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Financial instruments of green transition

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Summary

Green transition creates change not only for the real economy, but also for widely perceived finance, exposing them both to risks and opportunities. This is of fundamental significance for enterprises and financial institutions, which need to adapt. Risk increases in areas subjected to regulatory and market pressure, forcing changes in market strategies or production methods. Regulations may present opportunities as well, and those may include clean technologies, in particular technologies aiming to reduce greenhouse gas emissions, the development of renewable energy sources, a digital revolution on the energy market, and introducing new elements into the financial market. Taking these trends into account is essential to economic success. Underestimating the progressing climate change, and the intensive human activity, has made climate protection and the need to transform the economy a priority. Consequently, the implementation of green transition requires appropriate funds for the financing of green projects. Considering the above trends in the global economy, the authors strive to present the financial instruments available for supporting the development of green transition, taking into consideration, in particular, the power market. Hence, they discuss the financial instruments used for energy transition and the fight against climate change. The authors point to the importance of green finance, which as an element of the financial system, takes over the responsibility for providing the funds and tools both for financing climate goals, and for effective risk management by the entities involved in this process.

Key words: green transition; climate neutrality; green finance; power sector; financial instruments; risk; management; RES.

JEL: F23, L21, M1, G15, G24, G23

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I. Introduction

Green economy transformation may entail both risks and opportunities¹. Risk arises in an area that is subjected to regulatory and market pressure that forces changes in market strategies or production methods. Regulations may, however, give rise to opportunities, which include so-called “clean technologies”, in particular greenhouse gas emission reduction technologies, the development of renewable energy sources, a digital revolution on the energy market, and the introduction of new financial market tools. These changes make some of the previously used business models outdated. One example here is the changes on the energy market. The development of competitive power storage on a large scale, and in quantities significant for the wholesale power market, will allow Renewable Energy Sources (hereinafter: RES) to become the basic means of the security of supply. At the same time, the traditional power industry based on burning fossil fuels, will lose its competitive advantage on the market and will no longer be the guarantee of the stability of the power system.

These trends are significant not only for the world’s energy industry, but particularly for the success of individual economies. In the age of continuous automation and robotization, the cost of power becomes one of the key determinants for numerous industries. This becomes a challenge for the Polish economy, which is unable to function outside of the trends currently observed worldwide. The production of renewable energy within the EU has doubled since 2004. This applies mainly to the developed economies of Europe’s northern countries. In 2017, wind farms², photovoltaic and biomass power plants, have for the first time produced more power than coal- and lignite-fired blocks³. In 2019, the production of power in European coal power plants was for the first time lower than that in gas power plants, which directly results from the development of renewable power production. Reducing gas prices, and simultaneously maintaining the high level of prices of greenhouse gas emission allowances – the European Union Allowance (hereinafter: EUA) – as observed in 2019 and 2020, created the potential to switch from coal-power plants to 10 GW gas ones. In the following year, the high prices of EUAs and gas, as well as the reduced costs of RES technologies, have made RES more competitive than gas-power plants.

The aim of this article is to outline the specificity of green finance, and to demonstrate how important their development is for financing the green transition of the world economy. Therefore, the article discusses selected financial instruments available on the market, which are used for energy transition and to combat climate change. Underestimating the progressing climate change and the intense human activity to combat it, shows that climate protection and the necessity to transform the economy is now a priority, and that its financing must be appropriately arranged. In the subsequent parts of the article, the authors discuss the financing of green transition on the basis of Power Purchase Agreements (hereinafter: PPAs) and characterise this type of contracts.

The analysis considers original aspects of the subject matter of this article as identified by the authors on the basis of their long-term studies covering both the area of theory of finance,

¹ More about sustainable development in: W. Drożdż, A. Maroušková, G. Zych, G. Kinelski, M. Wójcik-Jurkiewicz, M. Czarnecka, *Determinants of Decarbonization – How to Realize Sustainable and Low Carbon Cities?* Energies 2021. DOI: 10.3390/en14092640.

² There are doubts, however, as to whether the problems with recycling wind turbine elements do not lower the positive environmental impact of wind farms by increasing landfill.

³ While, in 2012, coal-fired power plants produced two times more power than wind farms, photovoltaic and biomass installations.

and practical compliance issues concerning the usage of green finance instruments. Hence, utilized literature aims only to support the consideration in this article or show developments of economic processes.

An important step supporting the development of green finance was taken by the European Parliament in January 2020 that adapted the European Green Deal and legally confirmed the ambitions of net zero emission goal of the European Climate Law. It highlighted the need to de-carbonize the power sector. At the same time, the European Commission prepared a budget of EUR 1 trillion for investments in green projects by 2030, which considered the instruments attracting private investments as well. The EU climate aspirations were confirmed in the Fit for 55% legislation package, which aims to adjust EU climate and energy policy towards a minimum 55% reduction of Green House Gasses (GHG) emissions by 2030 (comparing to the year 1990). The following actions shall be executed for this purpose:

- application of emissions trading in new sectors of the economy, particularly in construction and transport;
- reduction of emission limits, and requirements of the acceleration of the reductions of emissions;
- re-investment of the obtained funds from the sale of European Emission Allowances (EUA) to projects related to the implementation of climate goals;
- improvement of energy efficiency;
- acceleration of low-emission transport development through a prohibition of the sale of cars burning fossil fuels from 2035 onwards, and the creation of a separate emission trading system for road transport fuels;
- adjustment of the fiscal policy in the EU to the implementation of the Green Deal objectives, by changes in product and technology taxation towards supporting green transition;
- prevention of emission leakage by the introduction of boarder climate carbon tariff – the Carbon Border Adjustment Mechanism – which shall improve the competitiveness of EU producers and their market position starting from year 2026 by charging imported products with emission costs based on EUA price;
- protection and development of natural GHG sinks, in order to ensure climate neutrality of EU land, forestry and agriculture sectors that shall remove 310 million t. CO₂ by 2030.

The scope of the package shows the cross-cutting nature of the fight against climate change, which applies to all sectors of the European economy, pointing to the important role of the financial sector.

II. Green finance

A sustainable financial system creates and values financial assets; it enables conducting transactions in a way that builds genuine prosperity, in order to meet the long-term needs that favour sustainable development. Promoting the financing of green transition on a large and economically viable scale, should guarantee that green investments are prioritised over investments that promote non-sustainable growth patterns. This means that the funds obtained are used to finance investments, or carry out activities, related to sustainable development, having a positive impact on the environment. Hence, green financing should be divided into two groups of funds:

- 1) transformation of the business models, both of economies and companies, towards the execution of the targets of green transition;
- 2) development of sustainable investments (including renewable energy sources).

