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EMPIRICAL ANALYSIS OF GREEN ENTERPRISES ACTIVITY AND PROSPECTS FOR RENEWABLE ENERGY DEVELOPMENT IN UKRAINE

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Purpose. This paper comprehensively analyzes the performance of five prominent Ukrainian green enterprises spanning the period from 2016 to 2020. Specifically, it focuses on PJSC Myronivskiy Hliboprodukt and NJSC Naftogaz, recognized as top contributors to green technologies in Ukraine, and delves into the green metallurgy advancements of PJSC Interpipe Steel, PJSC Energomashspetsstal, and PJSC Dniprospeksstal. The study not only evaluates their achievements but also formulates strategic recommendations, outlining a potential developmental roadmap for fostering positive transformations within the Ukrainian green economy.

Design/Methodology/Approach. The problem of establishing an effective financial mechanism in Ukraine, aimed at the development of the green economy through green investment, and, therefore, the search for sources of funding for green business, is currently open for discussion. The study of the financial statements of five green enterprises in Ukraine as well as the currently existing approaches to solving the above-mentioned problems made it possible to determine the sources of financing the green economy, which embrace the state budget (through targeted state and regional investments), foreign (international) investments, commercial funds (funds of off-budget investment, environmental and other funds), own funds (funds of enterprises and organizations creating market infrastructure - environmental investment banks, natural resource exchanges, consulting agencies).

Findings. Both social and economic benefits of the development of renewable energy sources are undeniable. However, no sector of the economy will be able to develop sustainably without appropriate state incentives and an attractive business climate in the country. Under current conditions, the Government of Ukraine faces the task of preserving those national and international investors in RES who have already invested in the economy of Ukraine, providing conditions for their further business activity in the post-war period. The financial mechanism for the formation of a green economy can function effectively if one understands the factors of a green financial system, which rely on environmentally determined transformations of the modern investment environment. These include: a) transformation of investors' assessments of environmental investment results; b) growing needs for intermediary services of the financial sector as a result of the development of market mechanisms for

ensuring sustainable development (carbon markets, green technologies among others); c) representativeness of market assessments of ecologically safe production; investment attractiveness of various financial instruments, peculiarities of their pricing.

Practical implications. The results obtained during the analysis of the profitability indicators of the mentioned enterprises made it possible to set recommendations for the potential developmental vector for changes in the green economy in the Ukrainian market. The prospects for the development of renewable energy sources in Ukraine have been analyzed to prove that starting from 2019, investments in new renewable energy projects in Ukraine have been consistently higher than those in fossil fuel projects.

Originality/Value. The paper not only contributes valuable data on sustainable practices of Ukrainian green enterprises but also formulates recommendations, outlining a potential developmental trajectory for advancing the green economy within the Ukrainian market. This dual focus on analysis and strategic recommendations enhances the originality and practical value of the paper.

Key words: energy transition; energy independence; green enterprises; renewable energy sources; Ukraine.

Paper type: research paper.

Formulation of the problem

The transition to a more sustainable and environmentally friendly economy has become a global imperative, with Ukraine being no exception. As the world grapples with the challenges of climate change, seeking to reduce its reliance on fossil fuels, the development of renewable energy sources has emerged as a crucial solution. In particular, in Ukraine, with its abundant renewable energy potential, green enterprises play a vital role in driving this transition.

This paper presents an empirical analysis of the green enterprises activity in Ukraine, while exploring the prospects for the development of renewable energy in the country. By examining key indicators of profitability, as well as assessing the market dynamics, we aim to shed light on the current state and future trajectory of the renewable energy sector in Ukraine. Moreover, the article examines the broader prospects for renewable energy development in Ukraine, considering the investment landscape, international cooperation, and the role of technology advancements in shaping the future of renewable energy in Ukraine.

The empirical analysis focuses on the comprehensive assessment of green enterprises, which use renewable energy sources such as solar, wind, biomass, and others. These enterprises play a critical role in harnessing the country's renewable energy potential, reducing greenhouse gas emissions, and contributing to a more sustainable energy future. Furthermore, it gives a better perspective into the opportunities and challenges faced by green enterprises in Ukraine and their potential for sustainable expansion.

By analyzing these key factors, this paper aims to provide a comprehensive assessment of the activity of green enterprises and the prospects for renewable energy development in Ukraine. It seeks to inform policymakers, investors, and stakeholders about the current state of the sector, identify areas of improvement, and highlight the opportunities for growth in the transition towards a more sustainable and resilient energy system.

In conclusion, the empirical analysis presented in the given research paper offers valuable insights into the activity of green enterprises in Ukraine and the prospects for renewable energy development. As the country seeks to reduce its carbon footprint and embrace cleaner energy sources, it is vital to understand the current landscape and future potential of the renewable energy sector in order to chart a path towards a greener and more sustainable future.

Analysis of recent studies and publications

Ukraine has established an extensive legal and policy basis for sustainable development. National SDGs for 2030 have been established by the presidential decree and are accompanied by a framework for monitoring progress, with annual reports [1]. The State Environmental Policy Strategy (Environmental

Policy) [2] and the more recent National Economic Strategy [3] both identify sustainable development as a key goal and principle. There are references to sustainable development in numerous other national sectoral policy documents.

The comprehensive study of energy transition is realized through the works of German researchers. Research work by two German scientists, Lars Holstenkamp and Jörg Radtke [4], provides insights into the transformation of the energy system in Germany and other countries within the context of civil society, actions taken in economic and state domains, and contributions from the social sciences and humanities. Fritz Dieter Erbslöh [5] describes how the energy transition project came about in his work. The research work of Andrew Dessler [6] comprises an introduction to economic and policy issues and is tightly focused on anthropogenic climate change.

The work done by Ukrainian researchers is significant. In his monograph Stepan Kudria [7] presents materials on energy conversion from various types of renewable sources. Natalia Stankevich notes in her article [8] that the transition to a green economy has both social and economic justification. There are compelling arguments in favor of redoubled efforts by both the state and the private sector to bring about such an economic transformation. The author believes that in this regard, the state faces the task of levelling the playing field for “green” products by refusing to provide outdated subsidies, reforming policy and creating new incentives, strengthening the market infrastructure and market mechanisms, redirecting public investments, and transitioning to green public procurement. Additionally, the article of Ukrainian scientist Igor Gaidutskiy [9] analyzes the effectiveness of measures taken at national and global levels to prevent climate change due to increased emissions of greenhouse gasses.

Formulating hypotheses and setting goals

Hypothesis 1: Green enterprises in Ukraine, particularly PJSC Myronivskiyi Hliboprodukt and NJSC Naftogaz, demonstrate significant contributions to the advancement of green technologies in the country. Hypothesis 2: The financial mechanisms for the development of the green economy in Ukraine, including state budget allocations, foreign investments, commercial funds, and enterprise funds, play a crucial role in fostering the growth of green enterprises and renewable energy projects.

Research objectives are: a) assess the performance and contributions of prominent Ukrainian green enterprises towards the advancement of green technologies from 2016 to 2020; b) analyze the profitability indicators of selected green enterprises in Ukraine, such as PJSC Myronivskiyi Hliboprodukt, NJSC Naftogaz, PJSC Interpipe Steel, PJSC Energomashspetsstal, and PJSC Dniprospetsstal, over the specified period; c) examine the effectiveness of financial mechanisms, including state budget allocations, foreign investments, commercial funds, and enterprise funds, in supporting the development of green enterprises and renewable energy projects in Ukraine; d) formulate strategic recommendations for fostering positive transformations within the Ukrainian green economy based on the findings of the empirical analysis and assessment of the prospects for renewable energy development in the country.

