly large variation in the length of operation in the market in the surveyed group of companies (table 21).

Table 21. Basic descriptive statistics of the length of operation of the facility in the market

Specification	N	Mean	Me	Mo	N_{Mo}	Min.	Max.	Std. dev.	V_z
The length of the operation	1200	13.3	12	9	130	0,5	73	8.3	62.4

Source: Own study based on own research.

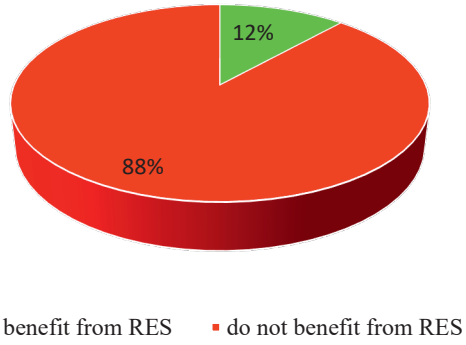
When analyzing the size of employment, it can be said that by far the largest share of the surveyed group were microenterprises with up to 9 employees (86%). Small enterprises, employing from 10 to 49 people accounted for 13% of the surveyed entities. The smallest share was represented by medium-sized companies employing more than 50 people – only 1%. The vast majority of respondents had their own premises where they conducted their business – 76% of all surveyed facilities, 24% were tenants.

4.2. Investment activity in the RES market in the tourism economy

4.2.1. Investments in RES in tourism enterprises in Poland

In the surveyed group of facilities operating in the tourism industry (lodging and food), 12% used and invested in renewable energy sources (fig. 45).

Fig. 45. The use of renewable energy sources (% share)



Source: Own study based on own research.

When analyzing RES facilities in detail, entities using three categories of facilities were considered: heat and cooling generation, electricity generation and RES use in transportation. This classification coincides with the division of technologies that use renewable energy sources, which can be grouped as follows:[5]

- those generating electricity (including hydroelectric power plants, wind power plants, photovoltaic cells),
- those generating heat energy, electricity, and both (e.g. installations for the energetic use of biogas from organic agricultural and industrial waste, solid biofuels, etc.),
- generating heat energy (e.g. geothermal heat plants, solar collectors),
- producing liquid biofuels for powering motor vehicles, and using hydrogen fuel cells.

Respondents indicated more than one technology they use and the presentation was made by presenting entities operating in accommodation and food services (table 22, table 23).

[5] M. Ligus, *Efektywność inwestycji w odnawialne źródła energii. Analiza kosztów i korzyści*, CeDeWu, Warszawa 2010, s. 118–119.

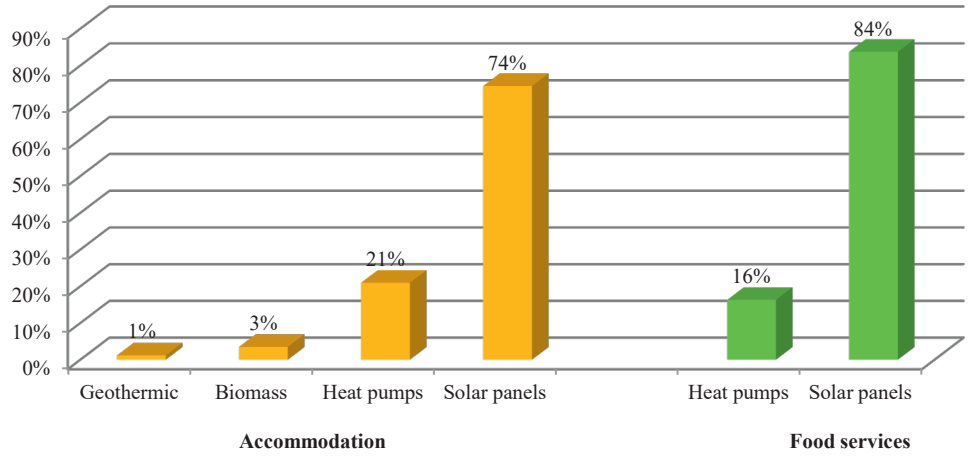
Table 22. Technologies used in the field of heat and cold extraction (accommodation)

Type of technology	Number of facilities	Year of investment start	Year of investment finish	Installation power (kW or MW)
Solid biomass – 3%	3	2002	2003	
		2010	2012	
		2012	2012	50 kW
Solar powers – 74%	1	2002	2003	
	2	2003	2003	
	1	2004	2010	
	1	2004	2005	
	2	2005	2005	
	2	2006	2006	
	1	2007	2007	
	6	2008	2008	
	1	2008	2009	
	2	2008	2010	
	2	2009	2009	30 kW
	1	2009	2010	
	6	2010	2010	
	1	2010	2012	50 kW
	4	2011	2011	
	1	2011	2012	
	1	2011	2018	30 kW
	5	2012	2012	2.3 kW
	1	2012	2013	
	5	2013	2013	
	2	2013	2014	
	5	2014	2014	
	3	2015	2015	
	1	2015	2017	2.3 kW
	3	2016	2016	5 kW
	5	2017	2017	
Heat pumps – 21%	1	2007	2008	45 kW
	1	2008	2008	32 kW
	1	2008	2018	
	1	2009	2009	30 kW
	1	2009	2010	
	1	2010	2012	
	1	2011	2011	45 kW
	2	2012	2012	30 kW
	1	2013	2013	
	2	2014	2014	45 kW
	4	2017	2017	45 kW
	2	2018	2018	
Geothermics – 1%	1	2012	2012	284 kW

Source: Own study based on own research.

In terms of obtaining heat and cooling, respondents operating in both accommodation and food services most often used solar panels and heat pumps. None used agricultural biomass (fig. 46).

Fig. 46. Frequency of use of listed technologies among respondents with accommodation and food services



Source: Own study based on own research.

Four types of investments were used among respondents operating in accommodation. Solar panels were invested in by 74% of respondents, one in four respondents used heat pumps, biomass was used by 3% of respondents. Only one facility used geothermics. This was a hotel located in Zakopane with between 10 and 49 employees. The group of respondents with operations in food services used two types of investments. Solar panels were invested in by 84% of respondents, and heat pumps by 16% of respondents (table 23).

Table 23. Technologies used in the field of heat and cold extraction (Food services)

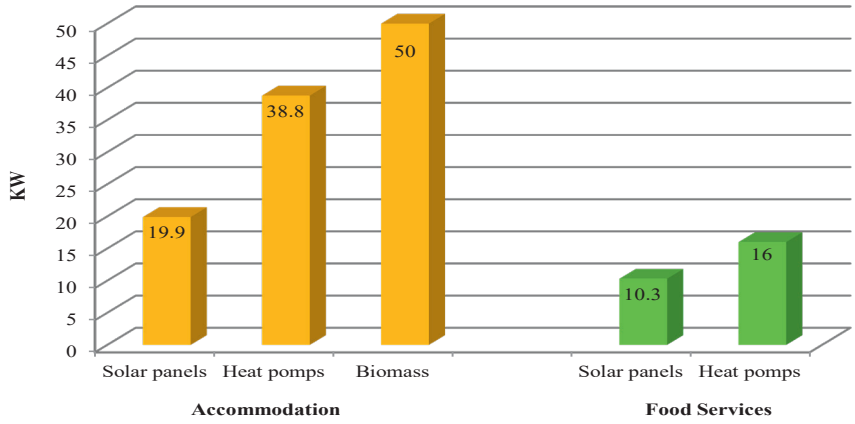
Type of technology	Number of facilities	Year of investment start	Year of investment finish	Installation powere (kW)
Solar panels – 84%	1	1998	1998	4.5 kW
	1	2000	2000	24 kW
	1	2005	2005	25 kW
	1	2006	2006	
	1	2007	2007	
	2	2008	2008	
	2	2008	2010	24 kW
	4	2009	2009	3 kW
	1	2009	2010	
	1	2010	2010	
	2	2011	2011	
	3	2012	2012	5; 2.3 kW
	1	2012	2013	
	1	2013	2013	
	5	2014	2014	2.3 kW
	5	2015	2015	3 kW
	2	2016	2016	2.5 kW
	2	2017	2017	
Heat pumps – 16%	1	2010	2010	14 kW
	2	2015	2015	15; 20 kW
	4	2017	2017	15 kW,

Source: Own study based on own research.

Based on the survey data, the average power output of the installations used, classified as RES, was calculated by accommodation and food services operators for heat and cooling extraction.

In the group of accommodation operators, due to the fact that the survey included only one case of investment in geothermics, the value given below will refer only to it. The other values are the average of the calculated power for the installations surveyed. In this case, it was the single geothermal observation that had the highest power output, while the second highest power output was biomass investments. On average, the least power was provided by solar panels of around 20 kW (fig. 47). Food businesses obtain the highest average power from heat pumps (about 16 kW on average) slightly less, about 10 kW, respondents get from solar panels.

Fig. 47. Average installation power in kW



Source: Own study based on own research.

Electricity acquisition is also presented by two categories: accommodation and food services operators. The facilities surveyed primarily used photovoltaic panels. There was one entity that used geothermal power and the power obtained from the installation was 284 kW.

All accommodation facilities obtained electricity from photovoltaic panels (table 24). The average power of the installations is about 17 kW.

Table 24. Technologies used in the field of electricity generation (Accommodation)

Type of technology	Number of facilities	Year of investment start	Year of investment finish	Instalation power (kW)
Photovoltaic panels – 100%	1	2009	2009	10 kW
	1	2009	2011	
	2	2010	2010	
	1	2011	2011	10 kW
	1	2012	2012	
	1	3013	2014	
	1	2014	2014	
	4	2016	2016	3; 12 kW
	3	2017	2017	30; 40; 12 kW,
	2	2018	2018	20 kW

Source: Own study based on own research.

Facilities operating in nutrition used photovoltaic panels 92% of the time, and one used a wind power plant – it was a farm located in the Dolnośląskie

Province, classified as a micro-enterprise. None used a hydroelectric power plant or a biogas plant (table 25). It is also worth mentioning that the average power obtained from this type of technology was about 9.5 kW in the studied group of facilities, and from the wind power plant it was 0.4 kW.

Table 25. Technologies used in the field of electricity generation (Food service)

Type of technology	Number of facilities	Year of investment start	Year of investment finish	Installation power (kW)
Photovoltaic panels – 92%	1	2002	2018	0.6 kW
	1	2010	2010	10 kW
	1	2011	2011	
	2	2013	2013	5 kW
	2	2015	2015	3; 15 kW
	1	2016	2016	10 kW,
	1	2016	2017	10, kW
	3	2017	2017	6,6;15; 12 kW,
Wind power plant – 8%	1	2001	2001	0.4 kW

Source: Own study based on own research.

Biofuels were used for means of transportation. For the surveyed group of tourist facilities, none used biofuels. Respondents were also able to indicate other technologies categorized as renewable energy sources used in the operation of tourism businesses. Only one indication was the use of an electric car, which was purchased in 2016.

All renewable energy installations are not a small purchase from the perspective of fixed assets in a business. Each time they are purchased, connecting them is related to the investment process in the company. Each installation described was, therefore, an investment project generating certain cash flows on the expenditures side. They are, therefore, investments as a category previously described on the theoretical side.

Accordingly, respondents in the course of the ongoing research were primarily asked about the amount of capital expenditures for each of the investments mentioned (in thousands of PLN) and to estimate the value of the various components, broken down into design work and construction work (in %). It turns out that 140 surveyed facilities invested in and benefited from RES, but some of them carried out more than one investment, with a total of 154. However, not all of them provided data on the total amount of investment and the share of expenditures for design work and permits, as well as the share of expenditures for installation construction and commissioning.

When analyzing the overall value of investments, the median is the most authoritative, as their amounts vary widely. Taking into account accommodation operators, the highest investment value appears in the installation of solid biomass – it was PLN 400 thousand. The median investment in heat pumps was PLN 55 thousand. The lowest investment value occurred in the installation of solar collectors – it was about PLN 20.5 thousand. It is worth noting the coefficient of variation, which is very high in the case of investment in solar panels, at over 240%, which means a very large variation in the level of investment in this technology. In the food category, the highest median investment was in wind power, with only one respondent reporting the total amount, and it was PLN 3.5 million. The second highest investment was heat pumps – where the median amount was PLN 55 thousand. There was also a very large variation in this type of investment, which amounted to 101%. In third place were photovoltaic panels – the median investment was PLN 35 thousand (table 26).

Table 26. Total amount of investment – basic descriptive statistics

Specification	Means	N	Min.	Max.	Median	Vz
	Accommodation					
Solid biomass	400 000	1	400 000	400 000	400 000	–
Solar panels	59 270	56	1700	1 000 000	20 500	242%
Heat pumps	106 066	15	7000	400 000	55 000	116%
Photovoltaic panels	57 687	16	8000	300 000	35 000	119%
	Food services					
Solar panels	24 824	34	10000	70000	15 000	80%
Heat pumps	96 250	4	35000	240000	55 000	101%
Photovoltaic panels	34 515	13	2000	80 000	35 000	69%
Wind power plant	3 500 000	1	3 500 000	3 500 000	3 500 000	–

Source: Own study based on own research.

The total level of investment in RES that we were able to estimate among the surveyed enterprises was PLN 11.4 million. It was 6.23 million for accommodation and 5.2 million for food services respectively, with this level largely determined by a project in a wind power plant – PLN 3.5 million. The average investment levels for individual technologies for the accommodation group were also correspondingly higher, which is mainly related to the cubic size of the facility and energy requirements. As for individual technologies, the highest level of investment was recorded for solar collectors – 4.16 million, followed by heat pumps – 1.97 million, and photovoltaics – PLN 1.37 million, respectively.

As for the spatial concentration of RES investments, the highest levels were recorded in the Mazowieckie, Małopolskie, Śląskie, Dolnośląskie, Wielkopolskie, Zachodniopomorskie and Pomorskie provinces. This distribution is, moreover, similar to the overall investment data in the accommodation and food section described in Chapter 2. Bearing in mind that 1,200 entities participated in the survey of enterprises, more general conclusions can be cautiously drawn. Assuming that in Section I 12% of entities would invest in RES with a median of 25,000 for the entire group, then for the 2017 survey year the level of investment in this sphere would be at 392.7 million. It should be noted that this is data not for one year, but up to the year of the survey conducted by the research studio. Taking the average, adjusted for wind power, at 58.5 thousand, the final figure for investment in RES by 2017 would approach PLN 919 million among Section I tourism enterprises.

Investment expenditures in RES were divided into two groups: the first included the percentage of funds allocated to design work and obtaining the relevant permits (table 27), and the second was the percentage of expenditures for construction, installation and commissioning (table 28). Expenditures were presented by accommodation and food operators.

Table 27. Outlays for design work, permits – total [%]

Specification	Means	N	Min.	Max.	Median	Vz
	Accommodation					
Solid biomass	7	3	0	20	1	161
Solar panels	17.6	61	0	50	20	113
Heat pumps	11.2	17	0	50	5	127
Photovoltaic panels	15.7	17	0	100	10	115
	Food services					
Solar panels	16	35	0	50	10	114
Heat pumps	17.5	4	0	30	20	86
Photovoltaic panels	16.8	14	0	50	7,5	132
Wind power plant	0	1	0	0	0	-
Others	0	1	0	0	0	

Source: Own study based on own research.

In the group of accommodation facilities, the largest share of expenditures on design work and permits was revealed in the case of investments in solar panels (17.6%) In other investments in RES technology, the shares ranged from 7% for solid biomass to 15.7% for photovoltaic panels.

Table 28. Construction, installation and commissioning expenditures – total [%]

Specification	Means	N	Min.	Max.	Median	Vz
	Accommodation					
Solid biomass	93	3	80	100	99	12
Solar panels	82.2	61	50	100	90	24
Heat pumps	88.8	17	50	100	95	16
Photovoltaic panels	84	17	50	100	90	22
						Food services
Solar panels	84	35	50	100	90	22
Heat pumps	82.5	4	70	100	80	18
Photovoltaic panels	83	14	50	100	92.5	27
Wind power plant	100	1	100	100	100	–
Others	100	1	100	100	100	–

Source: Own study based on own research.

Food entities spent the most on design work and permits in the case of heat pump installations (17.5%) In other types of installations, the percentage of expenditures on design work and permits was similar, ranging from 16% for solar panels to 16.8% for photovoltaic panels. Respondents who invested in wind power plants and other technologies put their shares for design work and permits at 0%. The largest variation in the shares of these expenditures was in investments in solid biomass (161%).

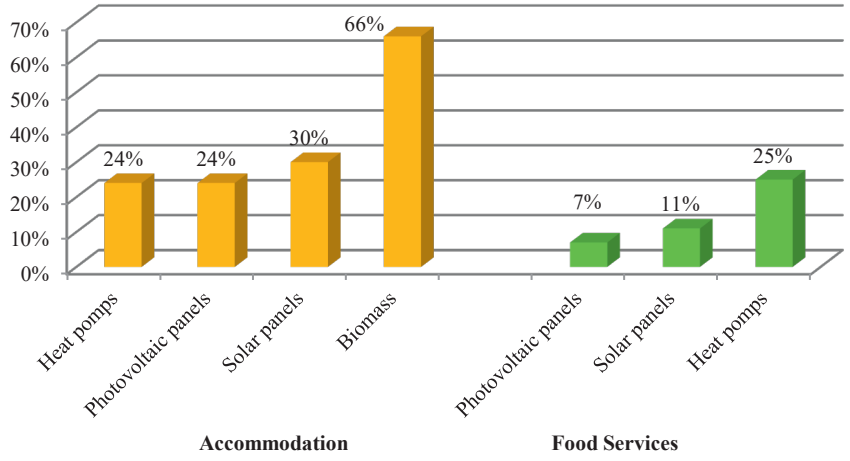
In the accommodation group, the share allocated for construction, installation and commissioning is very similar, ranging from 82.2% for solar panels, and up to 93% for solid biomass. The largest variation in percentage share was for solar collector panels (24%) and photovoltaic panels (22%).

For the entities in the food group, the largest percentage of investment in construction, installation and commissioning indicated in the case of wind power plant was 100% and other technologies also 100%. In other cases of investment in RES technology, expenditures on construction, installation and commissioning ranged from 82.5% (heat pumps) to 84% (solar panels). The largest variation in percentage share was for photovoltaic panels (27%) and solar panels (22%). Respondents were also asked about possible subsidies for completed investments. The survey showed that the share of subsidization of individual investments varied. Only 21% of investments were subsidized. The most common was EU subsidies – this was indicated by 16 respondents, and in the case of 3 people, financing was provided by a bank. In addition, survey participants also mentioned as a source of financing, among others: Municipality

Office, ARMA (The Agency for Restructuring and Modernisation of Agriculture), Marshal's Office and others. The percentage of investment subsidization varied widely, ranging from 5 all the way up to 100%. Most often, half of the investment amount was subsidized – this was reported by 30% of the respondents.

In accommodation, the most common investment subsidy was with biomass, (66%) while in other technologies, one in four facilities received subsidies. A different distribution of the percentage of respondents who received funding is arranged in the category of running a food business. One in four seeking to install heat pumps received funding, one in ten seeking solar panels and 7% wanting to invest in photovoltaic panels (fig. 48).

Fig. 48. Percentage of subsidized investments in particular technologies by facilities operating in the field of accommodation as well as catering (% share)



Source: Own study based on own research.

The entities under the survey were also asked about the expected payback period for RES investments (table 29). According to the respondents running accommodation-related facilities, the longest time to wait for a return on investment in solid biomass (an average of 17.5 years), while the shortest was for solar panels (more than 9 years).