The first group of financed activities carries out the transition to a more sustainable and ecological business model of the selected economy or entity, in order to gradually reduce the negative impact on the environment. The second group of funds finances particular projects that are expected to have a positive impact on the environment.

- Green finance encourages a long-term analysis of investments that have an environmental impact and include all criteria of sustainable development.
- Green finance includes a broad variety of products and financial services, which can be divided into investment, banking and insurance products.
- Green finance includes all the financial instruments that are used for the execution of initiatives and projects connected with sustainable development, economic products and policies within the framework of green transition.

Green finance ensures funding in all financial sectors and asset classes, which take into account environmental, social and investment decision-management criteria, considering their climate risk, and are executed to promote sustainable development. For instance, banks see climate risk as a factor impacting new loans – they may adjust granting loans, taking into account the environmental impact in their risk assessments and cost of capital. What is also important is coordinating the maturity of the available financing with the investors' needs. Hence, the definitions regarding green transition should be globally systematised – there is a need for a classification system of ecological activities to support investors and financial institutions in taking informed financial decisions (a global taxonomy). The definition of green financing must be transparent. Thus, it is essential to establish the criteria for defining assets as “ecological” or classifying financing as “green” or “sustainable”, since an increasing number of financial institutions strive to support initiatives completely free of fossil fuels. Such a set of minimum standards for green finance is essential to ensure the transparency of the capital flow towards green and sustainable investments, as well as for the analysis of the ever-changing financial market and climate risk.

An example of such standardization can be found in the EU taxonomy for sustainable solutions proposal outlined by the European Commission in November 2020. The following Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment (hereinafter: EU Taxonomy Regulation), was published in the Official Journal of the European Union on 22 June 2020, and entered into force on 12 July 2020⁴. The Taxonomy Regulation sets out conditions that an economic activity has to meet in order to qualify as environmentally sustainable, to make it easier for investors to assess their investment as regards their impact on the climate. The EU Taxonomy Regulation establishes six environmental objectives:

1. Climate change mitigation;
2. Climate change adaptation;

⁴ Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, OJ L 198/13, 9.12.2021 (hereinafter: the EU Taxonomy Regulation).

3. The sustainable use and protection of water and marine resources;
4. The transition to a circular economy;
5. Pollution prevention and control;
6. The protection and restoration of biodiversity and ecosystems.

The European Commission states that the EU taxonomy is a classification system, establishing a list of environmentally sustainable economic activities. The EU taxonomy provides companies, investors and policy-makers with appropriate definitions to determine which economic activities can be considered environmentally sustainable. In this way, it should create security for investors, protect private investors from *green-washing*⁵, help companies to become more climate-friendly, mitigate market fragmentation, and help shift investments to where they are most needed⁶. Different means can be required for an activity to make a substantial contribution to each objective. The implemented instruments of green finance are characterized by the necessity and obligation to specify the purpose of the activity, which must primarily have a positive impact on the environment.

The European Commission continuously develops the actual list of environmentally sustainable activities, by defining technical screening criteria for each environmental objective, through delegated acts. The EU Taxonomy Regulation of 2020 establishes the general framework for determining whether an economic activity qualifies as environmentally sustainable, for the purposes of establishing the degree to which an investment is environmentally sustainable. The Taxonomy Regulation applies to measures adopted by the EU or by Member States, and set out requirements for financial market participants or issuers with respect to financial products or corporate bonds that are made available as environmentally sustainable, to financial market participants that make available financial products⁷.

The EU taxonomy, defining the criteria for recognizing investments as compliant with the principles of sustainable development, means that managers of financial assets, funds and sellers of financial products must analyse whether their investments support the green transformation. For this purpose, they are obliged to report their business activity and the so-called green and non-green investments. This reporting is intended for both, competent national authorities as well as for investors. This will result in the presentation of financial and non-financial information and reports, as well as the modification of documents preceding the conclusion of a contract for the sale and marketing of financial products. The standards and principles of disclosing information helps to develop green financial assets. It is also essential that financial institutions require clients to reduce their carbon footprint, which should increase the global pressure on such activity. This is the result of the fact that even before reaching coherent and factual reporting, there is a particular sequence to the progress of enterprises as regards sustainable development namely: problem identification, policy establishment, information disclosure and standardisation.

⁵ The phenomenon of creating the impression, among customers looking for goods manufactured in accordance with the principles of green and sustainable development, that the product or the company that produces it is in harmony with nature and ecology.

⁶ More in: *What is the EU taxonomy?*, https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en#what, [archived on 12.03.2022].

⁷ Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives, OJ L 441/1, 9.12.2021.

III. Selected instruments of green finance

Green finance, and all activities connected with improving the environment, has become the main financing areas in which companies must adapt their operations to make them fit the requirements of green transition. Therefore, there is a growing list of financial instruments connected with sustainable development that attract investors worldwide. *Debt Capital* and *Equity* are the dominant financial instruments in green finance. In order to meet the growing demand, new financial instruments are available – *Green Bonds* and *Greenhouse Gas Emission Market Instruments*; there are also new financial institutions, such as *Green Banks* and *Green Funds*. Investment in renewable energy, financing sustainable infrastructure and green bonds, are currently the most popular areas of interest connected with green finance. A new way of financing green investments is *crowdfunding*, which is primarily used for power investments (photovoltaic installations, bio-fuels) in developing countries. Therefore, apart from a growing technological and geographical diversity, investments related to the execution of climate goals are connected with the emergence of new business models and investment tools that may encourage investors and finance all the life stages of green assets.

Green bonds

One of the instruments of green finance that promotes climate-friendly initiatives are *green bonds*, which are one of the main instruments of financing of the fight against climate change. They are used to raise money for projects with a positive environmental impact. Green bonds are fixed-income securities designed for finance dedicated, green fixed assets⁸. Green bonds should be defined as any type of bond instrument where the proceeds, or an equivalent amount, will be exclusively used to finance or re-finance, in part or in full, new and existing eligible green investments.

There is a whole array of bonds issued that are dedicated to climate-related projects: green bonds, climate bonds, sustainable development bonds; social impact bonds, Environmental, Social, and Governance (hereinafter: ESG) bonds; blue bonds (connected with ocean protection), and many more. Recently, a new type of bonds has appeared – bonds financing the reduction of waste from plastics, which will finance projects aimed at reducing packaging waste. *Sustainable development bonds* are used for financing projects with significant environmental and social benefits. They are aimed at producing positive economic effects for a given target group, with a neutral or positive environmental impact. By contrast, green bonds are designed to finance environment-friendly initiatives and projects. There can be no so-called “greenwashing”, which is characterized by:

- obtained funds are used to finance projects that do not meet the sustainable development guidelines, or have dubious green characteristics;
- investments are not fully related to ecological solutions;
- use of funds is not monitored by the issuer;
- use of funds to implement sustainable development is not documented, and the use of funds has not been audited by a third party.