Research methods

The methodology for empirical analysis of green enterprises’ profitability indicators involves, among others, gathering data, calculating profitability indicators, and interpreting the results. It is important to ensure that the data is reliable and accurate in order to consider a range of factors that may impact profitability. Thus, the empirical analysis of profitability indicators for green enterprises in Ukraine has been divided into several steps:

1. Selection of green enterprises: identifying the cases of green enterprises engaged in renewable energy or other types of environmentally sustainable activity in Ukraine.
2. Collection of data: gathering financial data for the five selected enterprises, comprising, among others, revenue, costs, assets, and liabilities supported by the official financial documentation of the enterprises.

3. Calculation of profitability indicators: calculating profitability indicators for each enterprise, such as gross profit margin, net profit margin, return on assets, and return on equity among others, thereby providing insights into the financial performance of the enterprises.

4. Interpretation of results: drawing conclusions on the financial performance of green enterprises and the factors that contribute to profitability as well as interpreting the results of the analysis.

1. General characteristics of the green enterprises activity in Ukraine

This article analyzes five Ukrainian green enterprises, namely, PJSC Myronivskiyi Hliboprodukt, NJSC Naftogaz, PJSC Interpipe Steel, PJSC Energomashspetsstal, PJSC Dniprospetsstal.

1.1. PJSC Myronivskiyi Hliboprodukt

The private joint-stock company “Myronivskiyi Hliboprodukt” (hereinafter – PJSC MHP) [10] is known in Ukraine and abroad as one of the leading producers of poultry in Europe featuring one of the strongest product brands in Ukraine (TM “Nasha Ryaba” [11]), the largest producer in the meat processing market of Ukraine. Additionally, it is one of the largest grain producers in Ukraine with significant growth potential. In 2019, the company’s enterprise introduced the technology of processing grain production waste into fuel briquettes that can be used in solid fuel boilers, which makes it possible to reduce the amount of production waste and the costs of transporting this waste, among others.

Currently, the company operates three biogas complexes, two of which are located in Ukraine (with the total capacity of 17.5 MW), another one in Slovenia with a capacity of up to 1.1 MW. These biogas complexes make it possible to efficiently dispose of production waste, generate clean energy, significantly reduce greenhouse gas emissions, and produce environmentally friendly organic fertilizers. The use of the latter for the development of organic agriculture in Ukraine will bring the enterprise to the top positions in the world production of organic products. In 2021, PJSC MHP received the fourth “Ekooskar” in a row for the new “Biogas 5.0” program [12], which caters for the utilization of waste, the generation of clean energy and organic fertilizers, the reduction of greenhouse gas emissions and the production of CO₂ and biomethane, as well as the integration of green technologies hydrogen. In 2021, it was recorded that the company consumed up to 18 % of electricity from renewable sources in the Ukrainian operating segment (up to 8 % in the European segment). In the summer of 2022, at the Global Biogas Industry Awards Competition “AD&Biogas Industry Award 2022”, the PJSC MHP biogas complex was recognized as one of the highly commended in the world in the “AD Circular Solution” category [13]. Currently, the company is implementing a program to achieve carbon neutrality of PJSC MHP by 2030.

1.2. NJSC Naftogaz

One of the leaders in the green energy market in Ukraine is the state-owned NJSC Naftogaz (national joint-stock company “Naftogaz”) [14], the leading enterprise in the country’s fuel and energy complex. During the period under review, the company set a course for the implementation of the “New Energy” direction, which involves activity in the field of renewable energy, in particular, solar and wind generation, as well as technologies for the production and transportation of hydrogen, bioenergy, carbon capture and storage. In the process of achieving the key task of ensuring the green transition of business by 2050, the company implements “green” practices in the following areas [15]:

- biomass: production of thermal energy from biomass (fuel wood chips) and household waste (RDF), as a component of the company’s low-carbon business strategy. Due to the implementation of these projects, NJSC Naftogaz plans to replace 1.8 billion m³ of natural gas by 2027;
- biogas: production of biogas and biomethane, which plays an important role in the process of decarbonization of business. The long-term ambition is to produce 5 billion m³ of biomethane and hydrogen annually, as well as to replace 1 billion m³ of gas (including biomass);
- solar energy: in 2020, the pilot solar power plant “Andriivka” in the Kharkiv region with a capacity of 1 MW was put into operation. A 33 MW solar power plant in the town of Chudniv, Zhytomyr region, is operating normally;

- wind energy: design work is ongoing to assess the prospects for the construction of the Maryivka wind power plant with a capacity of 20 MW in the Mykolaiv region, as well as two facilities in the Odesa region with a total capacity of 50 MW;
- hydrogen: it is planned to become a national leader in the production of green hydrogen for the domestic market and export to the EU. A memorandum for the implementation of joint projects was signed with the German RWE as well as other foreign and Ukrainian companies;
- electric charging stations: as part of the WeEnergy project, Naftogaz, together with partners, is developing the infrastructure for electric cars. 10 modern charging complexes are already operating on the busiest streets of Kyiv;
- projects on carbon capture, utilization and storage: the prospect of applying carbon capture, utilization and storage technologies, in particular, in depleted oil and gas fields, as well as potential underground gas storages, is being explored;
- energy service: PJSC Naftogaz works on energy-efficient solutions for end users, in the light of energy efficiency being not only the rational use of energy resources and cost savings, but also the issue of energy independence, national security and the fight against climate change.

1.3. PJSC Interpipe Steel

The flagship of Ukraine's green metallurgy is a private joint-stock company "Interpipe Steel" [16], which in 2012 made the largest environmental investment of a billion USD into the construction of the innovative electric steelmaking complex "Interpipe Steel", closing the environmentally outdated open hearth production plant, replacing it with the electric steel making furnaces. This made it possible to reduce the emissions of CO₂ by 10 times and harmful substances by 2.5 times, as well as the consumption of natural gas by 8 times [17].

The plant has built a closed cycle of circulating water supply, which allows to completely exclude the discharge of industrial wastewater into the Dnipro river and other water reservoirs. That is, all water used in production is purified and reused. The company takes water from the Dnipro River only to get the system going. Emissions of harmful substances into the air have been reduced to a minimum thanks to the installation of modern gas and dust cleaning systems, which effectively capture gas and dust generated in the course of steel production. The dust settles in the filters, after which it is granulated. As a result, purified, almost pure gasses enter the atmosphere.

In order to ensure the non-stop monitoring of these parameters, an atmospheric air monitoring post was built on the verge of the sanitary zone of the enterprise. These and many other highly effective environmental protection technologies make it possible to minimize the negative impact of production on the ecological situation in the region. PJSC Interpipe Steel is a benchmark not only for the further development of national green metallurgy, but also for the large-scale ecological transformation of the entire economy of Ukraine.

1.4. PJSC Energomashspetsstal

The following case study is the green metallurgy enterprise – a private joint-stock company "Energomashspetsstal" [18], which is the largest Ukrainian manufacturer of special cast and forged products of customized and small-scale production for metallurgy, shipbuilding, power engineering (wind, steam, hydro, nuclear) as well as general mechanical engineering. The enterprise has the latest metallurgical and mechanical processing equipment, which makes it capable of performing a full production cycle. It uses wind energy installations with a capacity of 2.5 MW, the joint project implemented with the German company Fuhrlander.