Table 29. Expected payback period for RES investments (in years)

Specification	Means	N	Min.	Max.	Median	Vz
	Accommodation					
Solid biomass	17.5	2	15	20	17.5	20
Solar panels	9.2	61	0	30	8	66
Heat pumps	10	17	0	19	10	59
Photovoltaic panles	9.7	17	3	30	9	66
	Food services					
Solar panles	7.7	33	0	16	7	49
Heat pumps	12.2	4	4	20	12.5	56
Photovoltaic panles	18.6	14	4	100	11.5	130
Others	5	1	5	5	5	–

Source: Own study based on own research.

According to food facilities, the longest time to wait for a return on investment is for the installation of photovoltaic panels (about 18.5 years) and the shortest for investments in other RES technologies (5 years).

4.2.2. Factors influencing the decision to implement the investment

An important part of the research process was to analyze the determinants of investment decision-making in tourism enterprises. One of the most important questions formulated during the research was related to the evaluation of factors that influenced the decision to invest in RES. Respondents rated the factors from 0, which meant no influence at all, to 10, which was a decisive influence. The most important factor influencing the decision to make an investment in RES, which received the most 10-point ratings, was the desire to reduce greenhouse gas emissions. As many as 69% of respondents indicated the maximum rating in this case. Protection of the environment also proved to be an important factor for respondents, with 56% of respondents giving this factor a 10-point rating, and only one percent less, 55% of the highest ratings were given to the desire to save fossil fuels. Half of the respondents gave 10 points to improving the environment in their area.

In order to rank the importance of individual factors in RES investment decisions, the average values of their scores were calculated and a ranking was created on this basis (fig. 49). The aforementioned factors, whose average score

was above 7, turned out to be the most important in the ranking of factors influencing investment in RES. These were: the desire to reduce greenhouse gas emissions – 7.99, environmental protection – 7.96, the desire to save fossil fuels – 7.95, and improvement of the local environment – 7.33. The least important factors for respondents influencing investment decisions turned out to be workforce reduction (0.89), health and safety requirements (1.46), national regulations (1.67) and introduction of a new product (1.69).

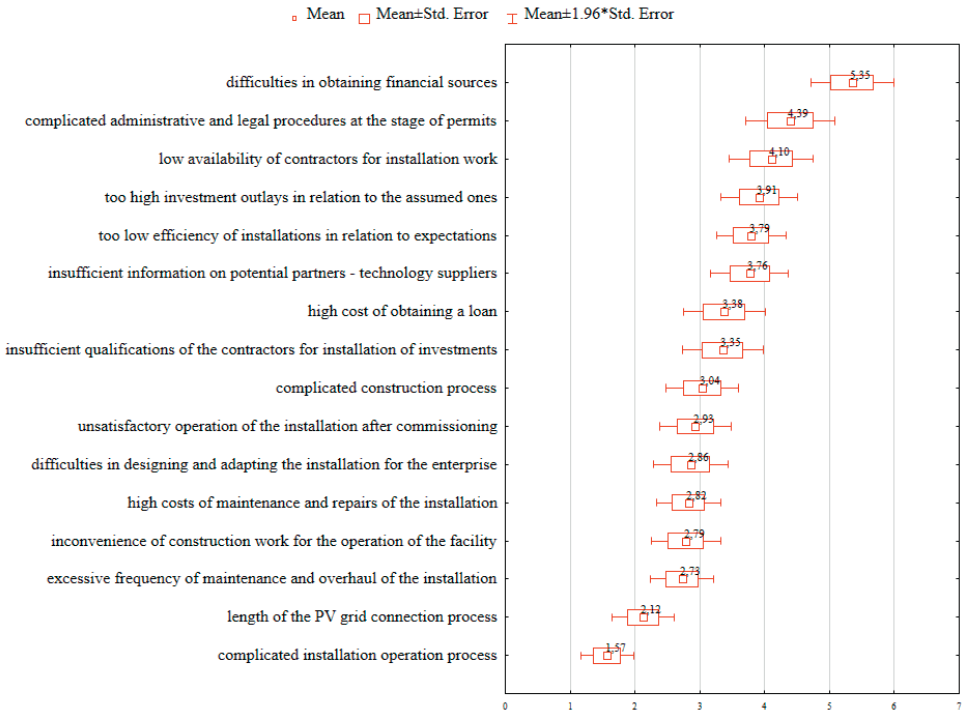
Fig. 49. Average rating of the influence of individual factors on the decision to invest in renewable energy technologies

Source: Own study based on own research.

Another important aspect analyzed in the course of the ongoing research were the barriers during the implementation of investments in renewable energy sources. Respondents could rate a given factor from 0 – meaning it was not a barrier, to 10 – the greatest barrier (fig. 50). The following were indicated as the most significant barriers to investment in RES in the average rating: difficulties in obtaining sources of financing – 5.35; complicated administrative and legal procedures at the stage of permits – 4.39; low availability of contractors

for installation work – 4.10; too high investment outlays in relation to the assumed – 3.91. The lowest ratings were given to the complicated process of operating the installation (1.57), the length of the process of connecting to the grid (PV) (2.12) and the excessive frequency of maintenance and repair of the installation (2.73). These barriers were not too inconvenient for respondents.

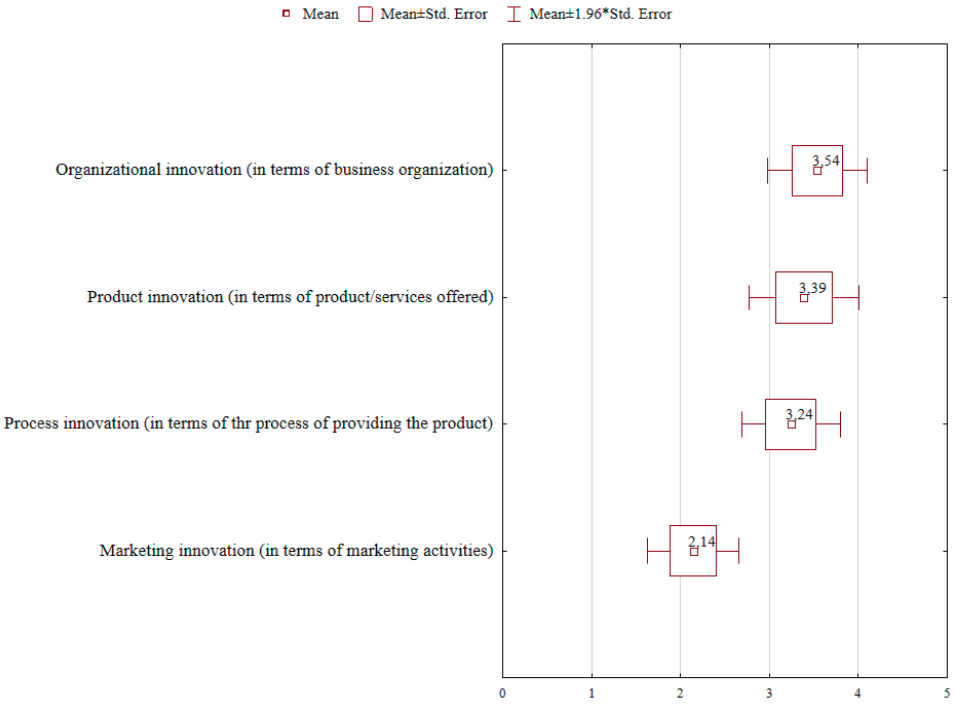
Fig. 50. Average assessment of the impact of individual barriers to the implementation of investments in RES technologies



Source: Own study based on own research.

Bearing in mind the established research tasks relating to the absorption of innovations, the respondents spoke out in this sphere as well. In carrying out the research, an attempt was made to check the impact of the implementation of RES technology on individual types of innovation (product, process, marketing and organizational). Taking into account the average assessment of the various types of innovations, it can be said that organizational innovations were rated highest (average score – 3.54), slightly lower were product/service innovations (3.39). Marketing innovations were rated lowest (2.14) (fig. 51).

Fig. 51. Average assessment of the impact of the implementation of individual RES technologies on the types of innovations



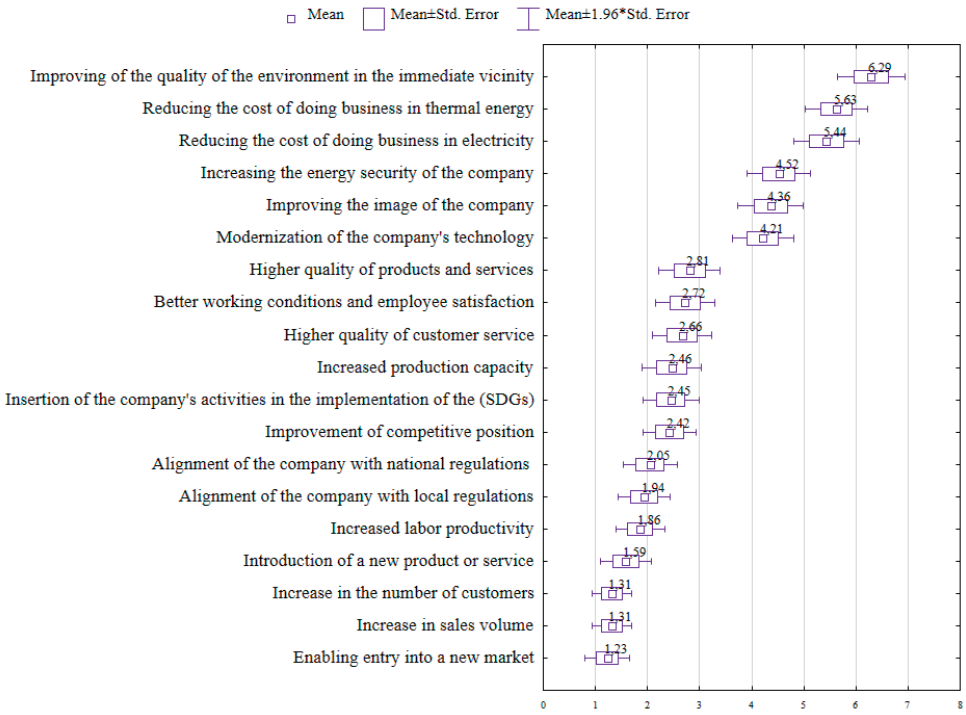
Source: Own study based on own research.

One of the elements of the survey was to obtain information about the impact of realized investments in enterprises on various aspects relating to the environment and the activities of the enterprises themselves. In order to further analyze the effects of the implementation of RES in entities operating in the tourism industry as indicated by respondents, averages were calculated and ranked (fig. 52). The highest averages were given to: improvement of environmental quality (6.29), reduction of business costs in thermal energy (5.63) reduction of costs in electricity (5.44). The lowest rankings were: ability to enter a new market (1.23), increase in sales volume and increase in the number of customers (1.31 each).

Respondents were also asked where they got their knowledge about the RES technology to be installed, and whether this information was helpful in making the final decision. When analyzing their answers, it can be said that the most common source of knowledge was the Internet, the websites of national companies (institutions) – this was answered by almost half of the respondents

(48%), slightly fewer pointed to companies involved in the sale and installation of RES technologies – 41%. One in five respondents drew information from either the press or the literature, and 16% from entities that already use RES technologies.

Fig. 52. Average ratings for individual effects



Source: Own study based on own research.

The greatest usefulness of the mentioned source of knowledge was when using the Internet. The least useful as sources of information on RES were foreign websites, industry exhibitions and fairs, company customers and tourists, industry and scientific literature, and foreign literature and press – these sources were indicated by individuals. Respondents also mentioned other sources that were helpful in the decision to install the chosen RES technology. These included training, the Municipality, energy audits, study visits to other centers, and their own knowledge – one respondent had previously built such installations himself and was familiar with it and had knowledge (table 30).

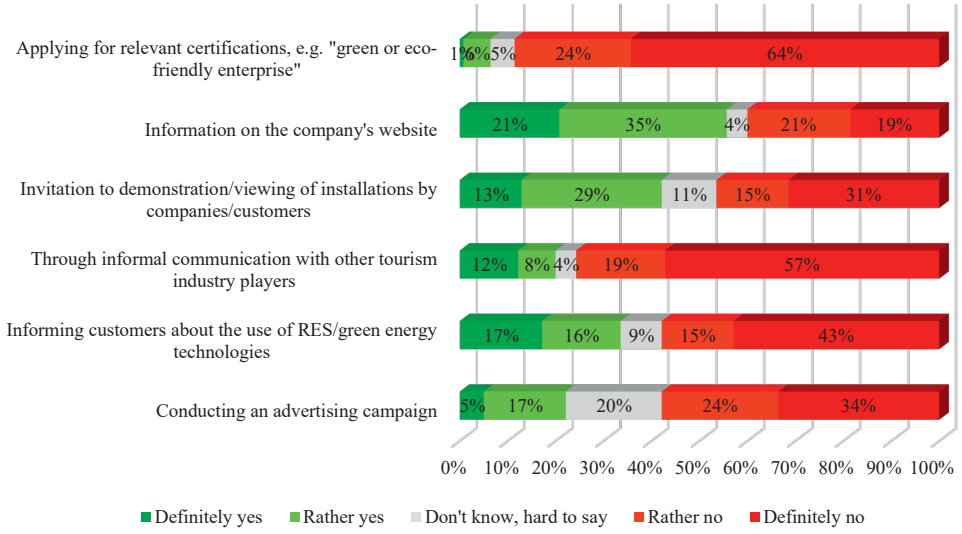
Table 30. Usefulness of individual sources of information on RES

	Evaluation ofusefulness					
Sourceofinformation	Percent-age of indications	Very helpful	Helpful	Rather helpful	Not very helpful	Nothelpful
From the Internet – national sites	48%	45%	24%	24%	7%	0%
From companies involved in the sale and installation of RES technologies	41%	19%	50%	26%	5%	0%
From the national press, literature	18%	36%	32%	16%	16%	0%
From individuals whouse RES technology	16%	23%	50%	9%	18%	0%
From other tourism entities in the country	7%	10%	0%	80%	10%	0%
From other tourism entities abroad	6%	20%	44%	44%	0%	0%
From television broadcasts	6%	11%	22%	44%	11%	11%
From companies that produce RES technology	4%	20%	80%	0%	0%	0%
From a public institution (e.g. municipality, county office)	3%	25%	50%	25%	0%	0%
From an advertising campaign	3%	50%	25%	25%	0%	0%
From the Internet – foreign websites	1%	50%	50%	0%	0%	0%
From exhibitions, trade fairs	1%	0%	0%	50%	0%	50%
From tourists, customers of the company	1%	0%	50%	50%	0%	0%
From industry/scientific literature	1%	0%	0%	100%	0%	0%
From foreign press, literature	1%	0%	0%	100%	0%	0%

Source: Own study based on own research.

Respondents were asked whether they would promote and publicize in their neighborhood the RES technology they had invested in. It turns out that most of them will definitely not conduct an advertising campaign (64% of "definitely not" responses). Only 7% of respondents said they would be willing to conduct such activities (fig. 53).

Fig. 53. Ways to promote investments in RES

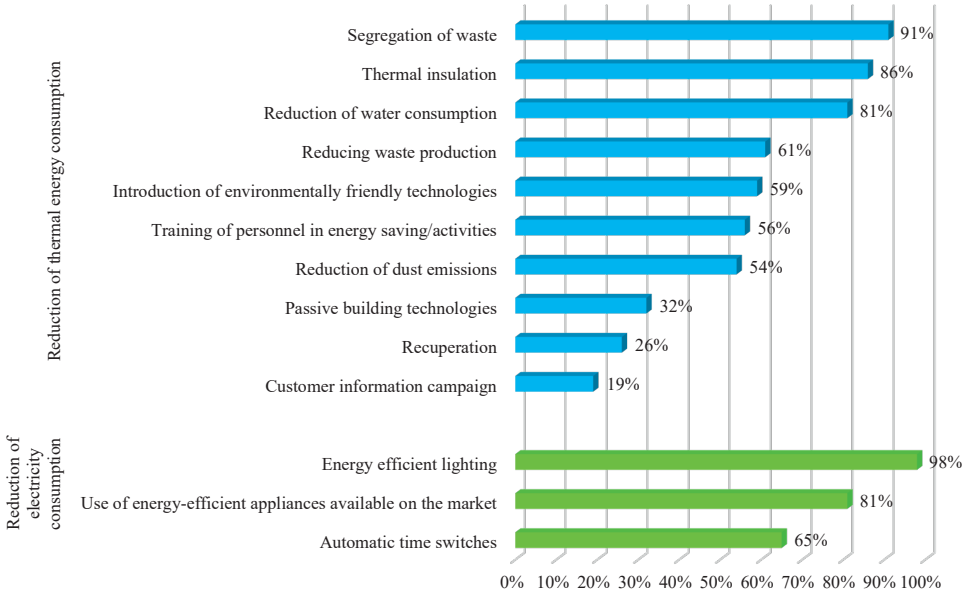


Source: Own study based on own research.

The most frequent respondents declared that they would promote their investment by informing customers about the advantages of green energy – as many as 56% indicated this way. Here, the results already obtained in other surveys, which show that investments in RES are supposed to build the image of a green company. This is supposed to be important for building an overall positive image of the company and contribute to its positive perception by the consumer – the tourist. A large percentage of respondents would try promotion through informal communication with other tourism industry players (about 42%). One in three would choose to promote the installation on their company's website. Only 22% of RES installation owners will apply for relevant certifications, e.g. "green or eco-friendly company".

During the survey, respondents were asked whether they use other environmentally friendly measures to reduce electricity and heat consumption (fig. 54).

Fig. 54. Other pro-environmental measures to reduce heat and electricity consumption

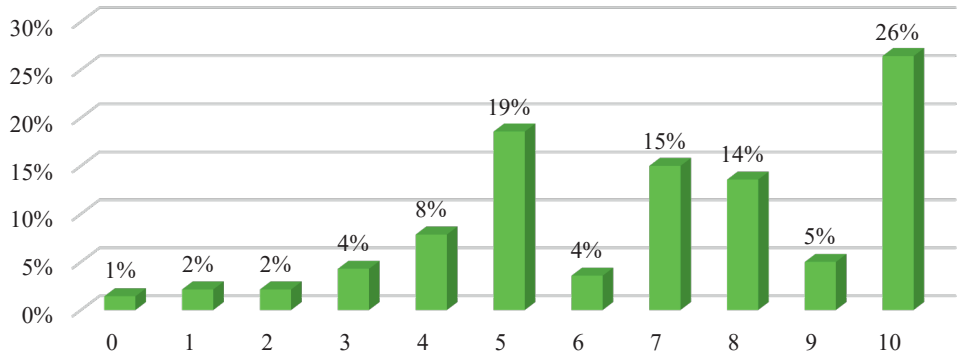


Source: Own study based on own research.

It turns out that with regard to reducing electricity consumption, as many as 98% of respondents use energy-efficient lighting, and 81% use energy-efficient appliances available in the market. More than half, 65%, had automatic time switches. As many as 91% of respondents segregated waste, 86% used thermal insulation, and 81% tried to reduce water consumption. More than half, 61%, of respondents were reducing waste production, and 59% were introducing environmentally friendly technologies. Fifty-six percent provided training for staff on energy conservation and environmental measures, and 54% sought to reduce fluid emissions.

Respondents were asked how they rated the impact of renewable energy sources on their company's operations. They could rate the impact on a scale of 0 – no impact, 1 – minimal impact (impact) to 10 – very high impact (fig. 55).

Fig. 55. Assessment of the impact of renewable energy sources on business operations



Source: Own study based on own research.