⁸ Green bonds bear the characteristic features of traditional bonds, since they give the issuer the opportunity to raise funds for a given project in return for a regular, periodic interest and full capital repayment on the maturity date.

Hence, *Green Bond Principles* (hereinafter: GBP)⁹ have been formulated describing green investments that meet the requirements for the green transformation¹⁰:

- development of renewable energy;
- energy efficiency;
- pollution prevention and control;
- environmentally sustainable management of living natural resources and land use;
- terrestrial and aquatic biodiversity conservation;
- clean transportation;
- sustainable water and wastewater management;
- climate change adaptation;
- circular economy adapted products, production technologies and processes;
- green buildings.

At the early stage of green transformation, there are *transition bonds* for financing the activities of entities which, albeit from less ecological sectors of the industry, can enter the sustainable development market and make a genuine difference to climate change by redesigning their business model into a more sustainable one, although their road to sustainable development may seem less direct. Thus, the objective of transition bonds is often quite similar to that of green bonds and may not always be achieved.

The green bond market fills the gap between capital suppliers and investors in green assets, thus ensuring that both investors and governments are able to finance projects relevant for the achievement of climate objectives. Local governments also issue such bonds. Together with other innovative instruments on the capital market, green bonds support new and existing environmental projects by giving access to long-term capital. The funds raised from green bonds are utilised for investments in Renewable Energy Solutions (RES) by national and local governments, financial institutions and companies. However, their issue entails higher costs than that of regular bonds, since it requires the financed projects to be certified as ecological – green bonds have a “green” label, which informs investors that the funds raised thanks to the bonds will be used for projects beneficial for the environment.

The main issuers of green bonds are corporations, financial institutions, agencies and countries that use green bonds for financing national climate initiatives. Green bonds have been issued in over 30 currencies¹¹. Most green bonds are issued to finance a broad variety of environmental categories such as: renewable energy, energy efficiency, or the adaptation of green transport to climate change. 23% of the accumulated amount of all green bonds issued since 2007 concerned RES. Other initiatives financed via green bonds applied to green transport, ecologically efficient technologies, energy efficiency, ecological construction, reducing pollutant emissions, sustainable management of natural and water resources, land and marine biodiversity protection¹².

⁹ The Green Bond Principles (GBP) are voluntary process guidelines that recommend transparency and disclosure, and promote integrity in the development of the Green Bond market by clarifying the approach for issuance of a Green Bond.

¹⁰ *Green Bond Principles. Voluntary Process Guidelines for Issuing Green Bonds*, ICMA Paris, Paris 2022, p. 4–5.

¹¹ *Global landscape of renewable energy finance 2020*, IRENA, Abu Dhabi 2020.

¹² More in: *Renewable energy finance: Green Bonds*, IRENA, Abu Dhabi 2020.

The global market of green bonds may be worth up to USD 1.36 billion by 2023, which also translates into a dynamic development of green finance¹³. The growth of the market of green bonds results also in an increased diversification of issuers. Although corporations and financial institutions dominate it, there are also more and more bonds issued by governments, used for financing climate goals. The Swedish SEB (banking) Group, together with the World Bank, issued green bonds for supporting projects combating climate change as early as 2008. In the US, *CalSTRS*, *AP2*, *AP3*, *UNJSPF* and *California State Treasurer* funds support the issue of green bonds and creating a market for them. Green bonds are a world-wide trend – they are issued in Peru (by *IFC*), in Germany (*KfW* bank) and in Australia (*World Bank*).

Green bonds usually spark long-term interest of investors in the enterprise of the issuer. One of the impulses for the growth of the green bonds market might be the activities of the Chinese government, which strives to develop RES. However, the China's public finances are only able to provide approx. 15% of the USD 400–800 billion necessary for financing pro-environmental projects. Hence, shortly after the Paris Agreement of 2015¹⁴, the Chinese government published national standards for green bonds in order to secure the remaining funds it needed. Further countries that promote the development of the green bonds market are India and Brazil. In India, green bonds have become a significant financial instrument that enables foreign debt capital to enter the Indian RES market. Since 2016, Indian companies and financial institutions have gained over USD 14.43 billion from green bonds, and in 2021 only, Indian companies have issued green bonds worth USD 4 billion. The importance and popularity of Indian green bonds seems to be on the rise – they give companies dealing with clean energy the opportunity for the global financing of projects that aid the Indian economy in meeting its RES goals, and they offer higher and more stable profits to global investors.

On 6 July 2021, the European Commission (EC) presented its strategy for acquiring funds under the European Green Deal in a manner that maximises applying the principles of sustainable investment, and minimises the negative impact on ESG factors. The financial sector plays a key role in the process of funding the achievement of EU climate objectives. The main assumptions of the strategy for utilising green finance include regulations aimed at facilitating access to green transition funds, especially for small and medium enterprises and households. The EC has stressed the need for the financial sector to increase its input in curbing climate change. This should result in a stable development of global green finance markets, thanks to creating international networks and bodies able to fully implement the principles of sustainable development in the financial sector itself. Green bonds will constitute as an essential instrument of green finance in funding the Green Deal. The EU is planning to annually acquire EUR 350 billion from private investors to cover the goals of the Green Deal – it has started the auctions of its green bonds on 15 September 2021. By using the strategy of sustainable finance and green bonds, the EU is aiming to become the leader in the market of climate-friendly investment. This is why it is essential to set up certain principles of issuing green bonds, such as to specify which entities may issue green bonds for raising funds or how to avoid greenwashing practices. Thanks to an EU standard, the issuers of green bonds

¹³ A. Słomka-Golebiowska, *Zielone finanse – ratowanie człowieka, nie planety*, <https://gazeta.sgh.waw.pl/insight/zielone-finanse-ratowanie-czlowieka-nie-planety>, [achived on 12.05.2021].

¹⁴ The Paris Agreement is the first-ever universal, legally binding global climate change agreement, adopted at the Paris climate conference (COP21) in December 2015.

will have a tool to verify whether the projects they finance are compliant with EU taxonomy. A new EU standard for green bonds should satisfy the clients' growing needs for green financial assets, which are necessary for modernising the power infrastructure, housing resources and transport networks, simultaneously greening these investments.