1.5. PJSC Dniprospetsstal

Moving on to the financial situation at PJSC Dniprospetsstal [19] – the only enterprise in Ukraine that specializes in the production of special steels: graded rolled steel, calibrated steel, as well as bearing, nickel-

free and chrome-nickel steel. The enterprise is the key manufacturer of grade stainless steel in the CIS markets. It manufactures more than 800 grades of steel and alloys and over 1,000 different rolled profiles.

To date, PJSC Dniprospsstal has fully implemented water protection measures: the AMIAD post-cleaning filter has been put into operation in the rolling shop. Thanks to this, the discharge of used technical water into the sludge storage tank is reduced by 1 million m³ per year. Building and putting into operation pumping systems, used for returning technical water to the circulating system of the plant, allows to reduce the use of clean water by 500,000 m³ per year.

The enterprise has a safety radiation and radiation control laboratory, which enables taking timely measures to protect city residents from sources of ionizing radiation. The commencement of CVS Makina dust and gas treatment plant with a capacity of 1,200,000 m³/hour ensures a significant reduction in the level of suspended solid particles emissions into the atmosphere [20].

Thus, as it can be seen from the above description of the main types of green enterprises activity in Ukraine, the country has a significant potential for dynamic growth of the domestic market for each of the above mentioned innovative segments and is successfully forming a developed institutional infrastructure for state support for the innovative development of the economy.

Presenting main material

To implement the algorithm for analyzing the profitability of green enterprises in Ukraine, it is necessary to describe the main indicators of their economic activity, which are included in the official financial statements.

The main indicators of the economic activity of PJSC MHP for 2016–2020 are specified in Table 1. In addition, Table 1 contains the results of the estimation of the main profitability indicators of this enterprise.

Table 1

Indicators of economic activity and indicators of profitability of PJSC MHP for 2016–2020, in thousands UAH

Indicator	2016	2017	2018	2019	2020
Sales Revenue	12724865.00	17849182.00	34464262.00	4996319.00	4300428.00
Cost of Goods Sold (COGS)	9629379.00	13118292.00	26943084.00	4125916.00	3843803.00
Gross Profit Margin	3095486.00	4730890.00	7521178.00	870403.00	456625.00
Net Income (NI)	-3551490.00	-1521408.00	3971908.00	-146473.00	1205797.00
Equities	-7279509.00	-15607360.00	-13525529.00	6868215.00	8074058.00
Long-term Liabilities	16997285.00	21248138.00	20945871.00	39002.00	36477.00
Assets	40718494.00	30767249.00	30524831.00	8363209.00	8980057.00
Return on Assets (ROA), %	-0.09	-0.05	0.13	-0.02	0.13
Return on Sales (ROSni), %	-0.28	-0.09	0.12	-0.03	0.28
Product Profitability Ratio (PPR), %	1.32	1.36	1.28	1.21	1.12
Return on Equity (ROE), %	0.49	0.10	-0.29	-0.02	0.15
Return on Invested Capital (ROIC), %	-0.37	-0.27	0.54	-0.02	0.15
EBIT	2000369.00	2966641.00	4520099.00	581769.00	287447.00
NOPAT	1500276.75	2224980.75	3390074.25	436326.75	215585.25
EVA	9717776.00	5640778.00	7420342.00	6907217.00	8110535.00
WACC, %	7.13	6.12	6.59	8.00	8.00

Source: calculations made by the author based on the company's financial statements.

The comparative analysis of the profitability indicators of PJSC MHP in the course of the specified period is presented in Fig. 1. As it can be seen from Fig. 1, in the course of the revised period, there has been a fluctuation in the indicators of profitability of assets, sales, equity, invested capital from negative values in 2016, 2017 and 2019 to positive values in 2018 and 2020 respectively. Simultaneously, in 2016, 2017 and 2018, with negative values of the ratios of return on assets, sales and invested capital, the company had a positive return on equity and products. It should be noted that throughout the studied period of 2016–2020, the profitability of the company's products remained high.

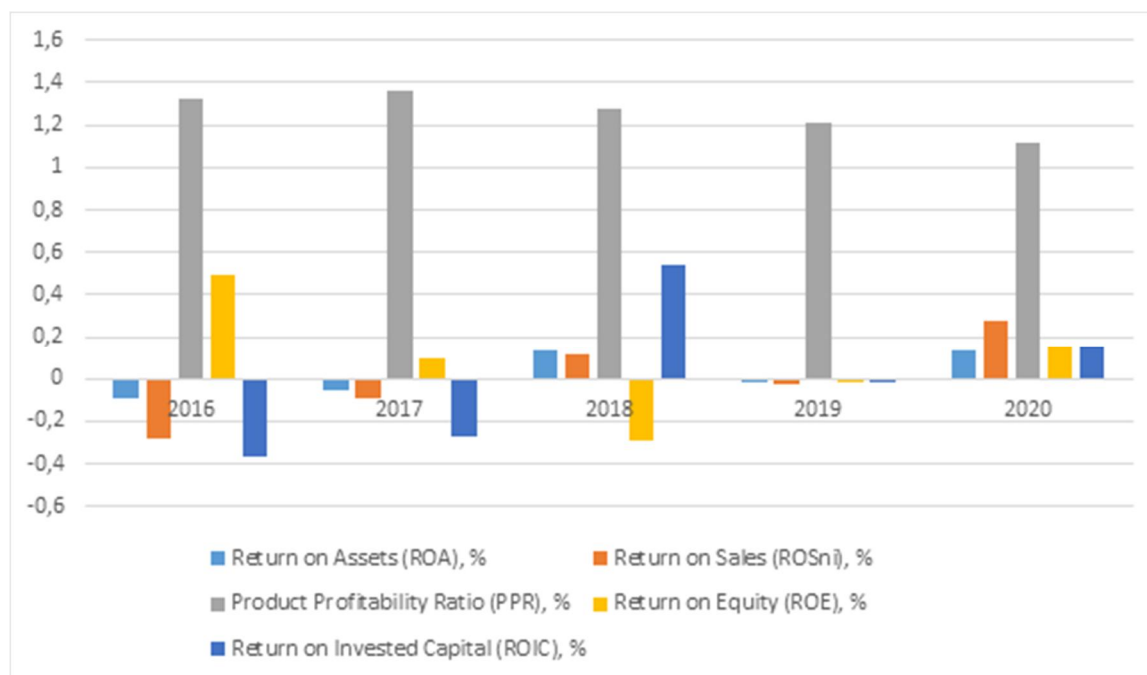


Fig. 1. Comparative characteristics of the obtained data in terms of profitability indicators at PJSC MHP in the period of 2016–2020

Source: calculations made by the author based on the company's financial statements.

From the Fig. 1 above, it can be concluded that, despite the negative values of profitability indicators of assets, sales and invested capital, the enterprise, due to the high profitability of products and equity capital, has the potential to increase its production capacity and the correlation of “weak areas” in the future. Once the positive values of all profitability indicators are achieved, it is seen as an opportunity in terms of effectively investing in the activity of PJSC MHP due to the existing efficiency of production activity and the company's pricing policy.

Table 2 demonstrates the main indicators of the economic activity of NJSC Naftogaz for the period of 2016–2020 as well as the estimates of the main indicators of the company's profitability.