Most, 26% of respondents rated the importance of RES very highly, giving the maximum rating of 10 points. The average rating among those who made these investments was almost 7 points (6.9). Overall, 60% of respondents rated the impact of RES on the company's operations at 7 and above. Among the respondents, there were also those who did not perceive the impact of RES – this was only 1% of the respondents. Most of them highly rated the impact of RES on the operation and activities of their companies. The coefficient of variation at 38% indicates the variation in the assessment of the importance of RES among the surveyed group (table 31).

Table 31. Descriptive statistics for assessing the significance of the impact of RES on enterprise operations

Specification	N	Mean	Me	Mo	N_{Mo}	Min.	Max.	V_z
Assessment of the significance of the RES impact	140	6.9	7	10	37	0	10	38%

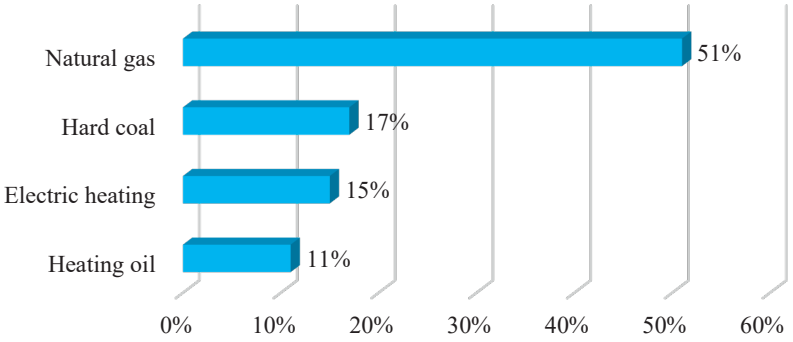
Source: Own study based on own research.

The most frequent respondents, in addition to the installed RES technology, used natural gas to obtain thermal energy – 51% of indications. Several percent each used coal (17%) and electric heating (15%). Respondents cited propane-butane gas, eco-pea, briquettes, firewood, pellets, and district heating as "other" thermal energy carriers (fig. 56).

In the course of the research conducted, respondents were asked whether they had heard of the Sustainable Development Goals developed in 2015 by

the UN[6]. It turned out that only slightly less than half had heard of the list of all-encompassing goals.

Fig. 56. Other thermal energy carriers used by respondents



Source: Own study based on own research.

4.2.3. Determinants of RES market development in the tourism economy

The questionnaire used in the research also included questions that were asked only to respondents who do not use RES technologies and thus do not make investments in their companies in this area. Questions on why they are not undertaking investment activity in this environmentally friendly and rapidly growing market were considered important. The logical design of the questions was to obtain information about the current state of the market, a diagnosis of this state, and to obtain predictive data to outline the directions of its development. Respondents were first asked about possible barriers that discourage them from investing in renewable energy sources. The biggest barriers that prevent respondents from using RES are:

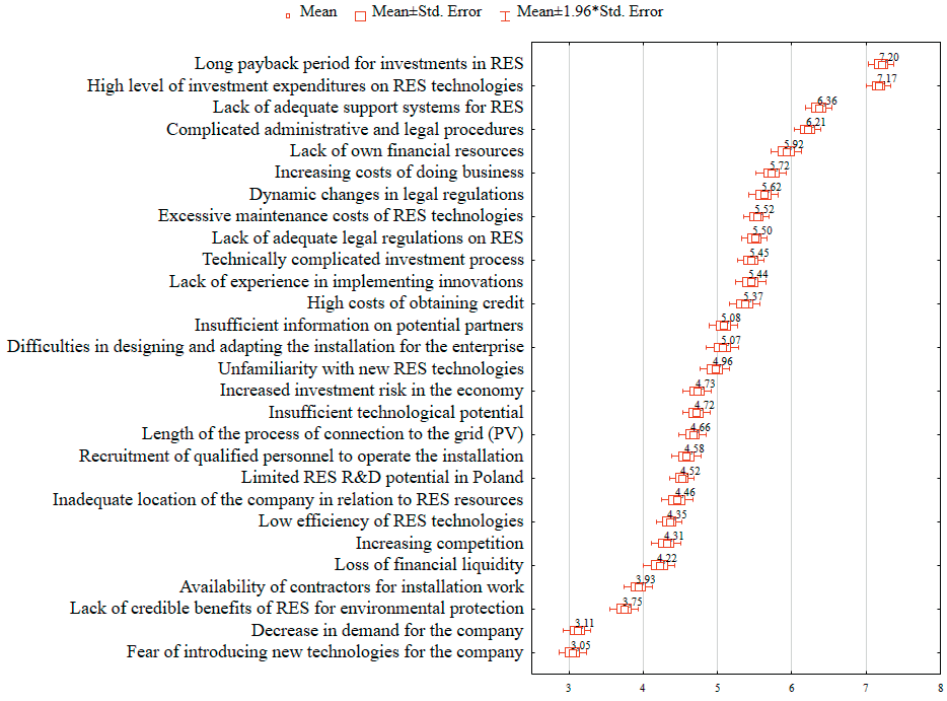
[6] In September 2015, at the so-called Sustainable Development Summit in New York, 193 UN member countries adopted a resolution entitled *Transforming our world: the 2030 Agenda for Sustainable Development*. The document set 17 global goals *(Sustainable Development Goals – SDGs)* and associated 169 targets for the world to achieve by 2030, the achievement of which is expected to help build a sustainable future and reduce poverty. Goal 7 is to ensure affordable access to sources of stable, sustainable and modern energy for all. The tasks included in the Agenda under Goal 7 are: (7.1) ensure universal access to affordable, reliable and modern energy services; (7.2) significantly increase the share of renewable energy sources in the global energy mix; (7.3) double the rate of increase in global energy consumption efficiency – Source: Resolution adopted by the General Assembly on September 25, 2015 titled: *Transforming our world: the 2030 Agenda for Sustainable Development*, United Nations, A/RES/70/1, New York 2015.

- long payback period,
- high level of necessary investment in the technology,
- lack of adequate support systems for these investments,
- lack of own financial resources.

Average ratings were calculated for the barriers mentioned. This shows that the most significant obstacle, according to respondents, was the long payback period for investments in RES (the highest average – 7.20), in second place was the high level of investment expenditures for this type of technology (7.17), in third place was the lack of appropriate support systems for RES (6.36), and in fourth place with an average score of 6.21 was the complicated administrative and legal procedures associated with this type of investment (fig. 57).

The smallest barriers preventing investment in RES, according to respondents, were fear of introducing new technologies into the company (3.05), a decrease in demand within the company (3.11), and a lack of reliable environmental benefits from RES (3.75). As "other" barriers, respondents indicated, among others: lack of title to the building used for business, lack of reliable information on RES, architectural barriers, complicated legal regulations, etc.

Fig. 57. Average ratings of RES investment barriers among respondents who do not use RES

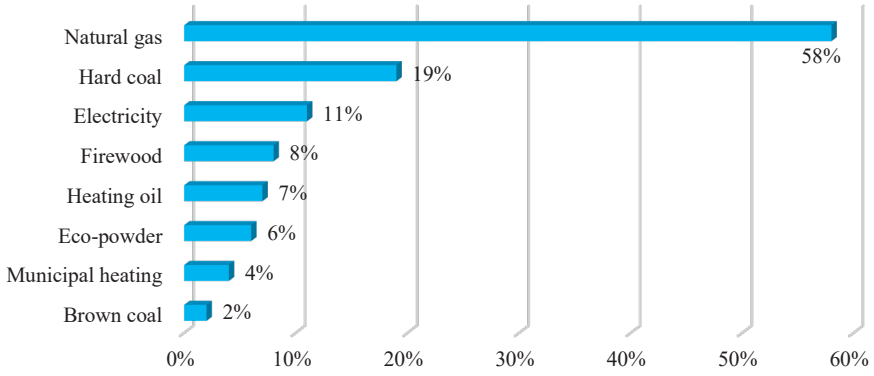


Source: Own study based on own research.

The thermal energy media used by respondents not investing in RES are mainly natural gas (58% of respondents). One in five used hard coal, and one in ten used electricity. A few percent each used firewood (8%), fuel oil (7%) and eco-pea (6%). Respondents in the "other sources" category (3% of indications) cited: pellets, propane/butane gas (bottled gas), coke, middlings, and air conditioning (Figure 58).

It is worth noting, a higher percentage of those using natural gas occurred among those not using RES than among those who declared their use. Similarly with the use of coal, the use of which was more often declared by respondents not using RES.

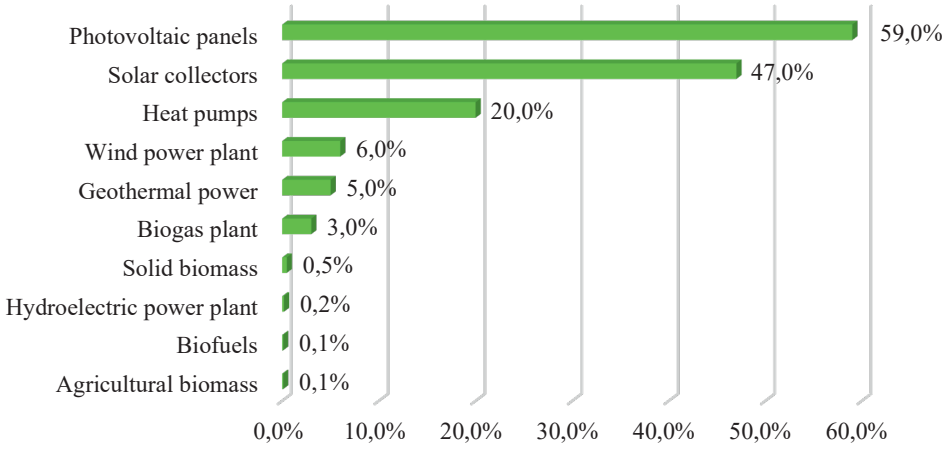
Fig. 58. Heat energy carriers used by respondents



Source: Own study based on own research.

Respondents were asked whether they intend to apply RES in the future, within the next 3 years. It turns out that 32% (339 entities) confirmed that they intend to invest in such technology. Of those who confirmed their intention to invest in RES, almost 59% want to introduce photovoltaic panels, and about 47% want to introduce solar panels. Heat pumps were mentioned, by one in five respondents. The fewest respondents intend to use agricultural biomass and biofuels – each (0.1%) (fig. 59).

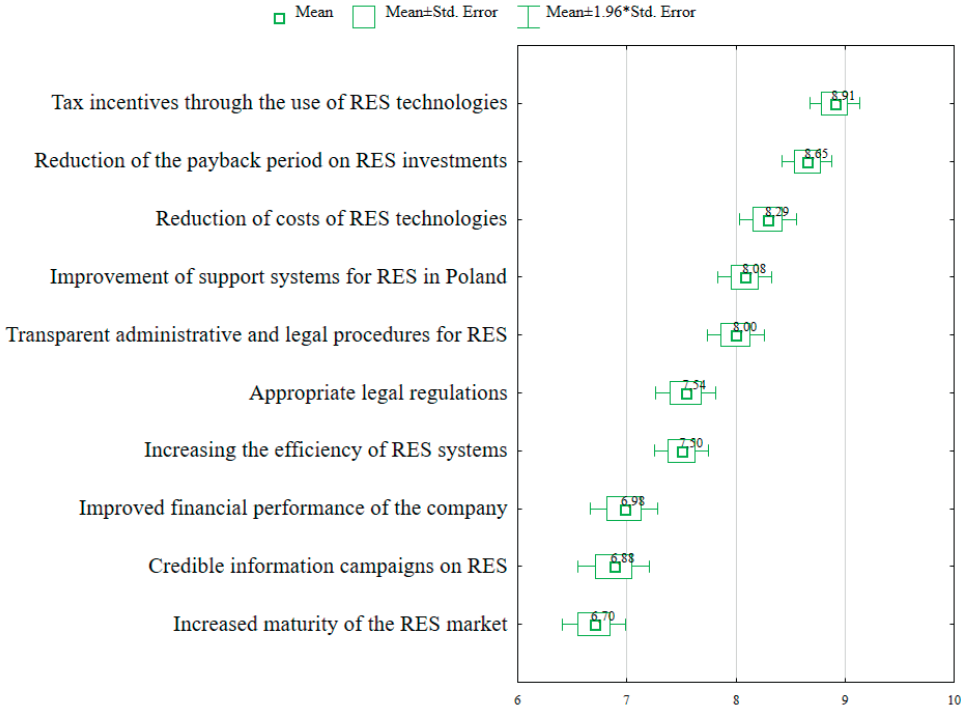
Fig. 59. RES technologies that respondents intend to install in the next three years (n=339)



Source: Own study based on own research.
**percentages do not add up to 100 because respondents could select more than one answer*

Respondents from this group, intending to invest, were asked what factors would influence the development of the RES market. They rated their importance on a scale of 0 to 10, where (0 – is no impact, 1 minimal impact and 10 maximum impact). On this basis, averages were calculated. Respondents indicated some of the most important factors that they thought would contribute to the development of the RES technology market. These were: tax incentives, shortening the payback period, lowering the cost of technology, and improving support systems for RES in Poland (fig. 60).

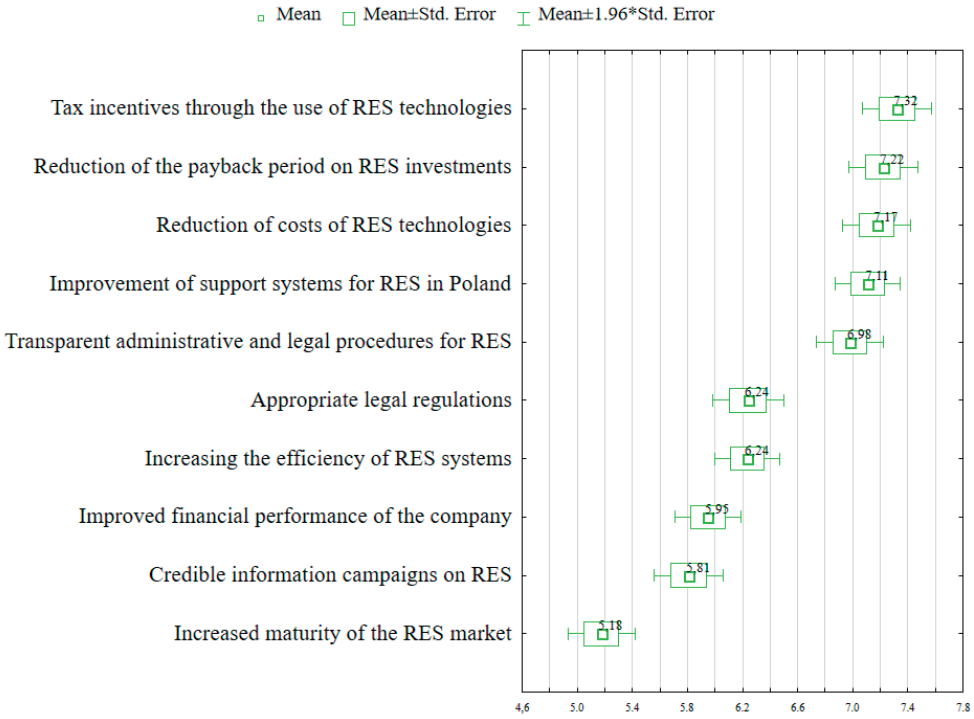
Fig. 60. Average rating of the factor's influence on the development of RES technologies (n=339)



Source: Own study based on own research.

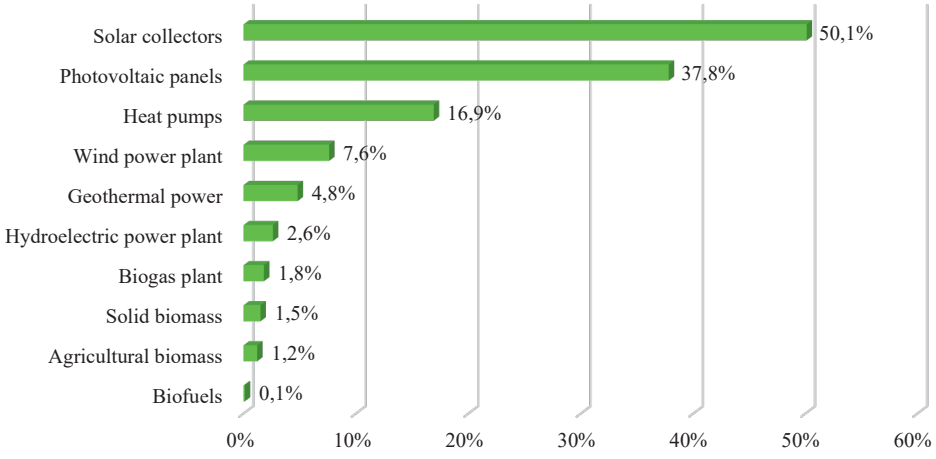
Respondents who showed no willingness to invest in RES technology (721 subjects) were asked which of the listed factors would influence their decision to invest in the selected RES technology. They made a rating on a scale from 0 – no impact, to 10 – maximum impact. The averages were then calculated. The analysis shows that the key factors that would influence the decision to invest in the selected RES technology are, for respondents who do not already have such a technology: tax incentives (mean 7.32), shortening the payback period for RES investments (mean 7.22), and lowering the cost of RES investments (mean 7.17) (fig. 61).

Fig. 61. Average rating of factors influencing the decision to invest in RES (n=721)



Source: Own study based on own research.

Fig. 62. RES technology that respondents were willing to invest in (N=721)



Source: Own study based on own research.

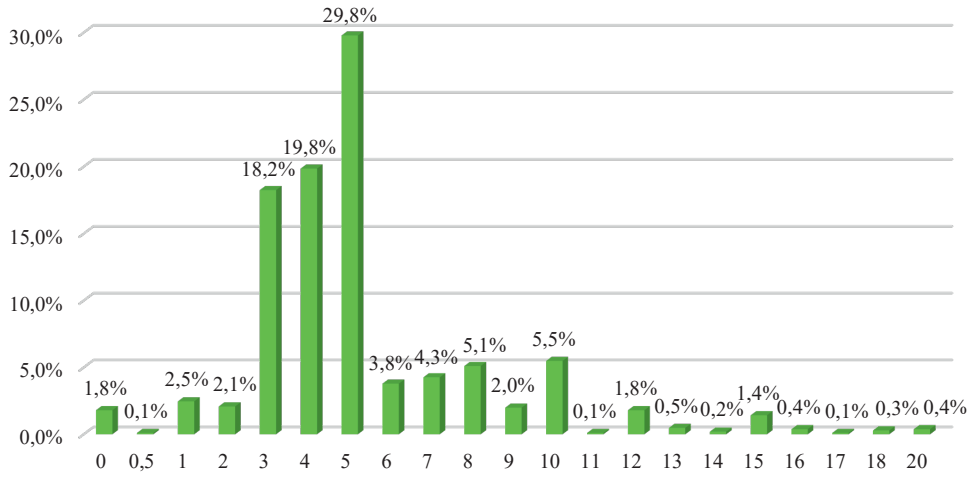
**percentages do not add up to 100 because respondents could select more than one answer*

When conditions were met (affecting the decision to invest in RES), respondents indicated which technology they would be willing to invest in (fig. 62).

It turns out that respondents would be most likely to invest in solar panels (50.1,% of indications), and almost 38% indicated photovoltaic panels. About 17% would invest in heat pumps, and more than 7% in a wind power plant.