Loans

Another example of “green” financial instruments are *green loans*. They differ from regular loans in two ways. First of all, they can only finance green initiatives and, secondly, they must be transparent as regards the selection of sustainable projects and fund allocation. Green loans are a form of financing that provides enterprises with funds for projects with a significant impact on the environment or, to be more precise, that steers them towards financing ecological projects. However, the concept is much broader than that, because it also includes an ecology-oriented methodology throughout the whole process of loan selection, structuring, utilising and reporting as regards any given green loan. Financing for enterprises is more readily available with sustainable development loans than with green loans or green bonds, thus giving access to financing also to small entities, increasing therefore, the pool of projects promoting green transition.

Provided the contract allows it, the structure of a *sustainable development loan* enables periodic use and repayment. This particular feature means that this type of loan is flexible and, hence, perfect for executing general corporate objectives that are not always clear at the preliminary stage of negotiating a loan. This way the loan agreement becomes a flexible tool for executing a company's climate objectives, and the execution of ESG goals ensures a financial benefit in the form of reduced loan costs¹⁵. Entities investing in their own sustainable development join the global trend of disclosing information regarding their carbon footprint. This also results from the fact that confirming an ESG standard directly translates into reducing such enterprises' credit risk.

An innovative instrument of green finance are ESG-linked loan agreements (*Environmental, Social and Governance loan agreements*), whose cost is partially established on the basis of the evaluation of the borrower's engagement in sustainable development as well as on responsible business practices. The number of this kind of loan agreements has been on the rise since 2019 (in 2019 it increased by 168% at a global value of USD 122 billion)¹⁶. ESG-linked financing requires the loan-taker to set up ambitious and significant objectives as regards their sustainable development, as well as to regularly (at least once a year) submit independently verified reports on their progress. The above goals may concern reducing greenhouse gas emissions, improving energy efficiency, or acquiring an external rating as regards sustainable development.

The funds from loans for sustainable development initiatives may be used for general business objectives as well. However, the interest rate is partially connected with the borrower's results in the area of sustainable development. The interest rate on the loan is lowered provided the borrower achieves their goals; it may however also go up, should the borrower fail to meet their objectives.

¹⁵ In February 2020, the investment management company *Neuberger Berman* was the first financial services company in North America to announce it would grant a USD 175 million corporate revolving credit for sustainable development initiatives. It is annually verified as regards its compliance with Environmental, Social, and Governance (hereinafter: ESG) criteria, in accordance with the UN's Principles for Responsible Investment.

¹⁶ *Sustainable Debt Sees Record Issuance At \$465Bn in 2019, Up 78% From 2018*, Bloomberg NEF, <https://about.bnef.com/blog/sustainable-debt-sees-record-issuance-at-465bn-in-2019-up-78-from-2018/>, [archived on 27.12.2020].

By the end of 2019, approximately 80% of all ESG-linked loans were granted in Europe. From the point of view of reputation and corporate governance, ESG-linked loans allow borrowers and lenders to demonstrate their engagement in the development of a sustainable economy.

Moreover, green credit instruments give borrowers access to a broader and more varied group of investors, in particular those who search for positive ESG-impact investments. It must also be noted here that there is a general market tendency for establishing lower interest rates for financing ecological projects, which encourages the borrowers to accept these kinds of instruments¹⁷. Borrowers observing Environmental, Social, and Governance (ESG) principles should also have effective procedures within their corporate governance (such as risk management, including climate risk management), which further lowers their credit risk.

Green finance derivatives

On the financial market, there are numerous derivatives connected with the achievement of ESG objectives¹⁸:

- sustainability-linked derivatives,
- Credit Default Swaps connected with ESG,
- contracts related to ESG stock indices,
- derivatives concerning European Union Emission Allowances (EUA) trade,
- derivatives whose underlying asset are renewable fuels,
- weather derivatives.

Sustainability-linked derivatives

Traditional derivatives are modified with an Environmental, Social, and Governance (ESG) element in the form Environmental Key Performance Indicators (KPIs) for measuring the achievement of ESG objectives, which may influence the value of contract settlements – depending on the achievement of ESG objectives – as payment flow may be increased or reduced.

Credit Default Swaps (CDS) related to ESG

These instruments are designed to manage credit risks resulting from climate change, hedging against potential future losses caused by the contractor's bankruptcy due to a catastrophic event, as well as against a change of value of the owned ESG-related derivatives. An instance of a financial instrument hedging the risk of RES investments is a *proxy revenue swap* for the investor and a *proxy generation swap* for the owner. The former, a proxy revenue swap, hedges against risk that impacts the RES project owner's ability to produce a predictable revenue flow (e.g. weather risk). Similarly to other hedging agreements, the proxy revenue swap transfers the price risk onto the hedge provider. Additionally, the structure of a proxy revenue swap takes into account some of the elements of the volumetric risk (i.e. the volume of energy produced under an investment). The owner of the investment bears the additional cost of transferring the volumetric

¹⁷ In April 2017, the ING Bank granted Philips the first ever sustainable development-related credit, linking the EUR 1-billion credit's interest rate with the company's results in the area of sustainable development. Bloomberg News informed that by June 2018, ING closed 15 similar transactions, pursuant to which the bank reduced the costs of loans by 5%–10% on the basis on ESG ratings.

¹⁸ M. Maciaszczyk, *Czy rynki finansowe mogą wspierać proces zarządzania ryzykiem ESG?*, Biuletyn Ryzyka 2021, no 2.

risk onto the hedge provider, thanks to specifying the proxy volume of the energy generated by the investment (i.e. indicates how much the project should have generated), which is paid for by the buyer, instead of basing revenue flow on the actual output of the project.

Contracts related to ESG stock indices

Financial instruments (*options, future contracts*) where the value is connected with ESG benchmarks, thus enabling institutions hedging ESG investments and managing financial flow within ESG funds.

Derivatives related to European Union Emission Allowances (EUA) trading

Financial institutions also develop derivatives that hedge risks on the market of greenhouse gas emission allowance trading, which companies use in order to hedge their own risks related to environmental protection requirements. Operating in the EU, the European Trading System (hereinafter: ETS) is connected with a high market risk, which is particularly noticeable by investors, and so EUAs were consequently classified by the Markets in Financial Instruments Directive 2014 (hereinafter: MiFID II) as a financial instrument. In its history, the price-per-tonne of a carbon dioxide equivalent emission (EUA) within the EU ETS varied from EUR 0.00/EUA to over EUR 60/EUA. It is not surprising that both industrial enterprises and lenders perceive the EUA price as an insufficiently reliable basis for final investment decisions. This is particularly the case if these are commercial decisions, and the risk involves hundreds of millions or even billions of invested EUR.