Table 2

Indicators of economic activity and profitability indicators of NJSC Naftogaz for the period of 2016–2020, in thousands UAH

Indicator	2016	2017	2018	2019	2020
1	2	3	4	5	6
Sales Revenue	16138284.00	18792748.00	25631785.00	22876257.00	28959409.00
Cost of Goods Sold (COGS)	11627732.00	14663950.00	25074344.00	22205178.00	28252253.00
Gross Profit Margin	4510552.00	4128798.00	557441.00	671079.00	707156.00

Continuation of Table 2

1	2	3	4	5	6
Net Income (NI)	26528.00	39330.00	29569.00	18987.00	115207.00
Equities	447832.00	431505.00	1725438.00	1535563.00	383496.00
Long-term Liabilities	303173.00	14258.00	15898.00	11504.00	7878.00
Assets	5997926.00	6389467.00	9052410.00	6333283.00	14137225.00
Return on Assets (ROA), %	0.00	0.01	0.00	0.00	0.01
Return on Sales (ROSni), %	0.00	0.00	0.00	0.00	0.00
Product Profitability Ratio (PPR), %	1.39	1.28	1.02	1.03	1.03
Return on Equity (ROE), %	0.06	0.09	0.02	0.01	0.30
Return on Invested Capital (ROIC), %	0.04	0.09	0.02	0.01	0.29
EBIT	3896541.00	3201485.00	391203.00	420961.00	451672.00
NOPAT	2922405.75	2401113.75	293402.25	315720.75	338754.00
EVA	751005.00	445763.00	1741336.00	1547067.00	391374.00
WACC, %	7.80	7.98	8.00	8.00	7.99

Source: calculations made by the author based on the company's financial statements.

The comparative analysis of profitability indicators of NJSC Naftogaz for the specified period is presented in Fig. 2.

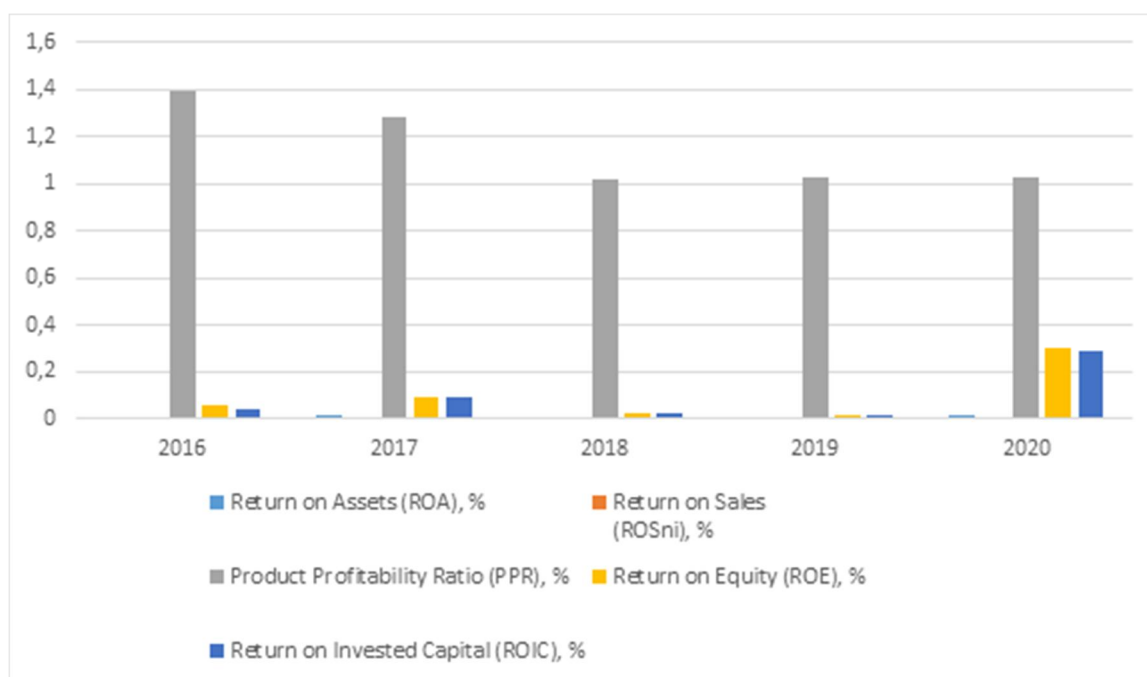


Fig. 2. Comparative analysis of NJSC Naftogaz profitability indicators for the period of 2016–2020

Source: calculations made by the author based on the company's financial statements.

So, as can be seen from Fig. 2, the comparative diagram of NJSC Naftogaz does not provide a sales profitability ratio, i.e. it equals zero. Return on sales is a key indicator of a company's financial outcomes, showing how much of an organization's revenue constitutes profit. In the given case, the company's profit

is respectively 0. The average return on assets also accounts for 0. The ratios of return on equity and invested capital are negative, but they also tend to zero. These indicators demonstrate that the company, taking into account the potential that is embedded in it, is unprofitable, despite the positive value of the profitability of the products during the studied period. Based on the fact that this enterprise is subsidized by the state, it is absolutely necessary to emphasize its unprofitability for the time being.

It is essential to analyze the main indicators of economic activity and the calculated main profitability indicators of the PJSC Interpipe Steel for the period 2016–2020, which are presented in Table 3.

Table 3

**Indicators of economic activity and profitability of PJSC Interpipe Steel for 2016–2020,
in thousands UAH**

Indicator	2016	2017	2018	2019	2020
Sales Revenue	5052242.00	10423283.00	13664542.00	14624632.00	9470237.00
Cost of Goods Sold (COGS)	4291563.00	8072886.00	10408619.00	9584769.00	6803259.00
Gross Profit Margin	760679.00	2350397.00	3255923.00	5039863.00	2666978.00
Net Income (NI)	-1136428.00	313396.00	1027889.00	3562297.00	22905.00
<i>Equities</i>	473589.00	784785.00	1113061.00	4677387.00	4676228.00
Long-term Liabilities	3671147.00	3789075.00	511829.00	2460156.00	3281211.00
Assets	11980103.00	16269021.00	19069157.00	20704488.00	18518475.00
Return on Assets (ROA), %	-0.09	0.02	0.05	0.17	0.00
Return on Sales (ROSni), %	-0.22	0.03	0.08	0.24	0.00
Product Profitability Ratio (PPR), %	1.18	1.29	1.31	1.53	1.39
Return on Equity (ROE), %	-2.40	0.40	0.92	0.76	0.00
Return on Invested Capital (ROIC), %	-0.27	0.07	0.63	0.50	0.00
EBIT	492235.00	1906542.00	1859520.00	4937001.00	1068335.00
NOPAT	369176.25	1429906.50	1394640.00	3702750.75	801251.25
EVA	4144736.00	4573860.00	1624890.00	7137543.00	7957439.00
WACC, %	7.56	7.59	7.84	7.83	7.79

Source: calculations made by the author based on the company's financial statements.

A comparative analysis of PJSC Interpipe Steel profitability indicators during the specified period is presented in Fig. 3.

As can be clearly seen from Fig. 3, 2016 was the unprofitable year for the enterprise, since all indicators, except for product profitability, had a negative value. However, during the period of 2017–2019, the situation changed for the better, as the company managed to increase the efficiency of its economic activity, namely, return on assets, return on sales, return on equity, return on invested capital increased and adopted positive indicators. However, in 2020, the situation worsened again, as all indicators (except product profitability) dropped to 0, which demonstrates the worsening of the company's financial condition and a significant decrease in its profitability. Although PJSC Interpipe Steel at the end of 2020 accounted for the net profit of 22,905,000 UAH, this figure decreased 155 times over the course of the year. Simultaneously, during the studied period, the profitability of the products had a positive value.