Since one of the important factors influencing investment decisions is the payback period, respondents were asked about this issue as well. The question already included a whole group of subjects who have not yet invested in RES. The maximum payback period for RES investments (in years) that would be satisfactory and appropriate for investing funds is 5 years for respondents. This was indicated by almost 30% of them, or 315 entities (fig. 63).

Fig. 63. Maximum acceptable payback period for RES investments (in years) (n=1058)



Source: Own study based on own research.

The average maximum payback time for RES investments was slightly more than 5 years (5.3). Overall, 5 years and less as an acceptable investment payback period was indicated by 74.3% of respondents. Respondents identified the shortest maximum payback period as 0 and the longest as 20 years. The coefficient of variation indicates a wide variation in the maximum investment payback time and is 56% (table 32).

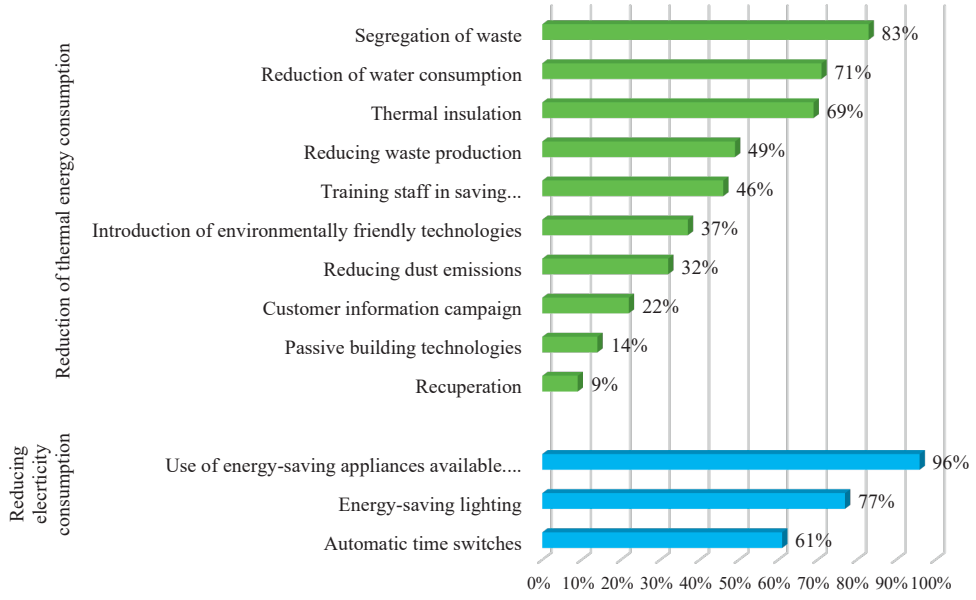
Table 32. Basic descriptive statistics of maximum payback time for RES investments

Specification	N	Mean	Me	Mo	N_{Mo}	Min.	Max.	V_z
What maximum payback period in RES (in years) would be satisfactory, suitable for investing the funds?	1058	5.3	5	5	315	0	20	56%

Source: Own study based on own research.

Other environmentally friendly measures that respondents used in their companies to reduce the consumption of caloric and electrical energy were: segregation of waste (83%), reduction of water consumption (71%) and use of thermal insulation (69%). Nearly half, 49%, of respondents sought to reduce waste production. In terms of reducing thermal energy consumption, up to 96% of respondents used energy-saving lighting, and 77% used energy-saving appliances available on the market. The following were indicated as "other" ways: a separator for municipal waste, no chemicals used for plant cultivation, ecological stoves, condensing technology (condensing boilers), sewage treatment plant, among others (fig. 64).

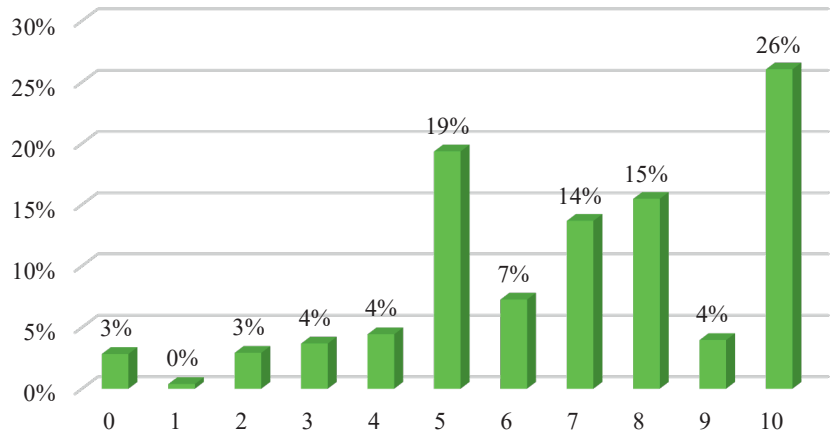
Fig. 64. Other pro-environmental measures taken to reduce heat and electricity consumption (n=1060)



Source: Own study based on own research.

Respondents were asked to rate the importance and impact of RES on their companies' operations on a scale from 0 to 10, where 0 means no importance, no impact, and 10 is very important, very high impact (fig. 66). When analyzing their responses, it can be seen that the largest number, 26%, rated the impact of RES influence very high – out of 10 points. There were 276 subjects. In the surveyed group, there were also respondents who saw no connection at all and stated no impact at all. However, there were few of them, only 3%. A fairly large percentage, 19%, rated the impact at a medium level, awarding 5 points.

Fig. 65. Ocena znaczenia odnawialnych źródeł energii na działalność przedsiębiorstwa (n=1060)



Źródło: Opracowanie własne na podstawie zrealizowanych badań własnych.

The average rating of the impact of renewable energy sources on the company was almost 7 points (6.9). The coefficient of variation indicates the diversity of respondents' opinions on the impact of renewable technologies on their companies' operations (table 33).

Table 33. Basic descriptive statistics of the impact of RES technologies on the enterprise's operations

Specification	N	Mean	Me	Mo	N_{Mo}	Min.	Max.	V_z
What is the impact of renewable energy technology on the enterprise?	1060	6.9	7	10	276	0	10	38

Source: Own study based on own research.

Respondents were also asked whether they had heard of the Sustainable Development Goals. 35% of them answered in the affirmative to this question (this was less than in the group of respondents who already have RES technologies).

4.3. Investments vs. ability to absorb innovation in the tourism economy in renewable energy sources

4.3.1. Construction of the economic model-innovation variant

For the purposes of the study, a synthetic variable was created on the ability to absorb innovation – it consists of four variables responsible for determining the relationship of product innovation, process innovation, organizational innovation and marketing innovation to the implementation of RES technology. The variable has a range from 0 to 40 points. These characteristics were adopted, as the dependent variable Y. As a set of potential independent variables for the construction of the econometric model, the following 24 indicators related to investment decision-making in the company were adopted:

- X_1 – increase in revenue,
- X_2 – increase in production and service potential,
- X_3 – improvement and/or change in the production and service process,
- X_4 – increase in the number of customers due to environmental activities,
- X_5 – introduction of a new product or service,
- X_6 – reduction of operating costs,
- X_7 – high wear and tear of fixed assets,
- X_8 – health and safety requirements,
- X_9 – adaptation of the company to the trends of technological progress,
- X_{10} – introduction of modern technology into the company,
- X_{11} – imitation of other companies' RES activities,
- X_{12} – regulations at the national level,
- X_{13} – regulations at the local level,
- X_{14} – downsizing,
- X_{15} – environmental protection,
- X_{16} – desire to save fossil fuels,
- X_{17} – improving the local environment,
- X_{18} – desire to reduce greenhouse gas emissions,
- X_{19} – improving the company image,
- X_{20} – energy independence of the company,
- X_{21} – increasing energy security,

- X_{22} – use of local RES resources,
- X_{23} – social benefits of using RES,
- X_{24} – desire to achieve the UN Sustainable Development Goals (SDGs).

The first step was to check the coefficients of variation, i.e. whether the variables selected for model construction are not quasi-constant. The analysis shows that all the coefficients of variation take values above 10%, and therefore have adequate variability. The second step is to check the correlation relationships between the dependent variable and the independent variables (table 34). The study shows that there is no relationship between the variable Y and X_5, X_6, X_{11}, X_{13}, X_{15}, X_{17}. Therefore, these variables were not included in further considerations.

Table 34. Correlation analysis between the dependent variable and a potential set of independent variables

	Variable	r_{xy}		Variable	r_{xy}
X_1	increase in revenue	0.21*	X_{13}	regulations at the local level	0.15
X_2	increase in potential	0.24**	X_{14}	downsizing	0.21*
X_3	improvement in production process	0.29***	X_{15}	protection of natural environment	0.15
X_4	increase in number of customers	0.25**	X_{16}	desire to save fossil fuels	0.25**
X_5	introduction of a new product	0.15	X_{17}	improvement of local environment	0.12
X_6	reduction of operating costs	0.16	X_{18}	desire to reduce greenhouse gas emission	0.18*
X_7	high wear and tear of fixed assets,	0.33***	X_{19}	improvement of company image	0.41***
X_8	health and safety requirements,	0.35***	X_{20}	energy independence of company	0.32***
X_9	adaptation of the company to trends	0.24**	X_{21}	increasing energy security	0.26**
X_{10}	introduction of modern technology	0.31***	X_{22}	use of local RES resources	0.26**
X_{11}	imitation of other companies' activities	0.01	X_{23}	social benefits of using RES	0.21*
X_{12}	regulations at the national level	0.08	X_{24}	desire to use SDGs	0.23**

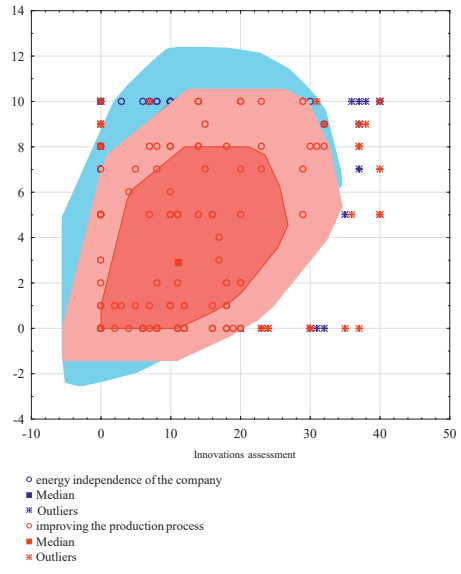
Source: Own study based on own research.

The analysis also shows that the highest correlation relationship is between variable Y (ability to absorb innovations) and:

- X_{19} – improvement of company image – 0.41,
- X_8 – health and safety requirements – 0.35,
- X_7 – high wear and tear of fixed assets – 0.33,
- X_{20} – energy independence of the company – 0.32.

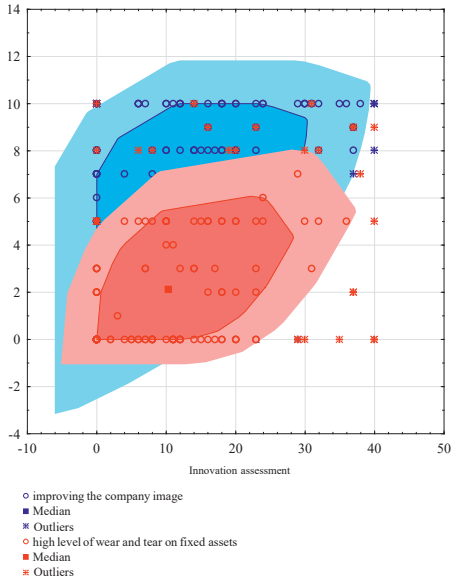
These relationships are positive and directly proportional. As X_{19}, X_8, X_7, and X_{20} increase, the innovation absorption score grows. It should be added that these are relationships only between two variables without taking into account the influence of other variables on them as is done in the econometric model. The nature of their relationship is presented in the bag charts (fig. 66 and fig. 67).

Fig. 66. The nature of the relationship between the evaluation of innovation and the evaluation of image improvement and the evaluation of high wear and tear of fixed assets



Source: Own study based on own research.

Fig. 67. The nature of the relationship between the innovation assessment and the energy independence assessment and the evaluation of the improvement of the production process



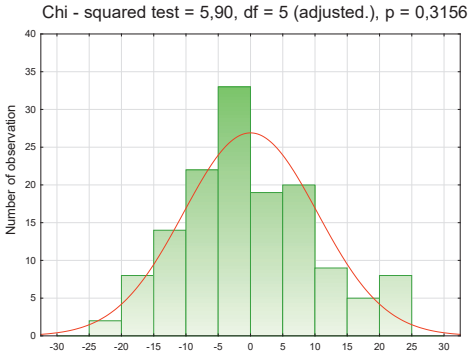
Source: Own study based on own research.

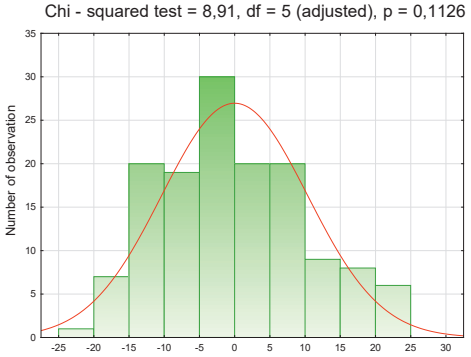
Two econometric models were constructed from the set of variables (table 35, fig. 68, fig. 69). Both the first and second fit the data at 24%. This is not the best result, but in the case of this type of variable it is satisfactory, especially since the factors that enter the model are statistically significant i.e. it

can be inferred that they are actually related and model the absorption capacity for innovation. The correctness of the model construction is also confirmed by the normal distribution of the residuals, both in the first and second models.

Table 35. Characterization and verification of model I and II

MODEL I	MODEL II
Dependent variable Y – ability to absorb innovations	
The set of independent variables I	The set of independent variables II
$X1_9$ improving the company's image X_3 improvement of the production process X_7 high wear and tear of fixed assets	X_{19} improvement of the company image X_7 high wear and tear of fixed assets X_{20} energy independence of the company
R^2 =0,24	R^2 =0,24
BSE = 10,49	BSE = 10,47
Checking the normal distribution of the residuals: H_0: the residuals of the model have a normal distribution; H_1: the residuals of the model do not have a normal distribution	
Fig. 68. Normal distribution of residuals for model I	Fig. 69. Normal distribution of residuals for model II





Source: Own study based on own research.

The variables that went into Model I have statistically significant parameters $p<\alpha$. Only the free expression is not significant $p>\alpha$ ($p=0.1714$). The coefficient of significance indicates that the most related to the propensity to innovate is the improvement of the company image ($b^*=0.31$) followed by the

improvement of the production process (b*=0.19), and the last to enter the model was the variable responsible for the high degree of consumption of fixed assets (the coefficient of significance is the smallest in this case (b*=0.17)) (table 36).

Table 36. The results of the estimation of the model parameters I

Specification	b*	Std. error from b*	b	Std. error from b	t(136)	p
constant			2.46	1.789	1.37	0.1714
company image improvement (X_{19})	0.31	0.08	0.98	0.252	3.89	0.0002***
production improvement (X_3)	0.19	0.08	0.60	0.250	2.39	0.0184*
high wear and tear of fixed assets (X_7)	0.17	0.08	0.66	0.323	2.06	0.0415

Source: Own study based on own research.

When subjecting each model to interpretation, it should be noted that the variables that went into them are related to the dependent variable, but also the independent variables influence each other, and it is this configuration that is presented that gives the best and most accurate results. By removing or adding another variable the others may become statistically insignificant because they explain the model in just such a combination.

Model I has the form:

$$Y = \underset{(0.252)}{0.98X_{19}} + \underset{(0.250)}{0.60X_3} + \underset{(0.323)}{0.66X_7}$$

Interpreting this, it can be said that: if the respondents' image improvement rating increases by one point, the innovation absorption capacity rating increases by 0.98 points, with no change in the other factors. On the other hand, if the evaluation of the improvement of the production process increases by one point, the evaluation of the ability to absorb increases by 0.60 points, with no change in the other factors. If the evaluation of high wear and tear of fixed assets increases – if it grows by a point, the evaluation of the ability to absorb innovations increases by 0 66 points, with no change in the other factors.

The variables that went into model II also have statistically significant parameters $p<\alpha$. Only the free expression is not significant $p>\alpha$ (p=0.3165). The coefficient of importance indicates that improving the company's image remains the most related to innovation (b*=0.26), followed by high wear and tear on fixed

assets (b*=0.21), and finally the company's energy independence entered the model, with a coefficient of importance (b*=0.20) (table 37).

Table 37. Results of estimation of model II parameters

Specification	b*	Std. error from b*	b	Std. error from b	t(136)	p
constant			1.877	1.861	1.01	0.3165
company image improvement (X_{19})	0.26	0.09	0.82	0.266	3.08	0.0025
high degree of wear and tear of fixed (X_7)	0.21	0.08	0.85	0.316	2.69	0.0081
company energy independence (X_20)	0.20	0.08	0.59	0.236	2.50	0.01388

Source: Own study based on own research.

Model II takes the form:

$$Y = \underset{(0.266)}{0.82X_{19}} + \underset{(0.316)}{0.85X_{7}} + \underset{(0.236)}{0.59X_{20}}$$

Interpreting model II, it can be said that: if the respondents' rating of image improvement increases by one point, the rating of innovation absorption capacity increases by 0.82 points, with no change in the other factors. If the evaluation of high wear and tear of fixed assets increases – if it grows by a point, the evaluation of the ability to absorb innovation increases by 0.85 points, without changing the other factors. On the other hand, if the company's assessment of energy independence increases by one point, the assessment of absorption capacity increases by 0.59 points, with no change in the other factors. Regression analysis showed that two factors are repeated in both models. These are: improvement of the company's image (X_{19}) and high consumption of fixed assets (X_7).

4.3.2. Factor analysis

From the input set of determinants, that is, from the 24 indicators, a factor analysis was performed to reduce the number of variables and create synthetic factors accounting for the main areas affecting innovation uptake (table 38).

Table 38. Results of factor analysis

Specification	Factor				
	1	2	3	4	5
Environmental protection	0.880	0.178	0.083	0.048	0.106
Improvement of local environment	0.849	0.067	0.056	0.019	0.086
Willingness to reduce greenhouse gas emissions	0.864	0.205	0.061	0.052	0.200
Increasing potential	0.156	0.789	0.019	0.163	0.083
Improvement of the production process	-0.051	0.809	0.092	0.164	0.150
Regulations at the national level	0.000	0.125	0.885	0.163	0.073
Regulations at the local level	0.087	0.140	0.896	0.211	0.048
High level of wear and tear on fixed assets	0.077	0.118	0.046	0.827	-0.011
Health and safety requirements	0.121	0.151	0.207	0.703	0.236
Energy independence of the company	0.274	0.147	0.090	0.055	0.850
Increased energy security	0.326	0.138	0.035	0.129	0.827
Increase in the number of customers	0.079	0.508	-0.009	0.351	0.315
Introduction of a new product	-0.103	0.356	0.130	0.506	0.169
Reduction of operating costs	0.159	0.022	-0.009	0.509	-0.367
Adaptation of the company to trends	0.497	0.098	0.286	0.506	-0.022
Introduction of modern technologies	0.480	0.168	0.348	0.417	0.094
Imitating the activities of other companies	0.318	-0.003	0.646	-0.003	0.010
Reduction of employment	-0.071	0.351	0.111	0.314	0.109
Willingness to save fossil fuels	0.625	0.199	0.212	0.135	0.275
Improvement of the company's image	0.459	0.168	0.051	0.406	0.306
Use of local RES resources	0.309	0.552	0.077	0.116	-0.008
Social benefits of using RES	0.352	0.639	-0.013	0.050	-0.075
Willingness to meet the UN Sustainable Development Goals (SDGs)	0.362	0.630	0.221	-0.053	0.103
Exit condition	**4.057**	**3.192**	**2.415**	**2.697**	**2.028**
Share	**0.176**	**0.139**	**0.105**	**0.117**	**0.088**

Source: Own study based on own research.