Instruments for the management of risk related to the EUA price are necessary to ensure investment financing. An example here is *Carbon Contract for Difference* (hereinafter: CfD) – an agreement between two parties (the buyer and seller), which establishes that the seller will settle the positive difference between the current EUA price (price on the day of contract execution) and its price as it was on the day of entering into the contract – a negative difference is paid by the buyer to the seller. The Energy Trading, Gas Trading and Energy Storage Associations reasoned that CfDs for the EUA price in certain sectors (such as steel) may reduce the demand for ETS allowances, thus decreasing greenhouse gas emission prices and, as a result, weakening the impulse to decarbonise non-supported sectors.

Derivatives with underlying asset in renewable fuels

Examples of the above derivatives include future contracts for bio-fuels quoted on the Chicago Mercantile Exchange, and future contracts for biodiesel quoted on the Intercontinental Exchange (ICE).

Weather derivatives

Weather derivatives are one of the methods to reduce the volumetric risk impact on the economic results of a company. Instead of the exercise price, these derivatives take into account weather variables (wind strength, rainfall, water level in retention reservoirs and rivers, temperature, cloud cover, etc.) and are usually set for a particular location. Under the transactions entered into on the market, money flows in correlation with weather conditions. With the aid of these instruments, companies can control financial risks that result from weather condition variations¹⁹.

¹⁹ J. Scarrow, *Weather Derivatives as a Financing Tool*, News Wire 2004, no 4.

Crowdfunding

Another instrument promoting RES developments, in particular in developing countries, is *crowdfunding*, which is based on many small payments made by a large number of people, or entities that support a particular investment. In modern times, the gathering of funds happens on-line via specialised platforms, which cuts out banks as agents and directly links the investors with those executing the investment. Crowdfunding also reduces the service costs of financing. The crowdfunding models used in green finance can be divided into two groups:

- 1) *donations* – the investors do not expect any benefits or return on their investment;
- 2) *financial crowdfunding* – the investors expect a return on their investment or an equity share.

The donation model is prevalent in developing countries, the while financial crowdfunding model dominates in developed regions. Crowdfunding undoubtedly allows small investors to become directly involved in the financing of projects related to renewable energy, be part of diverse Internet communities, make suggestions and to keep up-to-date with the projects they support.

Crowdfunding has many advantages for the investors and beneficiaries:

- it is a cheaper and faster alternative as compared with traditional financing models. Campaign organisers are also able to reach a much larger group of investors, both in terms of geographical range and risk appetite, which reduces the cost of capital;
- it can be organised from literally any location in the world, and it should ensure quicker and simpler access to capital as it minimises formalities as compared to acquiring a loan or issuing bonds;
- it has highly reduced costs connected with such formalities;
- it allows entrepreneurs to assess market demand for their products or services before turning to financial institutions to seek funds. At the same time, this model of financing can be used to build relations with buyers, suppliers and sellers, which enables investors to receive early feedback from their communities and to appropriately adapt the relevant product or service before any capital is actually invested;
- thanks to crowdfunding, providers of capital have access to new assets and, in case of debt and capital crowdfunding, they may see a higher return than from bank deposits or loans;
- it spreads the risk connected with the return on investing in RES among many investors;
- crowdfunding platforms allow investors to cooperate directly with project owners and to monitor their progress;
- crowdfunding platforms give investors the opportunity to analyse numerous offers at the same time and to quickly identify the areas of investment that best suit their portfolio strategy, risk tolerance and interests.

IV. Financing green transition with Power Purchase Agreements (PPA)

An instrument that is becoming more and more important for the development of RES are commercial *Power Purchase Agreements* (PPAs), which include long-term power supply agreements. They are an alternative for government support, while recipients receive power at a competitive price, investors have an opportunity for investment. PPAs allow purchasing power and certificates

of origin, alternatively in Poland – green certificates, from RES and at an agreed price. Apart from ensuring power supply from renewable sources, PPAs serve as a warrant of power prices as well as revenue security for renewable energy projects, which helps acquire financing²⁰.

In 2021, the importance of PPAs was noted by the European Commission, which is encouraging governments to promote long-term PPAs from RES, under the EU's overall efforts to increase energy production from renewable sources and curb emissions. The EC points out that the governments of EU Member States should remove all unjustified barriers for renewable PPAs, and to define how to reduce the financial risks they pose, for instance, by using loan guarantees. Governments would have to specify how they are promoting renewable PPAs in their national energy and climate plans, and to include the share of PPA-supported RES in their periodic progress reports.

The US has the largest market for corporate PPAs, although their number in Europe has trebled in 2020. In Spain, the number of PPAs with solar power plant developers is growing, similarly in Sweden with respect to regards wind-farm owners. In Latin America, Brazil is invariably the largest market for corporate PPAs, with an increasing number of projects based on long-term agreements concluded outside of the governmental auction system. In other Latin American countries, in particular in Chile and Mexico, the activity of PPAs has however decreased in 2020 due to a decline in economic activity and increasing financial challenges. Thanks to the development of the corporate PPA market in the US and Europe, larger and larger RES projects are becoming economically attractive, in particular in terms of investment cost reduction.

It is possible that, in the long run, the increased share of solar and wind energy, in the total energy supply, will decrease its price on the wholesale market, since the variable cost of RES production is zero. This may lower the return on RES investments, which is taken into account by financial institutions when assessing RES projects. They will thus consider among others how many new RES projects will be ready and operational before their investment project is commissioned and what to expect in the coming years in the area of power storage. Entering into a PPA allows investors and institutions financing RES hedge against such risks, and guarantee the expected return on their investment (e.g. measured at Net Present Value, hereinafter: NPV) as well as enable investors to fulfil their obligations towards financial institutions. Investors use NPV as an indicator for evaluating projects, so that they can eliminate the risk of misallocating financial resources. For a precise picture of future cash flows, the NPV must include the risk carried by the execution of a particular project. A PPA makes it possible to reduce the risk level used in calculating NPV as well as to determine the revenue expected from a given project. Consequently, for a project to be executable and to receive financing, certain guarantees as regards the production volume and its sales price are necessary.

The price of power in a PPA is based on numerous factors. The base of a PPA valuation is the price of power on the wholesale market. It could be its price on the futures market or its estimated future average spot price. Moreover, it must take into account the green energy premium. When the demand for green energy is higher than the supply, the price of green energy goes up, and so does the premium for sustainable development and the share in green transition. The price of green energy certificates of origin reflects the price consumers are inclined to pay. However,

²⁰ A PPA, apart from the commitment to sell and purchase a given volume of power, may also specify the efficiency or the operations and maintenance of the RES power plant – the energy producer agrees to make a contracted volume available to the Buyer and supply power in accordance with the Agreement.