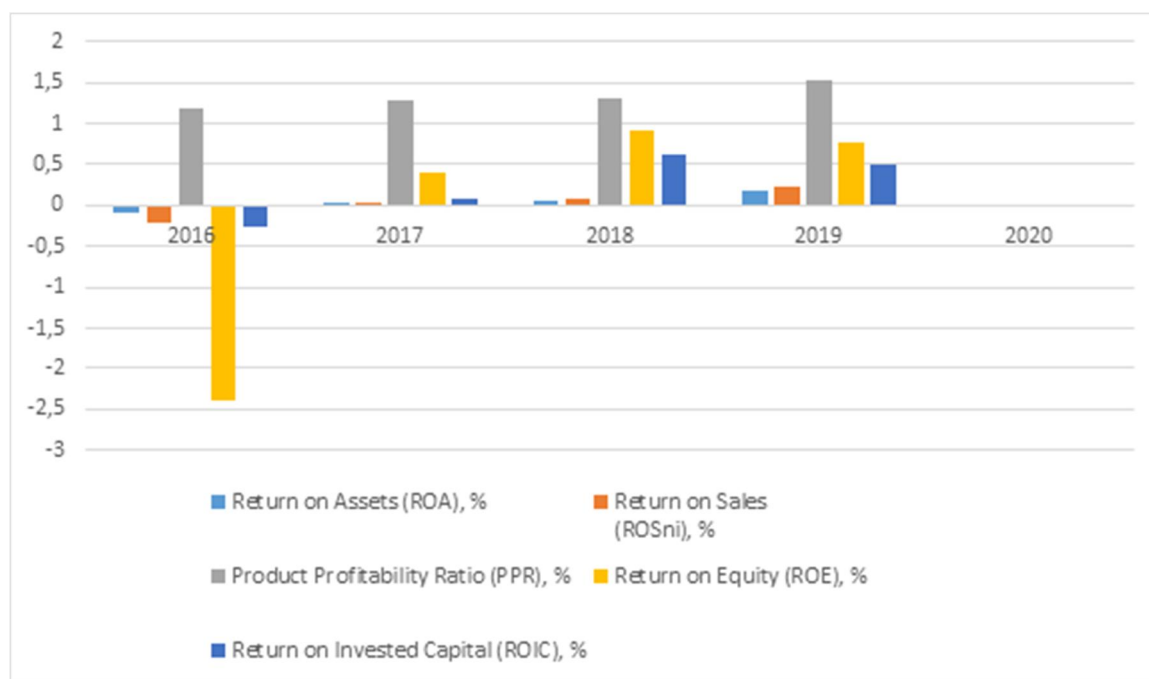


Fig. 3. Comparative characteristics of profitability indicators of PJSC Interpipe Steel for the period of 2016–2020

Source: calculations made by the author based on the company's financial statements

Table 4 shows the main indicators of the economic activity of PJSC Energomashpetsstal for the period of 2016-2020 and the estimated indicators of the company's profitability.

Table 4

Indicators of economic activity and profitability indicators of PJSC Energomashpetsstal for the period of 2016–2020, in thousands UAH

Indicator	2016	2017	2018	2019	2020
Sales Revenue	1853825.00	1500460.00	2373313.00	1935993.00	3313975.00
Cost of Goods Sold (COGS)	1574267.00	1441163.00	2084175.00	1930553.00	2368006.00
Gross Profit Margin	279558.00	59297.00	289138.00	5440.00	945969.00
Net Income (NI)	-1497854.00	-930557.00	-293620.00	866371.00	-1398580.00
Equities	1221680.00	2271706.00	-7058148.00	6011087.00	7431011.00
Long-term Liabilities	-5793619.00	-6745191.00	1396567.00	1398928.00	1323123.00
Assets	4053843.00	4042538.00	4106306.00	4381280.00	4390389.00
Return on Assets (ROA), %	-0.37	-0.23	-0.07	0.20	-0.32
Return on Sales (ROSni), %	-0.81	-0.62	-0.12	0.45	-0.42
Product Profitability Ratio (PPR), %	1.18	1.04	1.14	1.00	1.40
Return on Equity (ROE), %	-1.23	-0.41	0.04	0.14	-0.19
Return on Invested Capital (ROIC), %	0.33	0.21	0.05	0.12	-0.16
EBIT	569821.00	874596.00	1868795.00	1025964.00	2458633.00
NOPAT	427365.75	655947.00	1401596.25	769473.00	1843974.75
EVA	-4571939.00	-4473485.00	-5661581.00	7410015.00	8754134.00
WACC, %	7.37	7.25	8.12	7.91	7.92

Source: calculations made by the author based on the company's financial statements.

A comparative analysis of the profitability indicators of PJSC Energomashspetsstal during the specified period is presented in Fig. 4.

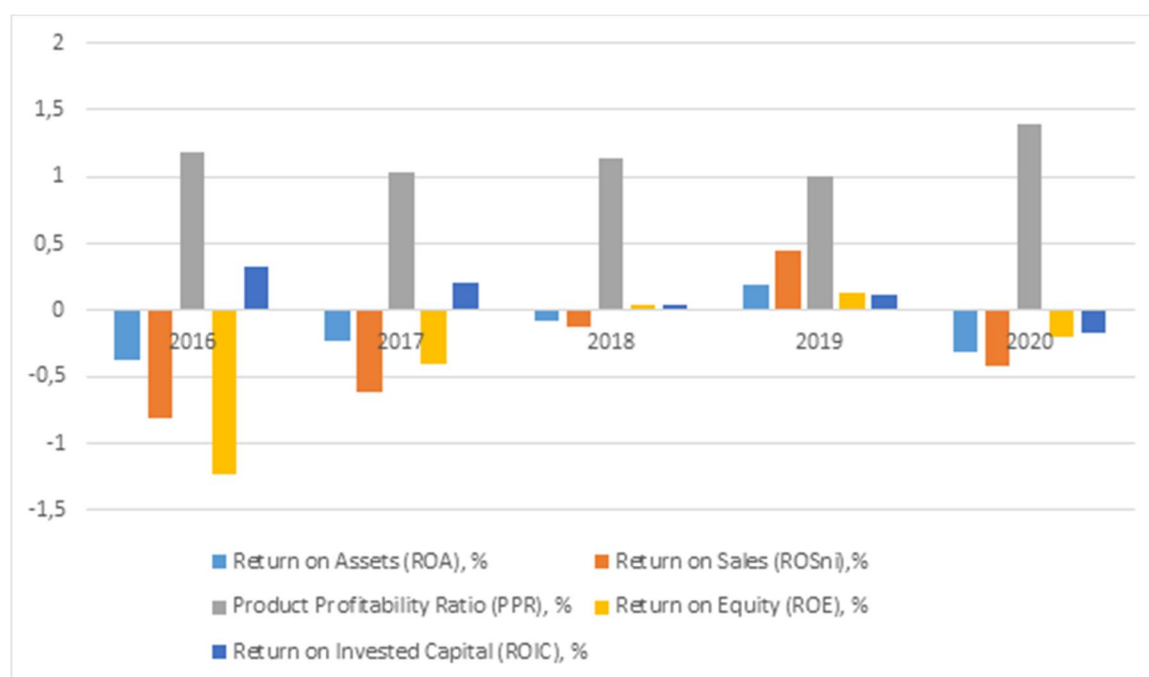


Fig. 4. Comparative characteristics of the profitability indicators of PJSC Energomashspetsstal for the period of 2016–2020

Source: calculations made by the author based on the company's financial statements.