Based on factor analysis, the following 5 factors or areas of the company's operations that affect the ability to absorb innovation were identified: environmental improvement, capacity growth, regulation, production process improvement and energy independence.

4.3.3. Construction of the economic model – enterprise potential variant

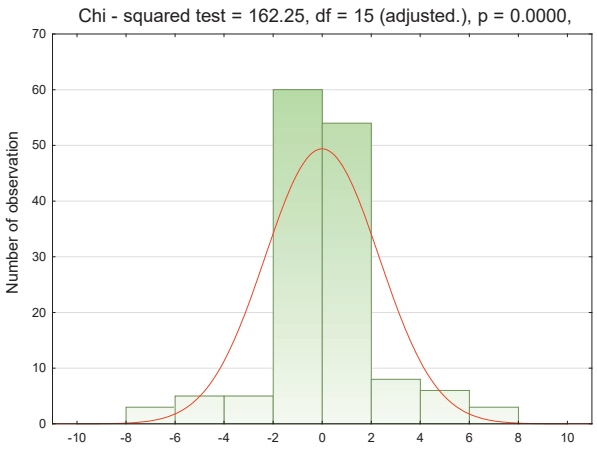
On the basis of the developed factor analysis, an econometric model was built in an alternative approach, which refers to the potential of the enterprise – both manufacturing and services. This will provide a starting point for assessing the factors that can increase this potential, and thus determine investment in RES. In the model, an increase in the potential of the enterprise was taken as the dependent variable Y, while the independent variables were the synthetic indicators in the five groups identified in the factor analysis, with the proviso that in the second group "potential" there will be only one factor (i.e. improvement of production processes), which causes the group to be renamed "processes".

The resulting model has a 63% fit to the data, which should be considered a very good fit and explanatory power of the model. The correctness of the model construction is also confirmed by the normal distribution of the residuals (table 39, fig. 70).

Table 39. Characteristics and verification of the model in the variant of the enterprise potential

MODEL in the variant of the enterprise potential	
Dependent variable Y – growth of the company's potential	
A set of independent variables (synthetic indicators):	
Environment (Z_1) X_{15} protection of the environment X_{17} improving the environment in the neighborhood X_{18} desire to reduce greenhouse gas emissions ***Law*** (Z_3) X_{12} regulations at the national level X_{13} regulations at the local level	***Processes*** (Z_2) X_3 production process improvement ***Technology*** (Z_4) X_7 high degree of wear and tear of fixed assets X_8 health and safety requirements ***Energy independence*** (Z_5) X_{20} company energy independence X_{21} increase of energy security
R^2 =0.63	
BSE = 3.66	
Checking the normal distribution of the residuals: H_0: the residuals of the model have a normal distribution; H_1: the residuals of the model do not have a normal distribution	

Fig. 70. Normal distribution of the residuals for the model in the variant of the enterprise potential



Source: Own study based on own research.

The variables that entered the model in the enterprise potential variant are statistically significant ($p<\alpha$). Only the free expression is not significant ($p>\alpha$, p=0.0637). The coefficient of significance indicates that the variable processes (b*=0.74) is most related to the enterprise potential, followed by the variable environment (b*=0.20) (table 40).

Table 40. Results of estimation of model parameters in the variant of enterprise potential

Specification	b*	Std. Error from b*	b	Std. Error from b	t(137)	p
Constant			-0.92	0.496	-1.86	0.0637
processes	0.74	0.05	0.73	0.051	14.31	0.0000***
environment	0.20	0.05	0.07	0.019	3.86	0.0001***

Source: Own study based on own research.

The model referred to above is in the form:

$$Y = \underset{(0.051)}{0.73Z_2} + \underset{(0.019)}{0.07Z_1}$$

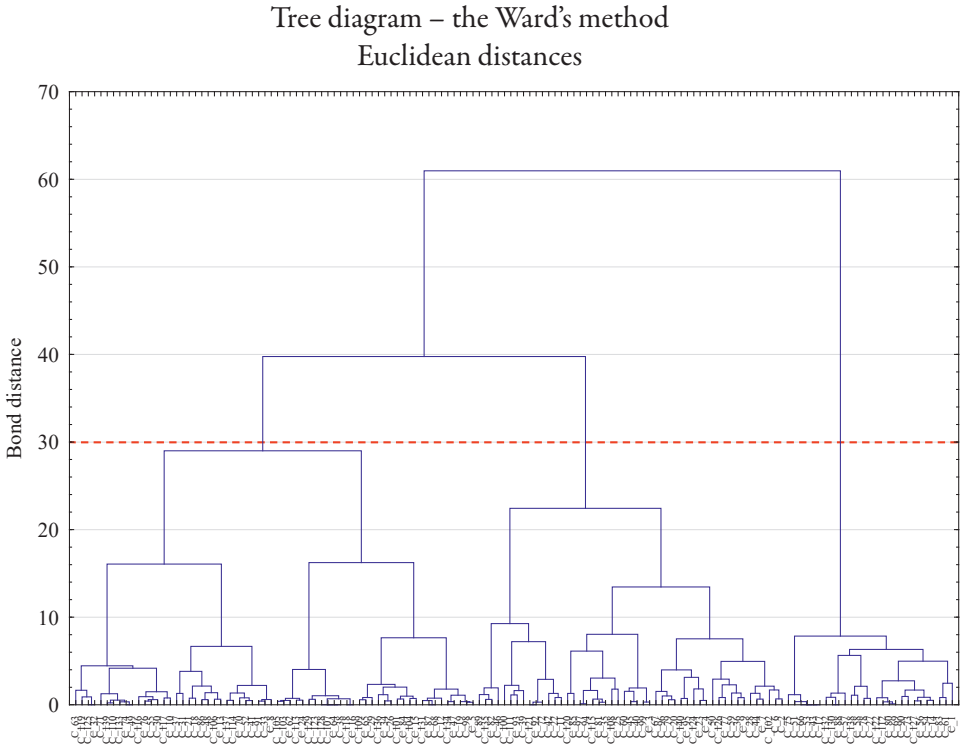
Interpreting the model, it can be said that: if the production processes (Z_2) of the enterprise improve by one point then the potential of the enterprise increases by 0.73 points, with no change in the other factors. In the

case of an increase in environmental aspects (Z_1), if it grows by a point then the company's potential score increases by 0.07 points, with no change in the other factors.

4.3.4. Cluster analysis

Cluster analysis was carried out to separate groups of entities using RES technology and similar to each other in terms of assessing the resulting determinants. This analysis yielded results to divide the surveyed entities into three different groups (fig. 71).

Fig. 71. Tree diagram – results of cluster analysis



Source: Own study based on own research.

The first group included 27 entities (19%), the second group included 49 entities (35%), and the third one included 64 entities (46%), so it was the most numerous. Based on the affiliation of the entities in question to the three

groups, they were subject to characterization by type of activity and RES facilities owned.

Group 1 is dominated by food facilities, in particular restaurants and other fixed catering establishments. The largest number of entities there were those that lease or rent the premises, as well as those where solar panels were most often installed (this group includes a facility with a wind turbine).

Group 2 is dominated by facilities engaged in accommodation, primarily hotels and similar accommodations. The largest number of companies there were those that installed photovoltaic panels, heat pumps and use biomass.

Group 3 is dominated by mixed facilities, in particular, there is a lot of tourist accommodation and short-term accommodation, as well as restaurants and other permanent catering establishments. These are predominantly the smallest enterprises employing up to 9 people. This group has the largest percentage of establishment owners. There is a geothermal investment, but there are also a lot of installed heat pumps, photovoltaic panels and solar panels.

4.3.5. Differences and relationships analysis

The next stage of the conducted analysis was to check if and how the different groups of entities identified in the cluster analysis differ in their perception and evaluation of the RES development determinants created in the factor analysis. For this, the Kruskal-Wallis ANOVA test was used (table 41).

Table 41. Results of Kruskal-Wallis ANOVA test

Factors	p-value
Environment	0.0000***
Potential	0.0001***
Law	0.0000***
Technology	0.0000***
Energy independence	0.0000***
Ability to absorb innovation	0.0186*

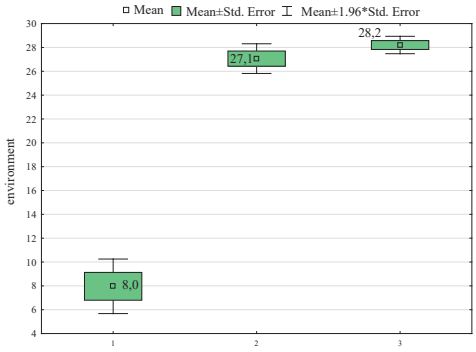
Source: Own study based on own research.

The study shows that there are statistically significant differences in the evaluation of individual factors (determinants) by the resulting groups of facilities operating in the tourism industry using RES installations. In each case $p<\alpha$. The environmental factor is rated the highest by the facilities gathered in

group three, slightly less important for group two, and rated lowest by group one (fig. 72).

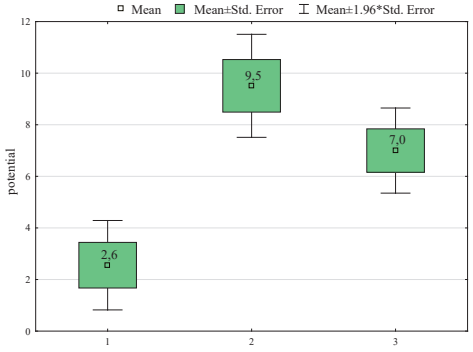
The potential factor turned out to be the most important for facilities located in group 2, slightly less important for group 3, and the least important attributed to them by group 1 (fig. 73).

Fig. 72. Evaluation of the environmental factor by group



Source: Own study based on own research.

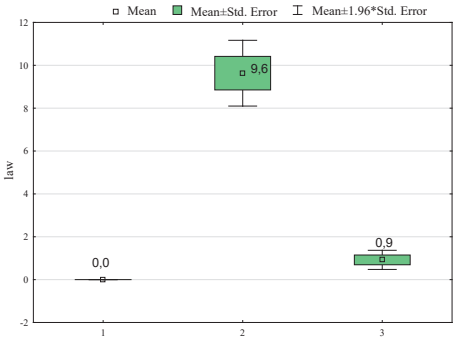
Fig. 73. Evaluation of the potential factor by group



Source: Own study based on own research.

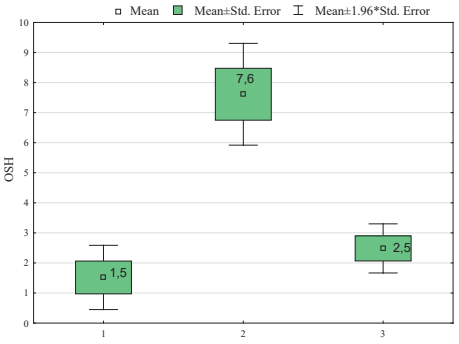
For facilities in group 2, the legal environment is of the greatest importance, slightly less weight is given to regulations by facilities in Group 3, and it is considered the least important by facilities in Group 1. A similar situation occurred when assessing the factor responsible for technology and OSH (fig. 74, fig. 75).

Fig. 74. Evaluation of the legal factor by group



Source: Own study based on own research.

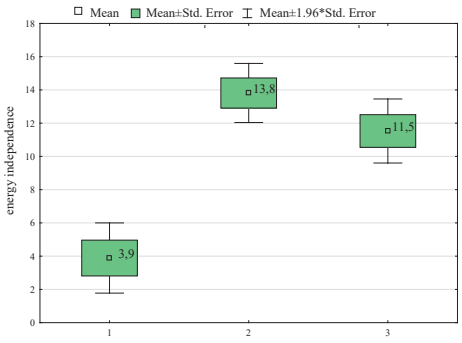
Fig. 75. Evaluation of technology + H&S factor by group



Source: Own study based on own research.

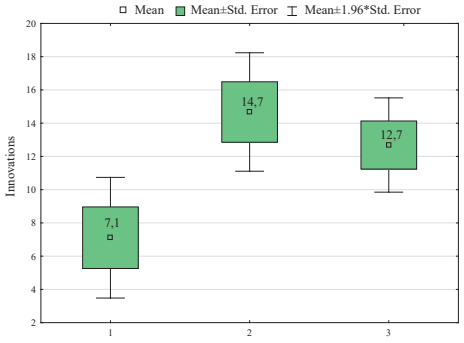
Energy independence is valued the most by facilities in group 2, and they are also the most focused on absorbing innovations. Slightly less importance is given to these factors by facilities in group 3, and the least importance is given to group 1. It, too, is the least focused on absorbing innovations (fig. 76, fig. 77).

Fig. 76. Evaluation of the energy independence factor by group



Source: Own study based on own research.

Fig. 77. Evaluation of the innovation factor by group



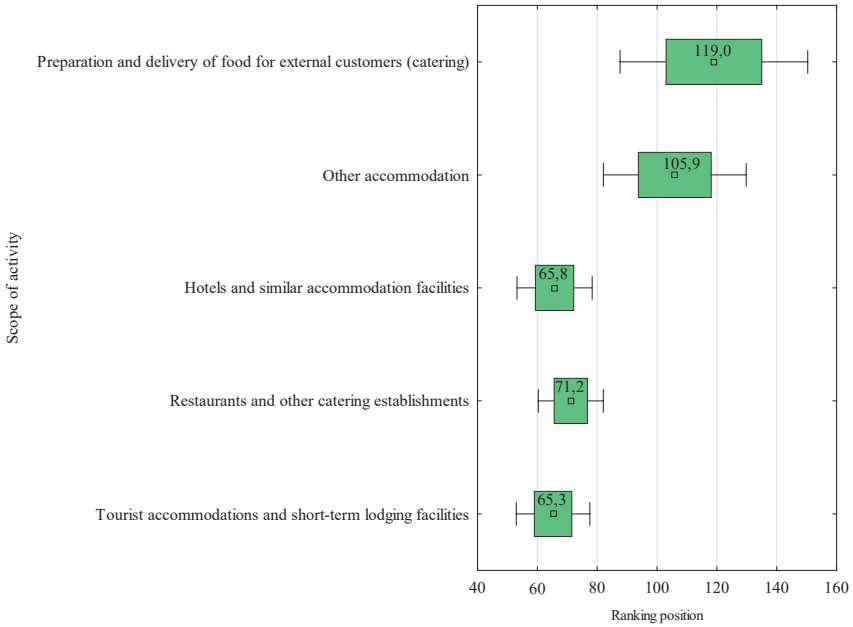
Source: Own study based on own research.

4.3.6. Synthetic innovation index

The final element of the analysis conducted was the construction of a synthetic innovation index. To construct it, the ranked values of variables relating to: (1) the amount of investment; (2) innovation, and (3) the effects obtained through investment were applied. The ranking assessed the studied facilities from the best in terms of innovation potential to the worst. The higher the ranking, the better the situation in terms of innovation potential (fig.78).

Enterprises engaged in traditional tourism-related activities (i.e. hotels and similar accommodations; tourist accommodations and short-stay accommodation, restaurants and other fixed catering establishments) were characterized by a higher value of the innovation potential indicator than enterprises engaged in so-called tourism-related activities (i.e. other accommodation; preparation and provision of food for external customers – catering). The difference between the value of synthetic indicators in the two groups was statistically significant and the Kruskal-Wallis ANOVA test was used to check ($p<\alpha$; p=0.0365).

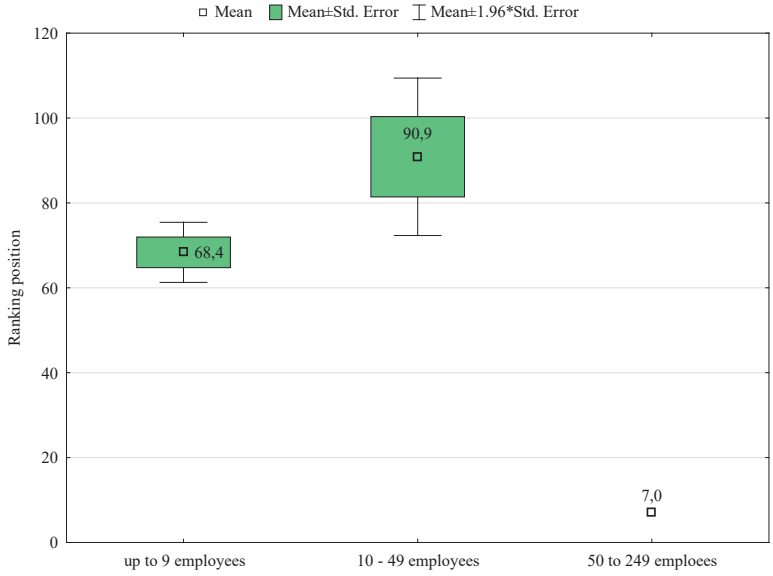
Fig. 78. Ranking of the innovative potential of the tourism economy in terms of the scope of conducted activity



Source: Own study based on own research.

Similarly, in the case of entity size, significant differences in the value of innovation potential were noticeable. The value of the synthetic index of innovation potential was the highest among medium-sized companies (from 50–249 employees). Its lowest value was recorded among small entities (from 10 to 49 employees). This was due to the fact that small enterprises were able to apply for lower investment funding than medium-sized ones. Among the latter, the average amount of investment was more than PLN 89 thousand, while among small ones, there was only slightly more than PLN 24 thousand. (fig. 79).

Fig. 79. Ranking of the innovative potential of the tourism economy by the size of its operations



Source: Own study based on own research.

The differences between the value of the synthetic index of innovation potential were statistically significant and the Kruskal-Wallis ANOVA test was used to check ($p<\alpha$; p=0.0329).

4.4. Verification of accepted research hypotheses

The results of the statistical analysis of the data obtained during the study made it possible to verify the adopted research hypotheses. In this study, the following main research assumption was made: *in contrast to the low level of innovation in the tourism economy, the capacity to absorb innovations in the field of RES and related investment demand is constantly increasing, mainly due to the dependence on local resources and the existence of heterogeneous inter-entity relations*.

Three specific hypotheses were formulated and successfully verified.

H_1: The determinants of RES investment in the tourism economy are endo – and exogenous in nature, with exogenous determinants, especially regulatory factors, playing a dominant role.

Two alternative approaches were used to verify hypothesis H_1:

- from the side of innovation,
- from the side of enterprise potential.

In the first approach, it was assumed that the ability to invest in RES is a manifestation of investment of an innovative nature. Since the research indicated the extent of the impact of RES investment on the innovativeness of the enterprise itself, this synthetic variable was used to analyze the factors influencing investment. The correlation analysis between this variable and the determinants of investment showed that six of them could be potential stimulants of investment in RES innovation. These factors were as follows:

- improvement of the production process,
- high wear and tear of fixed assets,
- health and safety requirements,
- improvement of the company image,
- energy independence of the company.

The aforementioned factors are endogenous (in addition to OSH requirements). This alone suggested that the results of the analysis would not support the accepted research hypothesis. In addition, in both econometric models built using these correlated variables, the variables of endogenous nature proved to be key. In the first model, these were:

- X_{19} – improvement of the company's image,
- X_3 – improvement of the production process,
- X_7 – high consumption of fixed assets.