RES doesn't produce the base product, but a so-called profile – hence there is a need to trade it on the spot market (purchasing the missing volume, selling the production surplus in relation to the products quoted on the derivatives market, which materialises the profile risk).

Undoubtedly, one of the advantages of PPAs is determining a fixed RES power price, which eliminates the impact of market risk and translates into project financing opportunities, since investors expect to secure their future revenue that is influenced by market risk (both the production volume and the sales price). They may accept the risk of volume under-production, but they expect to secure a price level that doesn't significantly deviate from the price established in the financial forecast of the profitability of a project. This is why a PPA in the form of a financial instrument makes acquiring the funds for an RES investment easier. There are two types of PPAs, depending on the physical flow of power:

- 1) PPA with a physical delivery of green power (*physical PPA*) – energy is supplied through a direct power network (via a Transmission System Operator (TSO) or a direct network between the producer and client);
- 2) *virtual PPA* (hereinafter: VPPA) – a financial instrument.

PPAs are usually quite complex as regards their structure and the competencies necessary for concluding them, which is why they are mainly concluded by large enterprises that can purchase power, or only the certificates of the power's origin, directly from the RES producer.

In a *physical PPA*, the producer and recipient must be connected to a power network (distribution or transmission). The delivery of the power in a physical PPA is usually handled by the owner of the distribution or transmission network, which means that the power supply network connects the producer and the recipient, and supplies green energy produced for the client/recipient.

If the parties are not interested in the supply of power – as is the case with the computing centres of big tech companies like Apple, Google or Microsoft – the *VPPA* is a better fit for them. It is also a solution to not being able to purchase the necessary green energy (to cover 100% of the required volume) from a local supplier's network. The offeror may be located in a different country or market area than the subject-matter of the agreement (a cross-border VPPA). A VPPA is a financial agreement where the RES installation and the recipient are connected through a financial instrument – the virtual PPA. The latter is similar to a contract for difference (for every MWh of power the buyer pays the producer a fixed price), or a swap contract. In return, the buyer gets from the producer the variable (spot) price as well as the green energy certificate of origin (Guarantee of Origin Certificate). Regardless of the virtual PPA, the RES producer may also sell their power on the open market, and the buyer may also buy power on the open market (or from a supplier). What is important in a VPPA is the fact that, on the basis of a given power price, the buyer of power who enters into a VPPA undertakes to finance part of the project. The investor or RES operator sells power on the wholesale market, while the VPPA buyer may make settlements with the project owner under a swap contract, for instance.

VPPAs are beneficial for both parties of the contract – the enterprise receives a financial equivalent of ecological power from RES at a pre-established price – while the party carrying out the project secures the necessary funds. Additionally, thanks to VPPAs buyers avoid having to physically transmit the power, and RES installation owners gain access to a larger group of entities to whom they can sell their product. Apart from traditional recipients (power companies), other

entities can be party to a VPPA too such as: financial institutions, administrative bodies, production companies or service providers (Internet companies, retail chains, chemical plants, producers of electronics, etc.). This is how these entities can show their engagement in the development of RES without directly carrying out such projects.

The VPPA can have two following characteristics:

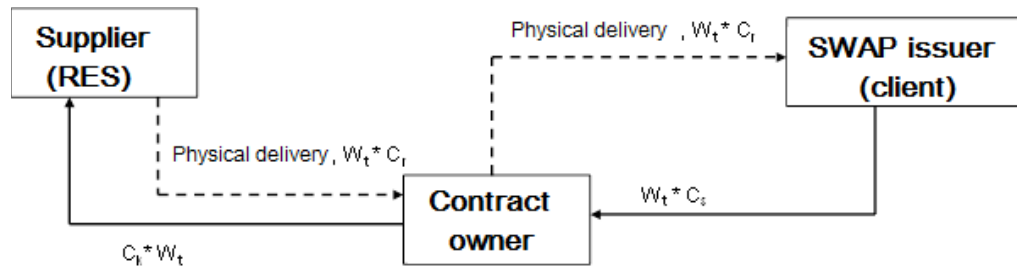
- 1) *CfD like* – a financial contract where we set a reference price and the difference is regulated by one of the parties;
- 2) *Commodity Price Swap like* – an exchange of standardized goods without its physical delivery and settled by payment with the difference in price.

As mentioned before, the PPA is a form of hedging against market risks. Analysing PPAs in this regard, we must identify a few types of VPPAs²¹ and physical PPAs:

- *SWAP* – there is no physical delivery of RES power. The contract is settled financially, the producer sells power directly to the spot market, and that is also where the buyer purchases the contracted volume of power. Thus, the market risk is mitigated for both parties – if the price of power on the spot market is higher than that specified in the contract, the developer of the RES project pays the difference to the buyer of green energy – if, however, the price on the spot market is lower than that specified in the contract, the buyer pays the difference. This mechanism would have the same effect if both parties transferred full amounts for the contracted power – the buyer pays the full amount for the whole contracted volume of RES power on the basis of the contract price – and the green energy seller transfers the full amount for selling that energy on the spot market;
- *Option* – there are two types of available options: *physically settled options* and *cash-settled options*. For VPPAs, the cash-settled option needs to be analysed, since it avoids physical power delivery. In this case, both parties have the right or obligation – depending on the type of option – to pay a given amount, calculated in accordance with the option contract;
- *Forward* – the sales of an asset, i.e. power from RES, at a specified price and with future delivery. The parties may divide the contract into two: *price of power* and *price of certificate* that confirms that the power is from RES. In this case, the price of power is directly linked to the futures or spot market (depending on the provisions of the contract).

As mentioned before, by entering into PPAs entities operating on the power market strive to hedge against market risks connected with their activity. One of the options to do that is making the PPA into a *commodity swap*. Such a contract can be used when the seller of power (e.g. an industrial plant) to the client, contracts green energy as a PPA, but at the same time concluding another PPA with the green energy producer as a way of securing its purchase.

²¹ In response to the need for PPA contracts, the European Federation of Energy Traders (EFET) prepared standard agreement templates for physical PPAs and virtual PPAs which are, in this standard, a financial instrument.

Figure 1. Applying a swap contract to hedge against the market risk of PPAs

Where:

C_k – price of the PPA contract from RES,

W_t – volume in period t ,

C_r – market price (spot, futures, etc. – selected market index),

C_s – fixed swap contract price in the PPA with the client.

Source: Own resources.