Thus, as shown in Fig. 4, PJSC Energomashspetsstal has demonstrated an unsatisfactory level of economic activity, with a tendency to maintain negative profitability indicators, which implies the inefficient operation of the enterprise. The ratios of return on assets, return on sales, return on equity have negative values in 2016–2018 and 2020, contrasted to the regeneration of indicators in 2019, yet up to the insignificant scales. Simultaneously, throughout the studied period, the product profitability ratio has positive values (2016 – 1.18; 2017 – 1.04; 2018 – 1.14; 2019 – 1.00; 2020 – 1.40 respectively).

Table 5 presents the main indicators of the economic activity of PJSC Dniprospetsstal for the period of 2016–2020 and the estimated indicators of the company's profitability.

Table 5

Indicators of economic activity and profitability indicators of PJSC Dniprospetsstal for the period of 2016–2020, in thousands UAH

Indicator	2016	2017	2018	2019	2020
1	2	3	4	5	6
Sales Revenue	6319107.00	8151198.00	9616951.00	8280234.00	7113451.00
Cost of Goods Sold (COGS)	5543947.00	7143259.00	9103504.00	7815501.00	6571619.00
Gross Profit Margin	775160.00	1007939.00	513447.00	464733.00	541832.00
Net Income (NI)	-403651.00	61024.00	-428452.00	78131.00	-887843.00
Equities	70564.00	1275364.00	1402346.00	157788.00	328890.00
Long-term Liabilities	2792816.00	1649268.00	4730315.00	3749796.00	1261075.00
Assets	5938143.00	7969936.00	8125445.00	7253907.00	6642701.00

Continuation of Table 2

1	2	3	4	5	6
Return on Assets (ROA), %	-0.07	0.01	-0.05	0.01	-0.13
Return on sales (ROSni), %	-0.06	0.01	-0.04	0.01	-0.12
Product Profitability Ratio (PPR), %	1.14	1.14	1.06	1.06	1.08
Return on Equity (ROE), %	-5.72	0.05	-0.31	0.50	-2.70
Return on Invested Capital (ROIC), %	-0.14	0.02	-0.07	0.02	-0.56
EBIT	2232591.00	3548961.00	5681237.00	4811276.00	4255538.00
NOPAT	1674443.25	2661720.75	4260927.75	3608457.00	3191653.50
EVA	2863380.00	2924632.00	6132661.00	3907584.00	1589965.00
WACC, %	7.51	7.72	7.61	7.52	7.60

Source: calculations made by the author based on the company's financial statements.

The comparative characteristics of the obtained results in terms of PJSC Dniprospsststal profitability indicators for the studied period are presented in Fig. 5. This may lead to the following conclusions. In 2016, 2018 and 2020 respectively, the company's profitability indicators remained at a negative level, which indicates significant losses of the company. In 2017 and 2019, the company gained profit, yet in the insufficient amount to ensure the profitability of the company.

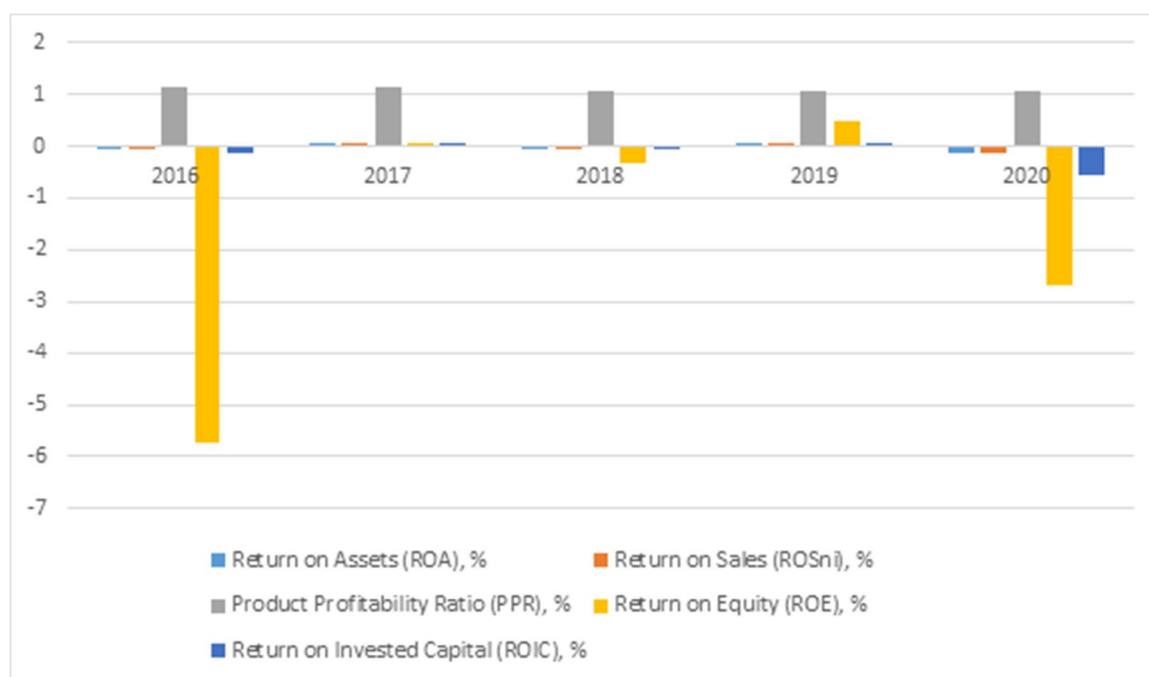


Fig. 5. Comparative characteristics of PJSC Dniprospsststal profitability indicators for the period of 2016–2020

Source: calculations made by the author based on the company's financial statements.

Results

Based on the data mentioned above, it can be concluded that all five enterprises under research using green technologies are unprofitable or remain extremely low-profit enterprises. Still, for higher objectivity, it is necessary to analyze two more indicators of the company's profitability, such as EVA and WACC,

which serve as active indicators for potential investors to make a decision about the feasibility of investing. EVA (Economic Value Added) is an analytical measure of a company's financial performance based on the residual wealth calculated by deducting its cost of capital from its operating profit, adjusted for taxes on a cash basis. This implies that the negative value of EVA indicates inefficient use of capital. The value of EVA, which is equal to zero, characterizes the possibility of the business remaining in the market, due to the fact that investors receive a return that compensates for their investment risk. Summary information on this indicator is presented in Fig. 6.