In model two, these were:

- X_{19} – improvement of the company's image,
- X_7 – high degree of consumption of fixed assets,
- X_{20} – energy independence of the company.

Thus, in the first analytical approach, it was not possible to confirm the adopted research hypothesis about the exogenous nature of RES investment determinants.

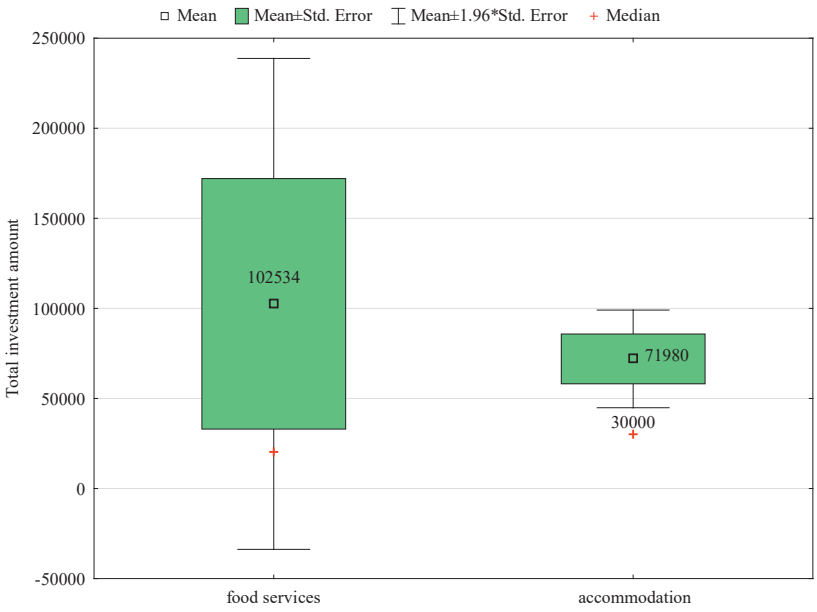
The second approach used synthetic variables developed from the factor groups shown in the factor analysis. An econometric model was built where the dependent variable was the potential of the enterprise (production or service). From the results of the regression analysis it was concluded that the variables that significantly influence and explain changes in the potential of an enterprise were the factors in the process group and the environment. The model and this variant did not include factors from the law group, which included regulations at both the local and national levels. Thus, in the adopted research hypothesis, only one of the components was confirmed – the influence of exogenous

factors, but only in the form of environmental factors. Regulatory factors did not play a significant role in determining the investment potential in RES in the tourism sector. Therefore, it should be considered that the research hypothesis was confirmed only partially, with the emphasis on environmental factors.

H_2: The degree to which the ability to absorb innovations influences capital allocation decisions in the tourism economy varies and depends mainly on the size of the entity and the type of business.

Innovation absorption in RES is considered as the ability to create and realize innovative investments. Information on the amounts of individual investments made in renewable energy sources was used to verify this hypothesis. Starting from the total, it should be pointed out that only 140 surveyed entrepreneurs implemented RES solutions in their business, and in this group the hypothesis was verified. However, there were slightly more investments, as several entrepreneurs invested in more than one RES technology. The total investment amount was, therefore, counted for the 143 investments given by the respondents. The median value in both types of business is at a similar level, amounting to PLN 20 thousand. in the case of catering and PLN 30 thousand. for accommodation (table 42, fig. 80).

Fig. 80. Amount of investment by type of activity



Source: Own study based on own research.

Table 42. Basic descriptive statistics for the amount of investment by type of activity

Specification	N	Mean	Me	Min.	Max.	σ	V_z
Food services	50	102 534	20 000	2000	3 500 000	491 651	479%
Accommodation	93	71 979	30 000	1700	1 000 000	133 438	185%
Total	143	82 662	25 000	1700	3 500 000	308 481	373%

Source: Own study based on own research.

When analyzing the differences in investment expenditures in the two types of activities (food services, accommodation), the Mann-Whitney U test was used. Its results showed that there was no significant difference in the amount spent on investment between food services and accommodation activities ($p>\alpha$, $p = 0.1299$). The second factor analyzed was the size of the business, measured by the number of people employed in it (table 43, fig. 81).

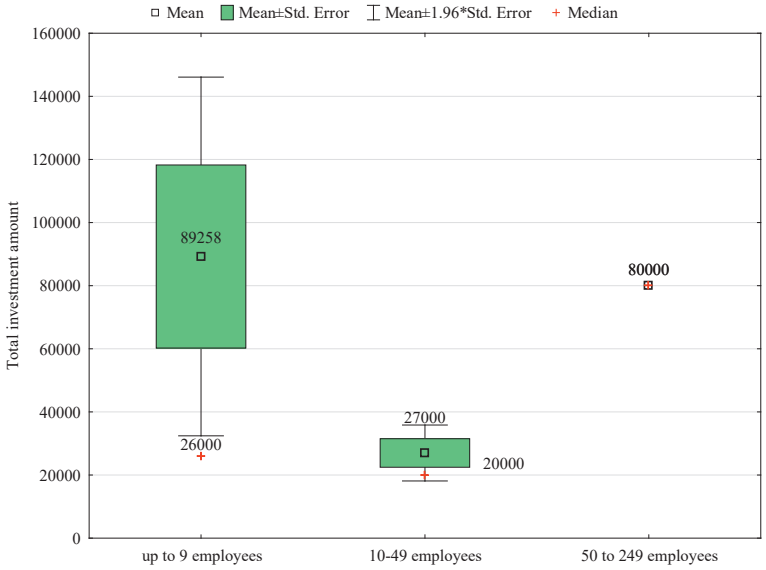
Table 43. Basic descriptive statistics for the amount of investment by company size

Specification	N	Mean	Me	min	max	σ	V_z
Up to 9 employees	127	89 258	26 000	1700	3 500 000	326 799	366%
10–49	15	27 000	20 000	10 000	70 000	17 505	65%
50–249	1	80 000	80 000	80 000	80 000	–	–

Source: Own study based on own research.

The average amount of investment in microenterprises in the survey was PLN 89 thousand, while the median was PLN 26 thousand. Both of these values were higher than for small companies, where the average investment amount was PLN 27 thousand, while the median was PLN 20 thousand. Due to the fact that there was only one entity in the group of medium-sized companies, both the mean and median were the investment values of PLN 80 thousand. The coefficient of variation indicates a very significant variation in the total amount of investment in microenterprises (366%) while in small ones there is no such large variation.

Fig. 81. Investment amount by company size – mean, standard error and median



Source: Own study based on own research.

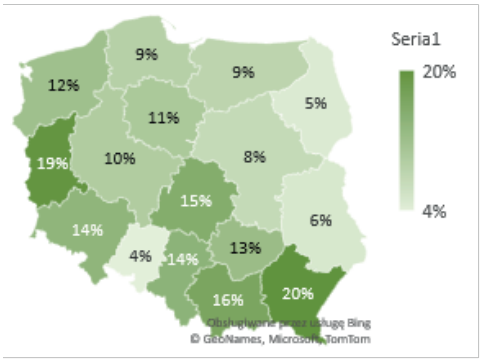
When analyzing the differences in investment expenditures by company size, the Kruskal-Wallis ANOVA test was used. Its results showed that the differences in the amount spent on investment between different sizes of companies were not statistically significant ($p<\alpha$, $p = 0.2821$). So, there are no significant differences in the level of the total amount of investment by company size. Based on the results obtained, it can be pointed out that the assumptions made in the second detailed research hypothesis are not confirmed. It is possible to see some differences in the average level of investment, but they are not statistically significant. However, it is also possible to read that micro enterprises invested the most and medium enterprises invested the least. This is not a positive relationship in the surveyed group. It was the micro entities that invested more than the small ones. This was related to the funding obtained. The calculations show that the smallest entities (micro) received subsidies for investment in solar panels alone in the amount of PLN 878 thousand, while small companies for the same purpose subsidized investments in the amount of only PLN 85 thousand. It is worth noting, however, that most investments were not subsidized at all.

H_3: The diffusion of RES innovations is determined by the open nature of the tourism economy on the one hand, and is subject to spatial concentration on the other.

Two analytical approaches were used to verify hypothesis H_3. The first analyzed differences in the value of the amount of investment by province. The results of the Kruskal-Wallis ANOVA test showed that there were no statistically significant differences in the amount of investment due to the location of companies ($p > \alpha$, $p = 0.9576$). Similarly, the value of the synthetic innovation index was also not statistically significantly different due to provinces ($p>\alpha$, $p = 0.1510$).

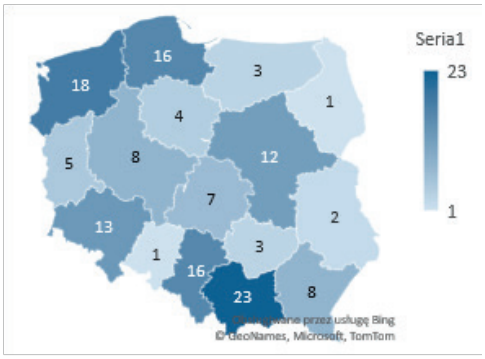
The second approach compared two parameters: the percentage of companies investing in RES and the synthetic innovation evaluation index (fig. 82, fig. 83, fig. 84).

Fig. 82. Percentage of enterprises using RES



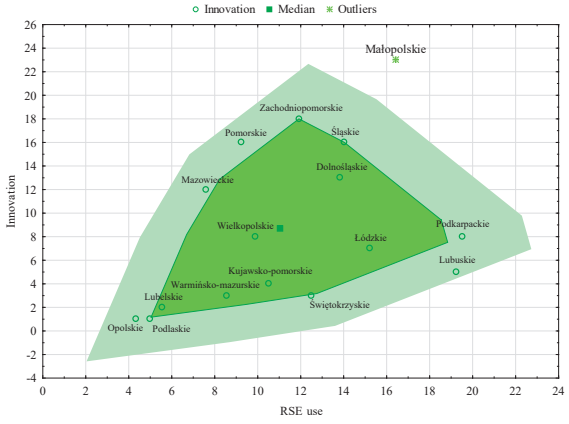
Source: Own study based on own research.

Fig. 83. Value of the synthetic innovation index



Source: Own study based on own research.

Fig. 84. RES use vs. innovation by province

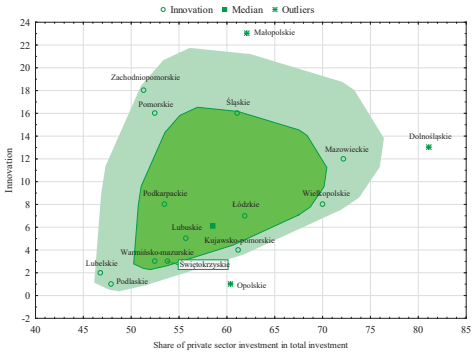


Source: Own study based on own research.

The value of Spearman's rank correlation coefficient was moderate (r=0.53) and proved statistically significant ($p<\alpha$, p=0.0361). Thus, it can be concluded that the percentage of RES users in the provinces is related to the level of innovation index. The relationship is positive, so the higher the percentage of entities using RES, the higher the innovation index. A total of four pairs of variables were compared: (1) the percentage of businesses investing in RES; (2) the synthetic innovation evaluation index with (3) the share of private sector investment in total investment, and (4) the gross value of fixed assets in the national economy in accommodation and food service.

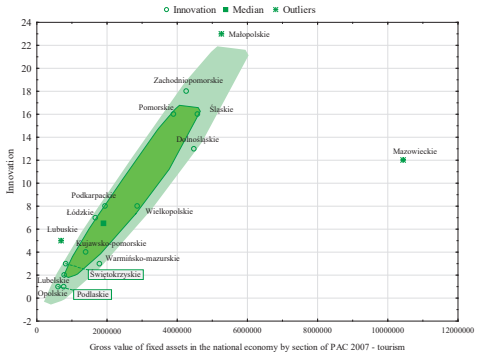
The second research approach juxtaposed both variables (i.e., innovation and RES use) with the data from public statistics. For this purpose, the previously presented figures relating to: (1) the share of private sector investment in total investment, and (2) the gross value of fixed assets in the national economy in accommodation and food service. In this way, four pairs of comparisons[7] were obtained (fig. 85, fig. 86).

Fig. 85. Share of private sector investment vs. innovation by province



Source: Own study based on own research.

Fig. 86. Gross value of fixed capital expenditures in 2020 vs. innovation by province



Source: Own study based on own research.

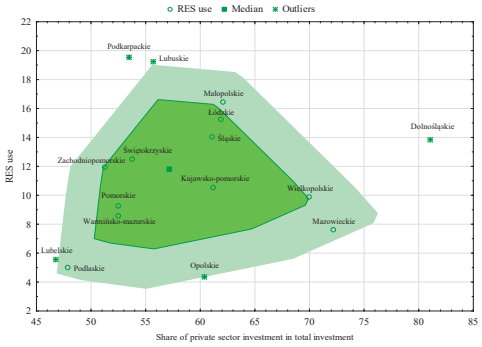
The share of private sector investment in total investment was lowly correlated with the surveyed entrepreneurs' assessment of innovation. The value of the Spearman's rank correlation coefficient turned out to be low and not statistically significant (r = 0.38) $p>\alpha$, (p=0.1456). In contrast to this pair of variables, the gross value of fixed assets in accommodation and food services turned out

[7] The first pair of variables is: private sector investment and innovation; the second is: gross fixed capital formation and innovation; the third is: RES use and private sector investment; the fourth is: RES use and gross fixed capital formation.

to be positively correlated with innovation. Spearman's rank correlation coefficient was $r = 0.87$ and it was statistically significant $p<\alpha$ (p=0.0000).

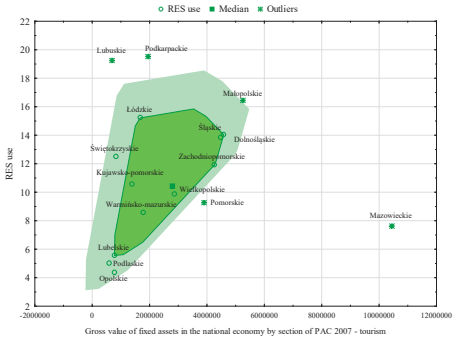
The second variable, the percentage of enterprises using RES, was related to the share of private sector investment in total investment. In this case, there was a weak positive correlation between the variables ($r = 0.30$), which turned out to be statistically insignificant ($p>\alpha$, p=0.2561). No correlation relationship was found between the percentage of companies using RES and the gross value of fixed assets in accommodation and food services. The value of Spearman's rank correlation coefficient was only 0.27 and was statistically insignificant ($p>\alpha$, p=0.3053) (fig. 87, fig. 88).

Fig. 87. RES use vs. share of capital expenditures



Source: Own study based on own research.

Fig. 88. RES use vs. gross value of fixed capital expenditures by province

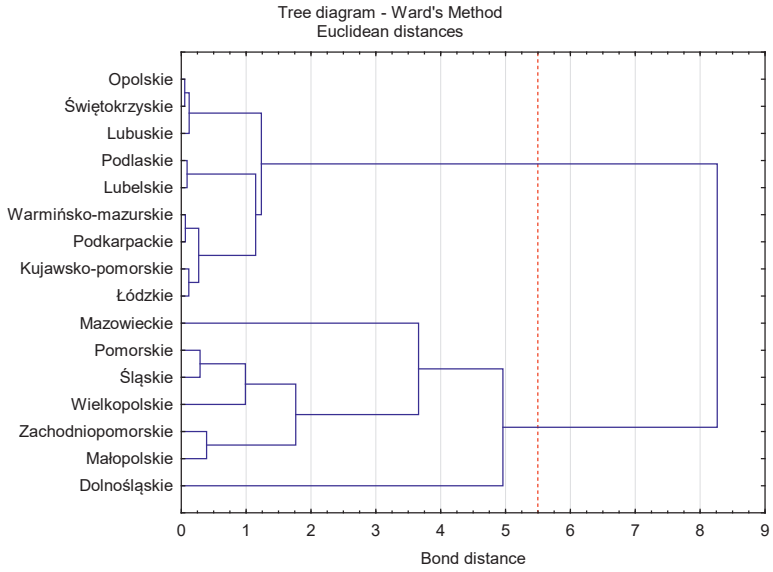


Source: Own study based on own research.

In order to test whether there is spatial concentration of investment in RES, two characteristics were selected to determine the amount of investment in RES by province and the gross value of fixed assets in the national economy by section of the PAC in tourism. A cluster analysis was carried out for the selected variables to reveal whether there is spatial concentration of investments in RES.

The results of the analysis are shown in a tree diagram (fig. 89). The provinces were divided into two groups. The first included the following provinces: Dolnośląskie, Małopolskie, Zachodniopomorskie, Wielkopolskie, Śląskie, Pomorskie i Mazowieckie. The second group included the following provinces: Łódzkie, Kujawsko-Pomorskie, Podkarpackie, Warmińsko-mazurskie, Lubelskie, Podlaskie, Lubuskie, Świętokrzyskie and Opolskie.

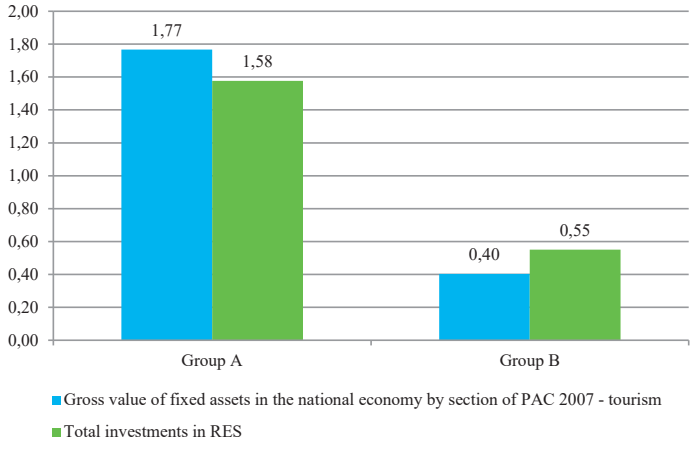
Fig. 89. Results of provinces grouping by RES investments



Source: Own study based on own research.

Using means of group data it was checked how the level of investment volume in RES is distributed by province and the gross value of fixed assets in the national economy by section of the PAC in tourism (fig. 90).

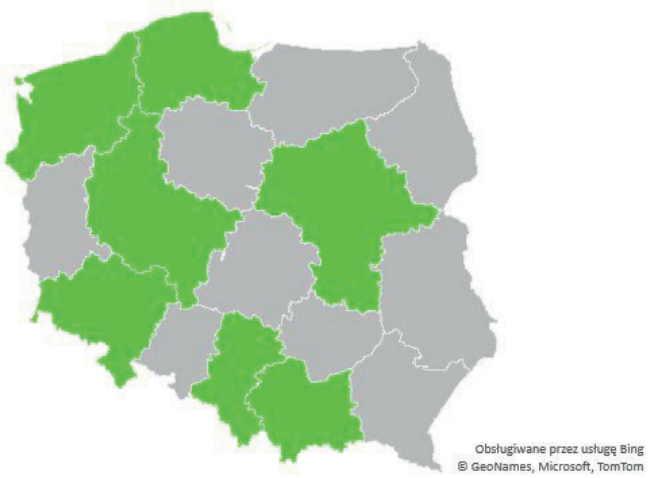
Fig. 90. Results of group averages for the adopted characteristics in the separated clusters



Source: Own study based on own research.