The above swap contract structure hedges against market risk both for the producer of green energy and for the client/enterprise trading power on the retail market, which is interested in purchasing green energy. It is essential to neutralise the influence of price fluctuations on the financial standing of the parties to such contract. If they were to buy and sell power on the spot market, for instance, they would be exposed to a very high risk connected with short-term price fluctuations resulting from power system balancing and, in the long run, to the risk associated with the situation on the futures power market. Thus, thanks to the specificity of swap contracts, the owner of a contract that links supply (RES) with demand (the client) enables both parties to hedge against potential power price variations by establishing one fixed price, as presented in Table 1.

Table 1. Applying a swap contract to hedge against the risk of PPAs (hypothetical prices)

C_k	C_r	Fixed SWAP price	SWAP P/L	Base instrument P/L	Contract owner's SWAP P/L
300	350	320	-30	50	20
300	230	320	90	-70	20
300	333	320	-13	33	20
300	290	320	30	-10	20

Source: Own resources.

The producer of green power (RES) supplies the swap contract owner with power at a fixed PPA contract price (C_k) in each period, despite the fact that the price with physical delivery (C_r) on the market fluctuates and varies for different delivery periods (hours, days, months) – the RES producer receives a payment from the contract owner in accordance with the price established in the PPA. The client (*demand*) would be purchasing power on the market and paying a market price for it (C_r). However, thanks to concluding a swap contract, with a swap contract owner (in this

case, the client becomes the issuer of a swap contract), the variable price (C_r) becomes a fixed swap contract price (C_s), determining the cost of purchasing green energy by the client (the swap contract becomes a quasi PPA). The difference between C_k and C_s is the profit of the swap contract owner, constituting also their premium for hedging against the renewables producer's and the client's market risk. Consequently, the swap contract becomes a risk management instrument for renewable energy producers as well as its consumers. The structure of hedging against the market risk presented above, or actually, reacting to risk by means of PPAs and swap contracts, aids to neutralise risks taken by market participants in the long term:

- the producer of renewable power is interested in guaranteeing a stable sales price level, in particular, hedging against a potential price drop on the wholesale power market in the future;
- the client (power consumer) is looking for an instrument that stabilises the purchase price of power, and hedges against a price spike on the wholesale power market in the future.

A swap contract guarantees a fixed price in a given time period, without the initial cost of acquiring a hedge, as well as an individual adaptation of the contract to the risk of the entity seeking the hedge.

The Engie initiative in Great Britain could be an example of the development of the derivatives market connected with PPAs, as it introduced fixed-price options for long-term PPAs to aid developers to overcome the obstacles of investing in capital-intensive RES projects. *Options* allow investors to choose a 100% fixed wholesale price for the entire duration of the contract, for contracts up to 10 years. Another solution could be found in *indexed price contracts*, based on reliable indices and connected with a given index, or contracts for difference. The increasing attractiveness of PPAs is also visible in trade on the financial market. The management of the European Energy Exchange (EEX) notes that some financial products, such as long-term future contracts, become directly linked with PPAs which, due to their duration, increases the demand for *PPA futures* with a maturity of up to 10 years. Creating future contracts for PPAs will also make it possible to eliminate the loan risk connected with this product, which makes PPAs more attractive as instruments for hedging risk. There is another method of hedging investment results – combining long-term PPAs, physical future contracts for 3–4 years, swap contracts for 10 years, etc. Such contracts have been present on various financial markets for years.

V. Regulatory conditions for PPAs on the Polish market

As mentioned before, negotiating a PPA requires certain competencies in the area of the energy market in financial instruments, which constitutes a high legal risk.

In view of Polish law, there is no unambiguous classification for PPAs. Essentially, it should be qualified as a bilaterally binding agreement for the purchase of power from a renewable energy source. However, VPPAs can't be classified as such, due to their strictly financial character, and since they do not include the delivery of a physical form of the subject-matter of the agreement (i.e. power), nor the transfer of its ownership. This is why a clear distinction must be made as regards the subject matter of PPAs – *standard purchase agreements*²² and *agreements for a financial settlement* that constitute a financial instrument. The former would include all PPAs

²² Art. 535(1) in connection with Art. 555 of the Civil Code [reference A].

that oblige the seller – the entity in charge of a renewable energy source – to physically hand-over the subject-matter of the agreement (power)²³. It is a secondary matter how the hand-over will actually occur, so this category will include both PPAs whose delivery of power will take place via a direct network as well as via a distribution network. It must be noted that the above category of PPAs should also meet all the requirements for power purchase agreements specified in Art. 5 of the Polish Energy Law²⁴ [reference B].

The second category – *financial PPAs (VPPAs)* – completely omits the element of handing over the subject-matter of the agreement, that is, the delivery of power. Due to omitting the element of a physical delivery of power to the buyer, where the latter can use it or re-sell it, these PPAs are called “virtual”. It is worth mentioning that purchase agreements are constituted both by transferring the ownership of the subject-matter of the agreement (power) and its hand-over²⁵. If the subject-matter of the agreement is not handed over, such an agreement cannot be considered a standard purchase agreement. Due to the above, as well as to the financial settlement mechanism of a VPPA, such agreements must be classified as financial instruments²⁶. Depending on the adopted settlement model: swap, options, financial forward or Carbon Contract for Difference (CfD), such an agreement will be classified as one of the financial instruments specified in Section C Annex 1 to the Markets in Financial Instruments Directive 2014 (MIFID II) [reference C].

Qualifying VPPAs as a financial instrument has consequences as regards the freedom of trading in these instruments. Trade in financial instruments is limited pursuant to Art. 69(1) in connection with Art. 69(2) of Act of 29 July 2005 on trading in financial instruments (hereinafter: ATFI) [reference D], although there are exceptions, as specified in Art. 70(1) ATFI [reference D]. Taking into account the purpose of PPAs explained in this article, the primary exception that makes entering into VPPAs on one’s own account practically unrestricted, is specified in Art. 70 (1) point 4 ATFI [reference D]: the possibility to purchase or sell on one’s own account financial instruments other than commodity derivatives, emission allowances or derivatives the underlying assets of which are emission allowances.

Commodity derivatives are defined in Art. 2(1) point 2 letters d–f ATFI²⁷ [reference D]. The practically unrestricted conclusion of VPPAs on one’s own account, will therefore only concern VPPAs structured as CfDs, because only this sort of contract, from the aforementioned list of the types of VPPAs, will not be classified as a commodity derivative. The remaining three types of VPPAs (swap, options or financially settled forward), the underlying asset of which is power, will be classified as commodity derivatives. As a consequence, concluding such contracts will only

²³ Art. 555 of the Civil Code [reference A].

²⁴ Act of 10 April 1997 – Energy Law [reference B].

²⁵ Art. 535 of the Civil Code [A].