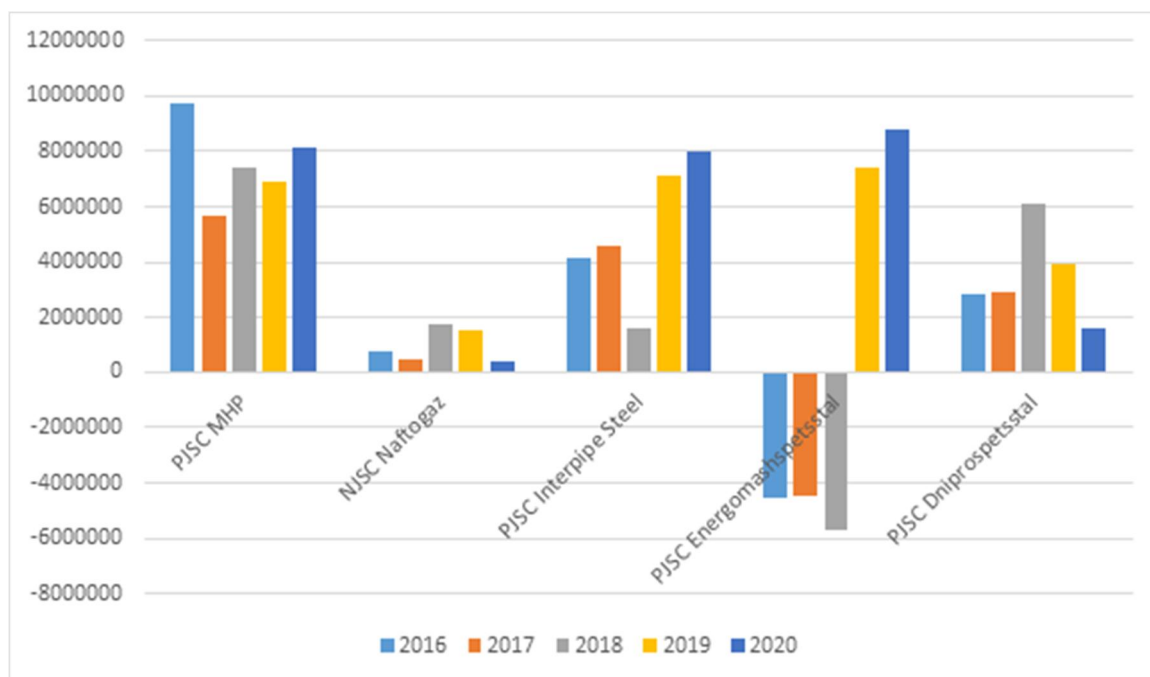


Fig. 6. EVA indicator dynamics of green enterprises in Ukraine for the period of 2016–2020

Source: calculations made by the author based on the company's financial statements.

As follows from Fig. 6, PJSC MHP demonstrates the largest indicator of economic added value. PJSC Interpipe Steel and PJSC Dniprospsststal also present a positive value in terms of this indicator. NJSC Naftogaz has a value that is close to zero. PJSC Energomashspetsstal had a negative value in 2016–2018, yet in 2019–2020 this indicator showed a positive value. Given that the target prospects of most investors are not so much to ensure the net profit of the company, but instead to increase revenues due to the growth of the company's value, it is believed that in terms of the EVA indicator, PJSC MHP has higher investment attractiveness.

Weighted average cost of capital (WACC) is the cost that the company bears to obtain its funds. The importance of deducting the cost of capital from net operating profit lies in deducting the opportunity cost of invested capital. In other words, it characterizes the average value of capital raised from each specific source, estimated by the specific weight of each source in the amount of capital used. The indicator characterizes the relative level of the total cost of securing each source of financing, comprising the weighted average cost of capital. The analysis of the dynamics of the WACC indicator of green enterprises in Ukraine for the period of 2016–2020 is shown in Fig. 7.

Other things being equal, a decrease in WACC contributes to an increase in the value of the enterprise, which normally implies its market value. From Fig. 7 it can be seen that the highest weighted average cost of capital is in NJSC Naftogaz, although it should be noted that all the analyzed enterprises have a high weighted average cost of capital. This means that these enterprises use mainly borrowed capital, which entails an additional burden of interest payments. However, this does not suggest that they are all operationally

inefficient. Company owners and management may wish to change the structure of sources, but there is a high degree of improbability due to a number of objective and subjective circumstances. It should also be taken into account that it is the weighted average cost of capital that allows evaluating and making the necessary financial decisions in order to manage the market value of the enterprise.

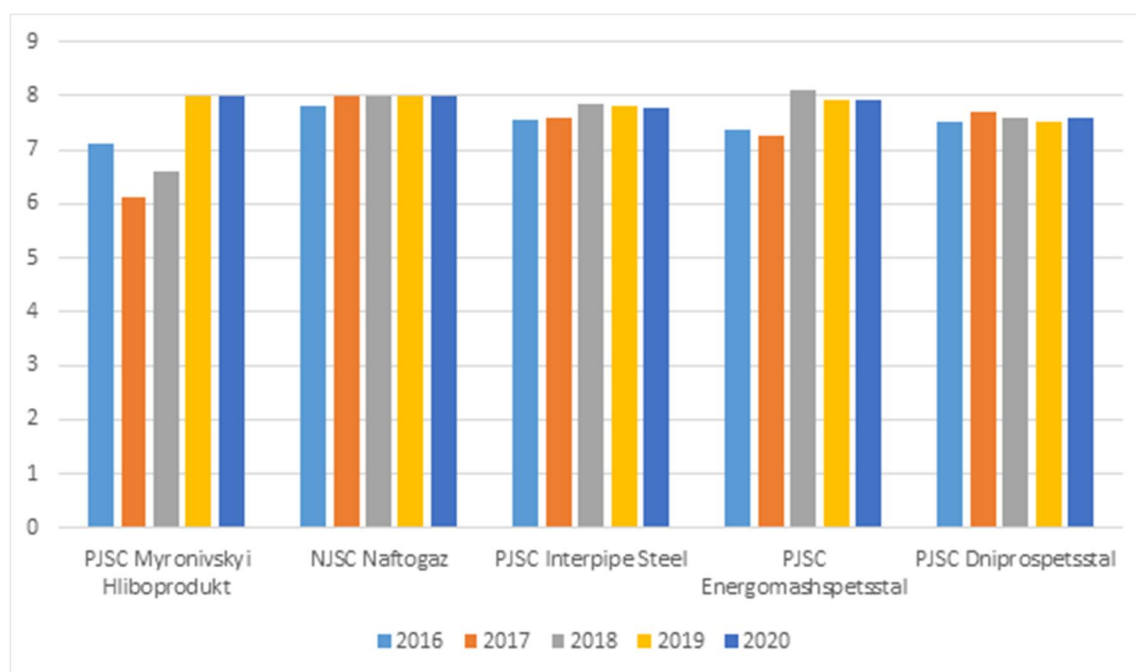


Fig. 7. Dynamics of the WACC indicator of green enterprises in Ukraine for 2016–2020

Source: calculations made by the author based on the company's financial statements.

Having analyzed the profitability of green enterprises of Ukraine, it should be concluded that the company PJSC MHP is conditionally the most profitable, with the highest economic added value as well as the weighted average cost of capital. PJSC Interpipe Steel, which has a sufficiently high economic added value and average cost of capital, can be tentatively considered second in terms of profitability. PJSC Dniprospetsstal is the third profitable, demonstrating quite insignificant indicators, alongside with the economic added value being at a fairly good level, as is the weighted average cost of capital. The fourth place is taken by NJSC Naftogaz, whose economic added value is close to zero, yet the weighted average cost of capital remains the highest, which indicates the complete dependence of the enterprise on external sources of financing. The most crisis-ridden enterprise is PJSC Energomashspetsstal, having suffered substantial losses in 2016 and 2020, with the EVA indicator having a negative value in 2016–2018, and the WACC being very high. The enterprise requires significant restructuring in order to increase profitability and improve the efficiency of economic activity as a whole.