The analysis shows that definitely higher values of the index of group averages occurred in cluster A. There, a higher concentration of both the gross value of fixed assets in the national economy by section of PAC 2007 in tourism, as well as a higher level of the index of total investments in RES were revealed. The map (fig. 91) vividly shows the concentration of resources that are invested in RES, and it is clear that they are concentrated in the western and southern provinces. The worst performing provinces are those of the eastern wall.

Fig. 91. Results of grouping provinces in terms of allocation of funds for RES in tourism



Source: Own study based on own research.

Based on these data and the results of their analysis, it can be indicated that the third specific hypothesis was confirmed, as the evaluation of innovation perceived by the surveyed entities was related to the investment expenditures incurred by companies in the tourism industry. Spatial arrangement – as the second component of the hypothesis analyzed – proved to significantly differentiate provinces in terms of resource allocation and investment in RES.

4.5. Key research findings

The research carried out for the study was aimed at identifying and classifying the determinants of the ability to absorb RES innovations by tourism economy entities. The main research problem was formulated in the form of the following question: what is the capacity of the tourism economy to absorb RES

innovations, and what are the determinants of this capacity and related investment demand? In proceeding with the study, the following research questions and, corresponding hypotheses were also developed, which were:

1. The determinants of RES investment in the tourism economy are endo – and exogenous in nature, with exogenous determinants, especially regulatory factors playing a dominant role.
2. The degree to which the ability to absorb innovations influences capital allocation decisions in the tourism economy varies and depends mainly on the size of the entity and the type of business.
3. The diffusion of RES innovations is determined by the open nature of the tourism economy on the one hand, and is subject to spatial concentration on the other.

To achieve the purpose of the study, verification of hypotheses required the use of a number of research methods and tools, including regression analysis, factor analysis, cluster analysis, statistical tests (Chi^2 test of independence, Mann-Whitney U test, Kruskal-Wallis ANOVA test).

The research, which the study was based on, was carried out in cooperation with a professional research company on a random sample of 1,200 entities operating in the tourism industry, in section I of the PAC (sections 55 and 56). Thus, the surveyed group in the course of data analysis was divided into two categories – the first being establishments operating in tourist accommodation and food establishments. A random stratified sampling was applied by location (provinces) and the type of business.

In the surveyed group of facilities operating in the tourism industry, only 12% used and invested in renewable energy sources. In terms of heat and cooling acquisition, solar panels and heat pumps were used most often. In terms of obtaining electricity, the surveyed facilities primarily used photovoltaic panels. These were applied by all accommodation businesses. Facilities engaged in catering 92% used photovoltaic panels, one used a wind turbine. Few of the surveyed facilities used subsidized RES investments – it was only 21%. The most common were EU grants and funds from banks.

The most important factors influencing the decision to invest in RES were: the desire to reduce greenhouse gas emissions, environmental protection and the need to save fossil fuels. The following were most often indicated as the most significant barriers to investment in RES: difficulties in obtaining sources of financing, complicated administrative and legal procedures at the permit stage, or low availability of contractors for installation work.

The questionnaire applied in the study also included questions that were asked only to respondents who do not use RES technology, and thus do not

make investments in their companies in this regard. The questions of why they are not undertaking investment activity in this pro-environmental and rapidly growing market were considered important (from the point of view of the purpose of the study). The surveyed non-renewables hardly used renewable energy sources, most often natural gas, coal and electricity. When asked about possible barriers that discourage investment in renewable energy sources, they most often pointed to: high level of necessary investment, lack of adequate support systems for these investments, and lack of own financial resources. Respondents who do not use RES were asked whether they intend to invest in this type of technology in the future within the next 3 years. Only 32% of them declared such an intention. As a form of investment, photovoltaic panels and solar panels were by far the most frequently mentioned.

The factors that would influence the decision to invest in RES, according to them, are: tax incentives, reduced payback period, and reduced investment costs.

The purpose of the research was to identify and classify the determinants of the ability to absorb RES innovations, so a synthetic variable was created to study it, which consisted of four variables responsible for determining the relationship of product innovation, organizational process innovation and marketing innovation to the implementation of RES technology. It was adopted as the dependent variable Y. As a set of potential independent variables for the construction of the econometric model, 24 indicators related to investment decision-making in the company were adopted. As a result of the analysis, it can be concluded that the highest correlation relationship occurred between the ability to absorb innovations and: improvement of the company's image, health and safety requirements, and high consumption of fixed assets and energy independence of the company. These relationships turned out to be positive and directly proportional. On the other hand, based on factor analysis, 5 factors were identified as those influencing the ability to absorb innovations: environmental improvement, capacity growth, regulations, production process improvement, and energy independence.

On the basis of the developed factor analysis, an econometric model was built in an alternative approach, which refers to the potential of the enterprise – both production and service. This was the starting point for assessing the factors that could increase this potential and, consequently, determine investment in RES. In this model, the dependent variable Y was taken as the growth of the enterprise's potential, while the independent variables were synthetic indicators in five groups. On the basis of factor analysis, the following five factors or areas of the enterprise's activity were identified as influencing the ability to

absorb innovations: environmental improvement, potential growth, regulation, production process improvement and energy independence.

For the purpose of the study, a cluster analysis was also carried out to identify groups of entities using RES technology and similar to each other in terms of the evaluation of the resulting determinants. The analysis resulted in 3 groups of objects. The first – was dominated by companies engaged in food services, where solar panels were most often installed. The second group was dominated by accommodation facilities, which installed photovoltaic panels, heat pumps and the biomass use. The third group was dominated by mixed facilities. Here there was geothermal investment, but there were also a lot of installed heat pumps, photovoltaic panels and solar panels.

A very important aspect of the analysis conducted was the construction of a synthetic innovation index. In order to do it, the ranked values of variables relating to: (1) the size of investment; (2) innovation, (3) the effects obtained through investment were used. The ranking assessed the surveyed facilities from the best in terms of innovation potential to the worst. Enterprises engaged in traditional tourism-related activities were characterized by a higher value of the innovation potential index than those engaged in so-called "tourism-related" activities. Similarly, in the case of enterprise size, significant differences in the value of innovation potential were noticeable. The value of the synthetic index of innovation potential was the highest among medium-sized companies. Its lowest value was recorded among small entities. This is related to the fact that small enterprises were able to apply for lower investment funding than micro enterprises.

The results of the statistical analysis of the data obtained during the study made it possible to verify the adopted research hypotheses. The first of these was partially confirmed. Two approaches were used for this purpose. The first one, of an analytical nature, failed to confirm the hypothesis on the exogenous nature of the determinants of RES investments. The second approach used synthetic variables developed on the basis of the groups of factors shown in the factor analysis. An econometric model was built, in which the dependent variable was enterprise potential. From the results of the regression analysis it was concluded that the variables that significantly influence and explain changes in enterprise potential were the factors in the process group and the environment. The model and this variant did not include factors from the law group, which included regulations at both the local and national levels. Thus, in the adopted research hypothesis, only one of the components was confirmed – the influence of exogenous factors, but only in the form of environmental factors.

Regulatory factors did not play a significant role in determining the investment potential in RES in the tourism sector.

The assumptions made in the second detailed research hypothesis were not confirmed. Some differences in the average level of investment can be noted, but they are not statistically significant, and it is also possible to conclude that microenterprises invested the most and medium-sized ones the least. This is not a positive relationship in the studied group. These were the micro entities that invested more than the small ones. This was related to the funding obtained.

Two analytical approaches were used to verify the third hypothesis. The first one analyzed the differences in the value of the amount of investment by province. In the second one two parameters were compared: the percentage of enterprises investing in RES and the synthetic index of innovation evaluation. The third research hypothesis was confirmed, as the evaluation of innovation perceived by the surveyed entities was related to their investment expenditures. Spatial arrangement – as the second component of the hypothesis analyzed – proved to significantly differentiate provinces in terms of resource allocation and investment in RES in tourism companies.

CONCLUSIONS

Renewable energy sources have enormous development potential. They are an essential element of socio-economic strategies based on sustainable development. Their use allows achieving economic and social benefits with the lowest possible impact on the environment. This is due to the depletion of non-renewable energy carriers and the need to supplement and in the future replace them with other available renewable sources.

The use of RES may become a necessity in the future. Regardless of the industry, they should, therefore, be the primary energy carrier for the reason that they are not only non-depleting (since they come from naturally complementary, repetitive, natural processes[1]), but also do not emit harmful substances into the atmosphere, especially carbon dioxide responsible for the greenhouse effect. Modern societies should promote a green approach to life, and modern economies should be based on renewable energy sources.

The issue of innovation and investment made in the sphere of renewable energy sources in the tourism economy is an area that requires a lot of research and analysis. The work in question is in line with the demand for analyses conducted in this area and is part of bridging the cognitive gap in the area of investment and innovation, in particular, learning about the capacity of the Polish tourism economy to absorb innovations in the field of RES, as well as identifying the determinants of this capacity and related investment demand. The research problem posed in the paper was solved by analyzing data from public statistics and conducting nationwide surveys on a representative sample of 1,200 enterprises belonging to the narrowly defined tourism industry, and including entities operating in Section I of the Polish Classification of Activities (PAC) (divisions 55 and 56). It is worth noting that primary research in the scopes presented in the paper has not yet been conducted on such a scale.

The analysis of the results made it possible to obtain answers to three specific questions, and thus to verify the three research hypotheses, as presented

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[1] T. Zalega, *Wykorzystanie odnawialnych źródeł energii w gospodarstwach domowych seniorów w Polsce w świetle wyników badań własnych*, [w:] *Rola odnawialnych źródeł energii w rozwoju społeczno-ekonomicznym kraju i regionu*, pod red. A.Z. Nowaka, M. Szałańskiego, W. Zborowskiej, Wydaw. Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego, Warszawa 2016, s. 50.

in the fourth chapter. The work in question is one of the first detailed studies indicating not only the current status in terms of investment and use of renewable energy sources by entities belonging to the tourism industry in Poland, but also a proposal to support key elements that can promote the growth of RES use in this part of the economy in the future. In this regard, the use of and investment in RES is primarily influenced by processes taking place within companies, including those involving improving the production process or increasing the energy independence of companies. It is important to mention the high environmental awareness of those who have invested in RES. In addition to the classical motives for making investment decisions, pro-environmental factors proved to be important. It is very thought-provoking that entities that have invested in RES only use 28% fossil fuels as their other energy carriers – in comparison, the percentage of companies that do not use RES is as high as 42% fossil fuels. Similar trends were shown in the use of a variety of environmentally friendly solutions in the two groups. The difference in leaving a so-called "carbon footprint" here is obvious, but it has not been demonstrated to this extent until now.

The assumed influence of external factors, i.e. those imposed on entities, did not turn out to be significant. In this regard, it is worth promoting attitudes that favor the greening of processes so that entities operating in this industry independently want to make an effort to implement RES in their operations. It is worth noting that shortening the payback period, reducing the level of capital expenditures, the use of tax incentives and improving support systems for RES in Poland were cited as important prerequisites for investment decisions in the future. In addition, the regional nature of the distribution of investment and innovation in RES was noted, largely correlated with the processes of development of the tourism economy of individual provinces in Poland. A broader investment climate, whether it is an orientation towards innovation or an orientation towards improving business operations, may be those factors that favor investment in RES technologies and their increasingly widespread use in business.

The tourism industry is currently facing a wide variety of challenges. The time after the COVID-19 pandemic and the need to make up for the losses caused by it, the challenges posed by climate change, the impact of which is increasingly being felt, or the problems posed by the need to secure access to cheap and efficient energy sources in the face of the energy crisis are just some of the challenges facing this sector of the economy. Due to its vulnerability and heavy dependence on the decisions of individual customers, it will have to take measures to reduce their negative impact on its business. Any support,

and even more so one that allows not only the implementation of savings, but also a competitive advantage, will result in the strengthening of individual entities and the sector as a whole. Support and facilitation of the implementation of cost-effective and competitive renewable energy technologies will increase independence and energy security.

Therefore, it is extremely important that the analysis of investment processes and the diagnosis of the absorption of innovations in the tourism economy in the field of renewable energy sources be undertaken on a continuous basis. The present study is, therefore, the first step towards achieving this goal. The subject matter undertaken in this work is so extensive, complex and multithreaded that it is almost impossible to exhaust it in a single study. It is hoped, however, that it will provide a basis for further inquiry, reflection, discussion and polemics on the matter, from which in today's world one cannot escape.

REFERENCES

Adamowicz M., *Zielona gospodarka, zielony wzrost i zazielenienie jako formy realizacji koncepcji zrównoważonego rozwoju*, „Wieś i Rolnictwo" 2021, nr 2 (191)

Agenda dla zrównoważonej i konkurencyjnej turystyki europejskiej, Komunikat Komisji Wspólnot Europejskich, 19.10.2007, KOM 621, Bruksela 2007

Alejziak B., *Kwalifikacje i kompetencje pracowników turystyki. Próba diagnozy turystycznego rynku pracy*, „Folia Turistica" 2014, nr 32

Alejziak W., *Przemysł turystyczny przyczynek do dyskusji na temat zasadności używania, definicji oraz zakresu znaczeniowego pojęcia*, [w:] *Przemysł turystyczny*, pod red. A. Schwichtenberg, E. Dziegieć, Wydaw. Politechnika Koszalińska, Koszalin 2000

An attempt to define "Green entrepreneurship", http://greentproject.eu/wp-content/uploads/2016/01/Definition-green-entrepreneurship.pdf, (03.08. 2022)

Benammar K., Gressel N., *Forget sustainability: go for green entrepreneurship*, https://www.thnk.org/insights/go-for-green-entrepreneurship/, (03.07. 2022)

Boczar T., *Energetyka wiatrowa. Aktualne możliwości wykorzystania*, Wydaw. PAK, Warszawa 2008

Bordun M., *Znaczenie inwestycji turystycznych w stymulowaniu popytu turystycznego na przykładzie gminy Biały Bór*, „Ekonomiczne Problemy Usług" 2012, nr 85

Bouaguel W., Alsulimani T., *Understanding the Factors Influencing Consumers' Intention toward Shifting to Solar Energy Technology for Residential Use in Saudi Arabia Using the Technology Acceptance Model*, "Sustainability" 2022, Vol. 14

Bramwell B., Lane B., *Sustainable tourism: An evolving global approach*, "Journal of Sustainable Tourism" 1993, No. 1(1)

Browen A., Hancke B., *The Social Dimensions of "Greening the Economy"*, Brussels 2019

Calza F., Parmentola A., Tutore I., *Types of Green Innovations: Ways of Implementation in a Non-Green Industry*, „Sustainability" 2017, Vol. 9

Cel: zielona turystyka, https://odpowiedzialnybiznes.pl/artykuly/cel-zielona-turystyka/, (11.08.2022)

Chodkowska-Miszczak J., *Obszar turystyczny Dolina Zielawy w kontekście wykorzystania energii słonecznej*, „Studia Ekonomiczne i Regionalne" 2012, Issue 2

Chodkowska-Miszczak J., *Odnawialne źródła energii w rozwoju turystyki na obszarach chronionych w Polsce na przykładzie ośrodka turystyki religijnej w Kodniu*, „Studia Ecologucae et Bioethicae" 2016, Vol. 14 (2)

Chudy-Laskowska K.; Pisula T.*, An Analysis of the Use of Energy from Conventional Fossil Fuels and Green Renewable Energy in the Context of the European Union's Planned Energy Transformation*, "Energies" 2022, Vol. 15, 7369.

Climo M., Lind L., Carey B., Bendall S., *The rise and rise of geothermal heat pumps in New Zealand*, New Zealand Geothermal Workshop, Proceedings, Auckland, New Zealand 2019

Czuczman J., Czerepanjak M., Sczur I., Golubowski P., *Generatory synchroniczne do autonomicznych, bezprzekładniowych elektrowni wiatrowych*, XII Konferencja nt.: „Problemy eksploatacji maszyn i napędów elektrycznych", Ustroń, 18–20.05.2005

Dąbrowski J., *Kolektory słoneczne do podgrzewania wody użytkowej. Efektywność i opłacalność instalacji*, Wydaw. Uniwersytetu Przyrodniczego we Wrocławiu, Wrocław 2009

Demirbas A., *Fuels from biomass*, "Biorefineries. Green energy and technology", Springer, London 2010

Demirel P., Li Q.Ch., Rentocchini F., Pamvada J.P., *Born to be green: new insides into the economics and management of green entrepreneurship*, "Small Business Economics" 2019, Vol. 52

Devine-Wright P., *Community versus local energy in a context of climate emergency*, "Nature Energy" 2019, vol. 4

Działalność innowacyjna przedsiębiorstw w latach 2018–2020, Wydaw. GUS, Warszawa 2022

Dziedzic E., Szymańska E., Zawistowski H., Heliński W., Migdał M., *Poradnik innowacyjności w turystyce*, Wydaw. Ministerstwa Sportu i Turystyki, Warszawa 2016

Elzek Y.S., Gaafar H.A., Abdelsamie H., *Evaluation of Sustainable Tourism Investment in Tourism Business: Evidence from Egypt*, "Journal of the Faculty of Tourism and Hotels" 2020, Vol. 23, No. 1

Energia ze źródeł odnawialnych, Wydaw. GUS, Warszawa (badane lata)

Energia 2020. Strategia na rzecz konkurencyjnego, zrównoważonego i bezpiecznego sektora energetycznego, Komisja Europejska 639, Bruksela 2010

Europejski Zielony Ład, Komisja Europejska 640, Bruksela 2019

Farinelli F., Bottini M., Akkoyuniu S., Aerni P., *Green economy: the missing link towards a green economy*, "ATDF Journal" 2011, Vol. 8, Issue 3/4

Flood E., McDonnell K., Murphy F., Devlin G., *A Feasibility Analysis of Photovoltaic Solar Power for Small Communities*, "The Open Renewable Energy Journal" 2011, Vol. 4

Furquan A., Som A.P.M., Hussin R., *Promoting Green tourism for future sustainability*, "Theoretical and Empirical Research in Urban Management" 2010, Vol. 5 (8) (17)

Galiano-Martin M.-A., Castano-Martinez M.-S., Mendez-Picazo M.-T., *The Relationship between Green Innovation, Social Entrepreneurship and Sustainable Development*, „Sustainability" 2020, Vol. 12

Georgeson L., Maslin M.A., *The global green economy a review of concepts, definitions, measurement methodologies and their interactions*, "Geography and Environment" 2017, Vol. 4, Issue 1

Godlewska J., *Teoretyczne i praktyczne aspekty rozwoju zrównoważonego turystyki na obszarach przyrodniczo cennych*, [w:] *Rozwój trwały i zrównoważony*, pod red. B. Kożuchowskiej, Prace Naukowe UE we Wrocławiu, nr 452, Wrocław 2016

Gontar B., *Etapy rozwoju strategii zrównoważonej turystyki*, „Europa Regionum" 2016, tom XXVI

Goryca Z., *Przydomowa elektrownia z wielołopatową turbiną wiatrową*, „Napędy i Sterowanie" 2017, Vol. 19(2)

Green Economy – wpływ zielonej ekonomii na klimat i rozwój gospodarczy, po red. A. Juszczak, W. Rabiega, Wydaw. Polski Instytut Ekonomiczny, Warszawa 2021

Green Innovation in Tourism Services, "OECD Tourism Papers" 2013, Vol. 1

Green innovations: industrial policy for a low-carbon future, "Economic Report Series" 2014, https://www.tuc.org.uk/sites/default/files/Green%20Innovation%20final%20combined.pdf, (04.08.2022)

Grudziński A., *Wybrane narzędzia usprawniające proces zazielenienia gospodarki*, „Rynek – Społeczeństwo – Kultura" 2018, nr 4 (30)