²⁶ Art. 2(1) point 2 of the Act of 29 July 2005 on trading in financial instruments ([D]; (hereinafter: ATFI).

²⁷ Commodity derivatives include: d) options, future contracts, swaps, forward interest-rate agreements, and other derivatives where the underlying asset is a commodity and which are, or can be settled in cash, at the discretion of any of the parties,

e) options, future contracts, swaps, and other derivatives whose underlying asset is a commodity and which can be carried out through delivery, on condition that they are admitted to trading on the financial instrument trading market, excluding energy products that are traded wholesale on an OTF, which must be carried out through delivery,

f) options, future contracts, swaps, forward agreements, and other derivatives not admitted to trading on the financial instrument trading market, whose underlying asset is a commodity and which can be carried out through delivery but which are not intended for trading and have the properties of other derivative instruments,

i) options, future contracts, swaps, forward interest-rate agreements, and other derivatives relating to climate change, freight rates, inflation rates or other official statistical data, which are or can be carried out via cash settlement, at the discretion of any of the parties, as well as derivatives specified in Art. 8 of Regulation 2017/565 and others that have the properties of other derivative instruments.

be possible under an *ancillary activity exemption*²⁸. This is why entities interested in concluding VPPAs structured as: swap, option or cash-settled forward contracts, will be forced to meet additional regulatory requirements that will enable them to conduct business under an ancillary activity exemption²⁹.

The second classification of PPA's proposed above was into *sensu stricto PPA's* and *corporate PPA's* – a classification based on the final customer status³⁰. PPA's where the recipient is a non-final customer, that is, contracts concluded on the wholesale market between the producer and trading company³¹, have been present on the market for a very long time. Trading companies would secure power for further re-sale. *Corporate PPA's* (hereinafter: CPPA's) are a relatively new construct on the market that directly links the producer with the recipient. Such contracts also come in two variants: *physical CPPA's* or *virtual CPPA's*. The latter do not entail any additional regulatory requirements than the ones for VPPA's already described above. By contrast, physical CPPA's must take into account all the requirements for agreements for the sale of power to a final customer.

Once again Art. 5 of the Energy Law [reference B] must be mentioned, which specifies the requirements for power sales agreements. From a regulatory point of view, it is more important for a trading company to fulfil its environmental duties, namely the obligation to redeem a given number of certificates of origin issued for power generated from renewable energy sources³² and from energy efficiency certificates³³. In order to fulfil these obligations, the entity in charge of the RES installation must secure the possibility of acquiring property rights (i.e. must have an account in the property rights register and be able to conclude stock transactions with property rights as their subject-matter). The necessity to ensure the above competencies on the part of the entities in charge of RES installations, constitutes a significant and additional organisational burden for them and, in consequence, has a negative influence on the development of power sales under CPPA's.

VI. Conclusions

The article's analysis of the selected green-transition financial instruments currently on the market clearly shows how varied and accessible they are becoming, thus being increasingly available to companies (the final recipients of power). Simultaneously, the regulatory conditions are complex and elaborate regarding both the financial instruments market, and the power market with its increasing need to ensure the security of supply. Thus, the companies that want to benefit from the instruments for the financing of green transition need to demonstrate a great deal of specialist knowledge, which is an obstacle in utilising those instruments. However, a detailed analysis of the mechanism of financing RES through PPA's proves that selecting the right contract model makes it possible to meet the needs of both the power producers and the recipients, at the same time minimising regulatory risks. The analysis carried out in this article proved that

²⁸ See: Art. 70(1) point 10 of the ATFI [reference D].

²⁹ By activities that are the company's ancillary business mentioned in Art. 70(1) point 10 are understood here as activities that meet the criteria described in the Commission Delegated Regulation (EU) 2021/1833 of 14 July 2021 [reference E].

³⁰ See Art. 3 point 13a of the Energy Law [B], which defines a final customer as: a customer purchasing fuels or energy for their own use; own use does not include power purchased with the aim of being used to produce, transfer or distribute power and gas fuels purchased with the aim of being used to transfer, distribute or storing gas fuels, liquefaction of natural gas or the re-gasification of liquefied natural gas.

³¹ A power company with a license for power trading.

³² See Art. 52(1) in connection with Art. 52(2) point 2 of the Act [F].

³³ See Art. 10(1) in connection with Art. 10(2) point 1 of the Act [G].

use of green finances' products makes it possible to hedge the market risk of both green power producers and customers, in compliance with the regulations of financial markets. Therefore, the issue of the application of green finance relates not only to economic problems, but to a broadly perceived area of compliance and legal category, a realisation stressed by the authors in the last section of the article.

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Instrumenty finansowe zielonej transformacji

Streszczenie

Zielona transformacja tworzy zmiany nie tylko dla realnej gospodarki, ale także dla szeroko rozumianych finansów, tworząc zarówno ryzyko, jak i szanse. Ma to fundamentalne znaczenie dla przedsiębiorstw i instytucji finansowych, które muszą się dostosować do nowych warunków funkcjonowania. Ryzyko powstaje w obszarach podlegających presji regulacyjnej i rynkowej, wymuszając zmiany strategii rynkowej lub metod produkcji. Regulacje również mogą stwarzać szanse, m.in. dla rozwoju czystych technologii, w szczególności wspierających ograniczenie emisji gazów cieplarnianych, rozwój odnawialnych źródeł energii, rewolucję cyfrową na rynku energii czy wprowadzenie nowych elementów na rynek finansowy. Uwzględnienie tych tendencji jest niezbędne dla powodzenia gospodarek. Niedocenianie postępujących zmian klimatu i intensywna działalność człowieka sprawiły, że ochrona klimatu i konieczność transformacji gospodarki stały się priorytetem. W związku z tym wdrożenie zielonej transformacji wymaga odpowiednich środków na finansowanie zielonych projektów. Biorąc pod uwagę powyższe tendencje w światowej gospodarce, autorzy przedstawiają instrumenty finansowe dostępne dla wspierania zielonej transformacji, uwzględniając praktyczne zagadnienia kształtujące przyszłość rynku energii elektrycznej. W związku z tym przedstawiają instrumenty finansowe wykorzystywane do transformacji energetycznej i walki ze zmianami klimatycznymi. Autorzy zwracają uwagę na znaczenie zielonych finansów, które jako element systemu finansowego przejmują odpowiedzialność za zapewnienie kapitału i narzędzi zarówno do finansowania celów klimatycznych, jak i efektywnego zarządzania ryzykiem przez podmioty zaangażowane w ten proces.

Słowa kluczowe: zielona transformacja; neutralność klimatyczna; zielone finanse; elektroenergetyka; instrumenty finansowe; ryzyko; zarządzania; OZE.

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