Guinot J., Barghouti Z., Chiva R., *Understanding Green Innovation. A Conceptual Framework*, "Sustainability" 2022, Vol. 14

Hadzik A., Hadzik A., *Wybrane aspekty turystyki zrównoważonej na wiejskich obszarach uzdrowiskowych*, „Infrastruktura i Ekologia Terenów Wiejskich" 2008, Nr 2

https://artemida.org.pl/2022/03/10/elektrownia-geotermalna-jak-dziala-wady-i-zalety/?gclid=Cj0KCQjworiXBhDJARIsAMuzAuw6pLu7s2jIkMjbMDJu_x9sUb_Edn-uRr7-vQjG4mxA6nF70mfrzC0aAo4YEALw_wcB, (11.09.2022)

https://columbusenergy.pl/blog/fotowoltaika-wady-i-zalety/?zrodlo=google-ads&medium=search&IDkampanii=1509955182&kampania=fotowoltaika-search-1&gclid=Cj0KCQjwxb2XBhDBARIsAOjDZ36sTXAgQtP4Py3hwZNAgCVrk42xi5keW_if1PbHXLkX4dfB25oVwfYaAozFEALw_wcB, (10.09.2022)

https://columbusenergy.pl/blog/pompa-ciepla-powietrze-woda-jak-dziala/, (11.09.2022)

https://domynowoczesne.info.pl/biomasa.html, (13.09.2022)

https://ec.europa.eu/info/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en#documents, (16.09.2022)

https://eur-lex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN, (16.09.2022)

https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/ DOC_1&format=PDF, (16.09.2022)

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0550&from=PL, (16.09.2022)

https://kb.pl/porady/cennik-pomp-ciepla-porownanie-producentow-i-technologii/, (11.09.2022)

https://kospel.pl/blog/jak-dzialaja-kolektory-sloneczne-b59.html, (10.09.2022).

https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/222,pojecie.html, (09.10.2022)

https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/223,pojecie.html, (08.10.2022)

https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/580,pojecie.html, (11.09.2022)

https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/3802,pojecie.html (12.10.2022)

https://swatt.pl/pl/SWATT_WIEDZY/energia-odnawialna/czy-kolektory-sloneczne-sa-oplacalne, (15.09.2022)

https://top-oze.pl/wady-i-zalety-pompy-ciepla/, (12,09.2022)

https://www.biawar.com.pl/blog/kolektory-sloneczne-wady-i-zalety/, (15.09.2022).

https://www.eumonitor.eu/9353000/1/j4nvke1fm2yd1u0_j9vvik7m1c-3gyxp/ vkcwedk9layr/v=s7z/f=/com(2016)860_en.pdf, (16.09.2022)

https://www.naswoim.com.pl/pompa-ciepla-dzialanie-plusy-i-minusy/, (15.09.2022).

https://www.24hplans.com/site-plans-for-geothermal-heating-and-cooling/, (12.09.2022)

https://1898242ae2014.weebly.com/how-it-works.html, (16.09.2022)

Ibnou-Laaroussi S., Rjoub H., Wong W.-K., *Sustainability of Green Tourism among International Tourists and Its Influence on the Achievement of Green Environment: Evidence from North Cyprus*, "Sustainability" 2020, Vol. 12

Innowacyjność w turystyce, pod red. J. Krupy, Wydaw. Stowarzyszenia na Rzecz Rozwoju i Promocji Podkarpacia PRO CARPATHIA, Rzeszów 2010

Inwestycje i środki trwałe w gospodarce narodowej w latach 2017–2020, Wydaw. GUS, Warszawa 2022

Jaskółowski W., Wiatr J., *Instalacje fotowoltaiczne. Podstawy fizyczne działania. Ochrona odgromowa. Zasady neutralizacji zagrożeń porażenia prądem elektrycznym w czasie pożaru*, Zeszyty Naukowe Szkoły Głównej Służby Pożarniczej w Warszawie, nr 59/3, Warszawa 2016

Jezierska-Thöle A., Gwiaździńska-Goraj M., Dudzińska M., *Environmental, Social, and Economic Aspects of The Green Economy in Polish Rural Areas – A Spital Analysis*, "Energies" 2022, Vol. 15

Jong-Soo K., Soo-Jung H., Sang II L., Bang Ho J., *The study of evacuated solar collector using pulsating heat pipe*, "Frontiers in Heat Pipes" 2013, Vol. 3(4)

Kalda G., *Wykorzystywanie w Polsce energii wiatru do oświetlania i ogrzewania*, Zeszyty Naukowe Politechniki Rzeszowskiej, Budownictwo i Inżynieria Środowiska, Nr 283, z. 59, Rzeszów 2012

Kapera I., *Rozwój zrównoważony w turystyce. Problemy przyrodnicze, społeczne i gospodarcze na przykładzie Polski*, Wydaw. Krakowskiej Akademii im. Andrzeja Frycza Modrzewskiego, Kraków 2018

Kazimierczak M., *Jaką aksjologię zakłada idea zrównoważonego rozwoju w turystyce?* [w:] *Uwarunkowania i plany turystyki*, pod red. Z. Młynarczyka, I. Potockiej, A. Zajadacz, tom VI, „Turystyka zrównoważona", Bogucki Wydawnictwo Naukowe, Poznań 2010

Keller P., *Towards Innovation-oriented Tourism Policy: A New Agenda?*, [in:] *Innovation and Product Development in Tourism: Creating Sustainable Competitive Advantage*, B. Walder, K. Waiermair, A. Sancho Pérez (ed.), Erich Schmidt Verlag, Berlin 2006

Kępińska B., *Energia geotermalna w Polsce – stan wykorzystania, perspektywy rozwoju*, „Technika Poszukiwań Geologicznych. Geotermia. Zrównoważony Rozwój" 2011, nr 1

Konkurencyjność małych i średnich przedsiębiorstw na polskim rynku turystycznym, pod red. M. Bednarczyk, Wydaw. Uniwersytetu Jagiellońskiego, Kraków 2006

Kowalewski L., *Amerykańskie piece kominkowe na pelety i granulki z trocin*, „Magazyn Instalatora" 2007, Vol. 5

Kowalczyk A., *Turystyka zrównoważona – aspekty kulturowe*, [w:] *Uwarunkowania i plany turystyki*, pod red. Z. Młynarczyka, I. Potockiej, A. Zajadacz, tom VI, „Turystyka zrównoważona", Bogucki Wydawnictwo Naukowe, Poznań 2010

Krajowy Plan na rzecz Energii i Klimatu na lata 2021–2030, wersja 4.1. z 18.12.2019 r., https://www.gov.pl/web/klimat/krajowy-plan-na-rzecz-energii-i-klimatu, (16.09.2022)

Leśniak W., Janczar-Smuga M., Podgórski W., Klimkowski M., *Pompy ciepła – ekologiczne źródło energii odnawialnej*, „Nauki Inżynierskie i Techniczne" 2012, Vol. 3 (6)

Łaniewska A., Łaniewski S., *Środowiskowe i ekonomiczne aspekty zielonej gospodarki w regionach przyrodniczych Polski i Białorusi*, Oficyna Wydawnicza Politechniki Białostockiej, Białystok 2020

Meler M., Ham M., *Green marketing for green tourism*, "Tourism & Hospitality Management", Conference Proceedings, 2012

Michalak M., Rosiek K., Szyja P., *Gospodarka niskoemisyjna, gospodarka cyrkularna, zielona gospodarka. Uwarunkowania i wzajemne powiązania*, Wydaw. Uniwersytetu Łódzkiego, Łódź 2020

Mieszajkina E., *Przedsiębiorczość w koncepcji zrównoważonego rozwoju*, http://wz.pollub.pl/files/21/attachment/konferencja_wz_2017/zrownowazony_rozwoj.pdf, (11.08.2022)

Mirowski T., Sornek M., *Potencjał energetyki prosumenckiej w Polsce na przykładzie mikroinstalacji fotowoltaicznych w budownictwie indywidualnym*, „POLITYKA ENERGETYCZNA" 2015, Z 2, Tom 18

Młynarski T., *Unia Europejska w procesie transformacji energetycznej*, „Krakowskie Studia Międzynarodowe" 2019, tom 16, zeszyt nr 1

Mosz J., *Pragmatyczne i ideowe aspekty turystyki zrównoważonej*, „Studia Ecologiae et Bioethicae" 2018, Vol. 16 (2)

Nawaz M. A., *Investment and Tourism. Insights from the Literature*, "International Journal of Economic Perspectives" 2016, Vol. 10, Issue 4

Nawrot Ł., *Biomas energy investment in rural areas – possible application in tourism industry*, "Actual Problems of Economics" 2012, No 7, Vol. 2

Nawrot Ł., Bąk-Filipek E., *Działalność B+R w gospodarce turystycznej na tle uwarunkowań rozwoju odnawialnych źródeł energii*, „Folia Turistica" 2017, Vol. 42

Nawrot Ł., Bednarska M., Zmyślony P., *Odnawialne źródła energii w gospodarce turystycznej jako obszar badań naukowych*, [w:] *Przeszłość, teraźniejszość i przyszłość turystyki*, pod red. B. Krakowiak, J. Latosińska, Wydaw. Uniwersytetu Łódzkiego, Łódź 2014

Nawrot Ł., Zmyślony P., *Wpływ inwestycji na konkurencyjność regionu turystycznego*, [w:] *Międzynarodowa konkurencyjność regionu turystycznego*, pod red. Ł. Nawrot, P. Zmyślony, Wydaw. PROKSEMIA, Kraków 2009

Niezgoda A., *Obszar recepcji turystycznej w warunkach zrównoważonego rozwoju*, Wydaw. AE w Poznaniu, Poznań 2006

Niezgoda A., *Uwarunkowania wdrażania koncepcji rozwoju zrównoważonego na obszarach recepcji turystycznej*, Prace Naukowe UE we Wrocławiu, nr 259, Wrocław 2012

Niezgoda A., *Zastosowanie analizy strategicznej dla rozwoju turystyki zrównoważonej*, [w:] *Uwarunkowania i plany turystyki*, pod red. Z. Młynarczyka, I. Potockiej, A. Zajadacz, tom VI, „Turystyka zrównoważona", Bogucki Wydawnictwo Naukowe, Poznań 2010

Niezgoda A., Markiewicz E., *Turystyka biznesowa a turystyka zrównoważona – przykład hotelu w aglomeracji*, „Zeszyty Naukowe Wyższej Szkoły Bankowej w Poznaniu", t. 63, nr 6

Nowak W., Stachel A., *Kolektory słoneczne i panele fotowoltaiczne jako źródło energii w małych instalacjach cieplnych i elektroenergetycznych*, „Automatyka, Elektryka, Zakłócenia" 2011, Vol 2, Nr 2 (4)

Ociepa-Kubicka A., *Wykorzystanie biomasy w przedsiębiorstwach energetycznych*, „Proceedings of ECOpole'14 Conference", Vol. 9(1), Opole 2015

Panfiluk E., *Problemy zrównoważonego rozwoju w turystyce*, „Economy and Management" 2011, Vol. 2

Papis-Frączek K., Sornek K.A., *Review on Heat Extraction Devices for CPVT Systems with Active Liquid Cooling*, "Energies" 2022, Vol. 15

Para A., *Zasady zrównoważonego rozwoju turystyki – bariery i szanse dla rozwoju branży turystycznej*, Zeszyty Naukowe „Turystyka i Rekreacja", zeszyt 11 (1), pt.: *Zrównoważony rozwój turystyki w regionach Polski*, pod red. M. Kozikowskiej, Warszawa 2013

Phillips J., Faulkner J., *Tourism investment and finance. Accessing sustainable funding and social impact capital*, George Washington University, https://www.usaid.gov/sites/default/files/documents/2151/InvestmentWorkbook_4%5B2%5D.pdf, (03.09.2022)

Polak A., Beżański A., *Małe elektrownie wiatrowe – przykłady praktycznego zastosowania*, XII Konferencja nt.: „Problemy eksploatacji maszyn i napędów elektrycznych", Ustroń, 18–20.05.2005

Polska energetyka na fali megatrendów, Forum Analiz Energetycznych, Warszawa, Styczeń 2016, https://forum-energii.eu/pl/analizy/1-2, (10.09.2022)

Pompy ciepła w istniejących budynkach – fakty i mity, „Chłodnictwo. Klimatyzacja" 2021/2022

Porter M., *Porter o konkurencji*, PWE, Warszawa 2001

Przekształcamy nasz świat: Agenda na rzecz zrównoważonego rozwoju 2030, Organizacja Narodów Zjednoczonych, A/RES/70/1, Nowy Jork 2015

Puciato D., Winiarz M., Woś B., *Rola gospodarstw agroturystycznych w realizacji koncepcji turystyki zrównoważonej w gminie Głuchołazy*, [w:] *Uwarunkowania i plany turystyki*, pod red. Z. Młynarczyka, I. Potockiej, A. Zajadacz, tom VI, „Turystyka zrównoważona", Bogucki Wydawnictwo Naukowe, Poznań 2010

Rachunek satelitarny turystyki dla Polski za rok 2013 i oszacowania za rok 2015, pod red. E. Dziedzic, Stowarzyszenie na Rzecz Badania, Rozwoju i Promocji Turystyki, Warszawa 2017

Radzikowska-Juś S., Owczarek S., *Czy warto inwestować w małe przydomowe elektrownie wiatrowe? – studium przypadku*, „Biuletyn WAT" 2016, Vol. LXV, Nr 3

Renewable Energy Statistics, IRENA, 2019

Reuvers F., *What is new about green innovation*, https://essay.utwente.nl/67437/1/Reuvers_BA_MB.pdf, (04.08.2022)

Rogowska D., *Wykorzystanie OZE w energetyce a zrównoważony rozwój*, „NAFTA-GAZ" 2017, Rok LXXIII, Nr 8

Roman M., *Teoria innowacji i jej zastosowania w turystyce*, [w:] *Innowacje w rozwoju turystyki*, pod red. K. Nuszkiewicza, M. Romana, Wydaw. Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie, Warszawa 2013

Roszkowski A., *Energia z biomasy – efektywność, sprawność i przydatność energetyczna*, Cz. 1, „Problemy Inżynierii Rolniczej" 2013, Vol. 1(79)

Rozporządzenie Parlamentu Europejskiego i Rady (UE), nr 549/2013 z dnia 21 maja 2013 r.

Rozporządzenie Rady Ministrów z dnia 24.12.2007 r.

Różycka E., *Analiza opłacalności zastosowania niekonwencjonalnych źródeł energii w projektowanym budynku jednorodzinnym. Kolektory słoneczne, pompy ciepła*, Środkowo-Pomorskie Towarzystwo Naukowe Ochrony Środowiska, Tom 11, Koszalin 2009

Ryszawska B., *Zielona gospodarka – teoretyczne podstawy koncepcji i pomiar jej wdrażania w UE*, Seria: Monografie i Opracowania, nr 247, Wydaw. UE we Wrocławiu, Wrocław 2013

Schulze K.H., Hofmeister G., Joeller M., Scharler R., Obernberger I., Korbee R., Cieplik M.K., *Development and evaluation of a flexible model for CFD simulation of ash deposit formation in biomass fired boilers*, https://obnizenie.pl/development/and/evaluation/of/a/flexible/model/for/cfd/simulation/of/ash/deposit/formation/in/biomass/fired/boilers/24235.html, (15.09.2022)

Sidorczuk-Pietraszko E., *Wpływ instalacji odnawialnych źródeł energii na tworzenie miejsc pracy w wymiarze lokalnym*, „Ekonomia i Środowisko" 2025, Nr 3 (54)

Smeral E., *Beyond the myth of growth in tourism*, [in:] *Tourism Growth and Global Competition*, P. Keller, T. Bieger (ed.), AIEST, St. Gallen 2001

Southgate C., Sharpley R., *Tourism, Development and the Environment*, [in:] *Tourism and development: Concepts and Issues*, R. Sharpley, D.J. Telfer (ed.), Channel View Publications, Clevedon 2002

Steer A., Wade-Gery W., *Sustainable Development: Theory and practice for a sustainable future*, "Sustainable Development" 1993, No. 1(3)

Stukalo N.V., Simakhova A., *Social dimension of Green Economy*, "Filosofija. Sociologija" 2019, T. 30, Nr 2

Szopa R., Szczerbowski M., *Turystyka czynnikiem przemian ekonomicznych*, [w:] *Ekonomiczno-organizacyjne problemy działalności turystycznej w regionach*, pod red. S. Nowaka, Wydaw. AWF w Krakowie, Kraków 2013

Szyja P., *Zielona gospodarka w Polsce – stan obecny i perspektywy*, „Nierówności społeczne a wzrost gospodarczy" 2015, Nr 4 (1)

Ślebocka M., Tylman A., *Zielona gospodarka a finansowo-prawne dylematy zrównoważonego rozwoju*, „Nierówności Gospodarcze a Wzrost Gospodarczy" 2014, nr 4 (40)

The 5 Principles of Green Economy, https://www.greeneconomycoalition.org/news-and-resources/the-5-principles-of-green-economy, (24.08.2022)

Tomaszewski K., Sekściński A*., Odnawialne źródła energii w Polsce – perspektywa lokalna i regionalna*, „Rynek Energii" 2020, Nr 4 (149)

Tourism in the Green Economy. Background Report, United Nations Environment Programme and World Tourism Organization, Madrid 2012

Traktat o funkcjonowaniu Unii Europejskiej, „Dziennik Urzędowy Unii Europejskiej" 2016, C 202

United Nations Climate Change, https://unfccc.int/sites/default/files/english_paris_agreement.pdf, (16.09.2022)

Urbaniec M., *Rola przedsiębiorczości w kontekście zrównoważonego rozwoju*, „Przedsiębiorczość – Edukacja" 2018, Vol. 14

Urbańska P., *Exploatation of Selected Res Instalation on the Example of Small Wind Power Station with Vertical Axis Wind Turbine*, "Energia-Ekologia-Etyka" 2016, Tom 1

Vicidomini M., D'Agostino D., *Geothermal Source Exploitation for Energy Saving and Environmental Energy Production*, "Energies" 2022, Vol. 15

Waiermair K., *Prospects for Innovations in Tourism: Analyzing the Innovation Potential Throughout the Tourism Value Chain*, [in:] *Innovation in Hospitality and Tourism*, M. Peters, B. Pikkemaat (ed.), Haworth Press, Binghamton 2005

Wartecka-Ważyńska A., *Kompetencje zawodowe absolwentów kierunku turystyka i rekreacja Akademii Wychowania Fizycznego w Poznaniu na rynku pracy*, „Ekonomiczne Problemy Turystyki" 2014, nr 1 (25)

Working towards a Balanced and Inclusive Green Economy: A United Nations System – wide Perspective, United Nations, Genewa 2011

Woźniak M., *Zrównoważona gospodarka energetyczna na obszarach wiejskich w Polsce*, „Polityka Energetyczna" 2018, tom 21, zeszyt 1

Zbytek Z., Adamczyk F., *Możliwości wykorzystania biomasy stałej. Uwarunkowania prawne i podział biomasy stałej*, „TECHNIKA ROLNICZA, OGRODNICZA, LEŚNA" 2017, Nr 2

Zielona Księga: Ramy polityki w zakresie klimatu i energii do roku 2030, Komisja Europejska 169, Bruksela 2013

Zielone miejsca pracy w turystyce – szansa dla Małopolski, pod red. M. Leńczuk, A. Chrześcijanek, E. Guzik, Wydaw. WUP w Krakowie, Kraków 2014

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