Considering the above, it is possible to make the following recommendations regarding the functioning of the financial mechanism of the green economy at the state and regional level in Ukraine, including such measures as: special rates for electricity from renewable sources, special deposits for financing the process of recycling waste, green bonds, green credits; legislative regulation of the process of transition to the best available technologies; stabilization of the political and economic situation, approval of relevant regional programs for the development of renewable energy; public promotion of renewable energy sources; taking into account the available energy potential to create real GDP.

In addition, a promising indicator of the development of the green economy is the introduction of the green bond market in Ukraine, which will contribute to reducing fuel and energy resources consumption as well as greenhouse gas emissions, strengthening the energy independence of the state and achieving national strategic goals, improving the investment attractiveness, business climate and competitiveness of the country and, which, ultimately, will create the positive image of the country in the world market.

2. Prospects for the renewable energy development in Ukraine

The problem of establishing an effective financial mechanism in Ukraine, aimed at the development of the green economy through green investment, and, therefore, the search for sources of funding for green business, is currently open for discussion. The study of the financial statements of five green enterprises in Ukraine as well as the currently existing approaches to solving the above-mentioned problems made it possible to determine the sources of financing the green economy, which embrace the state budget (through targeted state and regional investments), foreign (international) investments, commercial funds (funds of off-budget investment, environmental and other funds), own funds (funds of enterprises and organizations creating market infrastructure - environmental investment banks, natural resource exchanges, consulting agencies).

The increased profitability of Ukrainian green enterprises that use RES will have a positive impact on macroeconomic indicators, namely:

1. Reduction in and the prospect of eventually putting a stop on the energy carriers import. In 2018, it cost Ukraine about 12 billion US dollars per year in the categories of “oil and oil products”, “coal” and “natural gas”. Accordingly, reducing or stopping energy imports will have a positive effect on the country’s trade balance. Moreover, sun and wind will play a leading role in displacing imported fuels in electricity generation as well as biomass in the production of thermal energy and its transport.

2. Creation of a new innovative cluster in the Ukrainian economy resulting in new jobs and new machine-building plants. The number of jobs to be created exceeds the number of jobs to be cut in traditional energy, particularly coal. Job openings will be created not only during the operation of RES power plants, but also in related industries: construction, installation, preparation of fuel (especially biomass), production of equipment.

3. Raising energy security and independence of the country.

4. Obtaining new generation renewable energy sources to substitute the outdated traditional ones, which, in any case, needs to be replaced due to obsolescence and high wear and tear.

5. Significant improvements in ecology, duration and quality of life in the country.

In view of the above, it is worth noting that in 2019, Ukraine entered the Top-10 countries in the world in terms of renewable energy development rates, and in 2020 was among the Top-5 European countries in terms of solar energy development rates [21]. In addition, in 2019, Ukraine took an honorable 8th place (up from 63rd) among 104 countries in the world [22] in terms of the country’s investment attractiveness, precisely in the development of low-carbon energy sources and the construction of a green economy in the Climatescope [23] rating by Bloomberg New Energy Finance (Bloomberg NEF). In 2021, Ukraine took 48th place for the total investment potential of the state [24] among 136 countries in the world in the BloombergNEF rating.

In general, since 2019, investments in new renewable energy projects in Ukraine have been consistently higher than in fossil fuel projects. It is necessary to consider the fact that only in the last 10 years, leading international and Ukrainian RES investors have attracted more than 12 billion USD of direct foreign investment into the economy of Ukraine, and the share of foreign investors in the installed RES capacity as of the end of 2021 has reached more than 35 %, which defines the Ukrainian RES sector as quite competitive and open. For the time being, the list of the largest international creditors and investors in the RES sector in Ukraine includes: the European Bank for Reconstruction and Development [25], the Black Sea Bank for Trade and Development [26], the American International Development Finance Corporation (DFC) [27], the Federal Land Bank of Bavaria BayernLB [28], the Investment Fund for Developing Countries (IFU) [29], the Northern Environmental Finance Corporation (NEFCO) [30] among others. Thus, the geography of investments in the construction of Ukrainian renewable energy power plants extends to organizations or individual investors from China, the USA, Great Britain, Germany, the Netherlands, Sweden, Denmark, Norway, France, Luxembourg, Belgium, Spain, Canada and Turkey among others.

Both social and economic benefits of the development of renewable energy sources are undeniable. However, no sector of the economy will be able to develop sustainably without appropriate state incentives

and an attractive business climate in the country. Under current conditions, the Government of Ukraine faces the task of preserving those national and international investors in RES who have already invested in the economy of Ukraine, providing conditions for their further business activity in the post-war period. The Government of Ukraine needs to consider the full range of incentives and mechanisms for investing in renewable energy: public-private partnerships, cooperatives and energy communities, as well as new mechanisms for the development of RES, such as net metering of energy consumption and bilateral agreements on the purchase of electricity, which provide certainty and stability for both producers and long-term buyers of clean energy.

The financial mechanism for the formation of a green economy can function effectively if one understands the factors of a green financial system, which rely on environmentally determined transformations of the modern investment environment. These include: a) transformation of investors' assessments of environmental investment results; b) growing needs for intermediary services of the financial sector as a result of the development of market mechanisms for ensuring sustainable development (carbon markets, green technologies among others); c) representativeness of market assessments of ecologically safe production; investment attractiveness of various financial instruments, peculiarities of their pricing [31]. It is assumed that the ecologically determined expectations of investors regarding investments in ecological production and technologies in Ukraine will redirect the capital flows to these areas and drive a change in priorities in traditional industries and practices.

For the development of the carbon-free energy sector of Ukraine, accounting for RES considerations, the following steps might be necessary: a) to approve a single fundamental strategic document that determines the direction of energy development and, in particular, RES in Ukraine; b) to approve a 5-10-year action plan, which must be implemented by both the state (the President of Ukraine, the Verkhovna Rada of Ukraine, the Cabinet of Ministers of Ukraine, the Ministry of Energy of Ukraine, the National Power Company Ukrenergo [32], the National Commission of Ukraine, which carries out state regulation in the spheres of energy and communal services, etc.), and market participants; c) to call for all state bodies and state enterprises involved in the energy industry to include measures from the plan in their activity and development programs and to establish administrative and political responsibility for non-implementation.

A new green industrial partnership between Ukraine and the EU is also necessary for the rapid deployment of solar and wind energy technologies throughout the country. It is appropriate for Ukraine to create a vision of green recovery and set ambitious climate and energy goals by 2030, which will make Ukraine self-sufficient in energy supply. Thus, a path to renewable energy will create the market confidence needed to attract investment.

Conclusions

The analysis has been carried out in terms of the main profitability indicators of enterprises implementing green energy and metallurgy technologies in Ukraine: PJSC Myronivskiyi Hliboprodukt, NJSC Naftogaz, PJSC Interpipe Steel, PJSC Energomashspetsstal, PJSC Dniprospetsstal. It comprises the study of profitability of assets, return on sales, return on production, return on equity, return on invested capital, indicators of economic added value and weighted average cost of equity. The obtained results show a decrease during 2016–2020 in the rental capacity of these enterprises to zero level. At this profitability rate, the production remained consistently satisfactory. In addition to the analysis, the recommendations for implementing potential changes for the further advancement in the practices of the green economy in the Ukrainian market have been outlined. The prospects for the development of renewable energy sources in Ukraine have been analyzed to establish that, starting from 2019, investments in new renewable energy projects in Ukraine have been consistently higher than those in fossil fuel projects.

Thus, it may be concluded that the prerequisites for the promotion of the green economy in Ukraine have been defined. Ukraine has significant potential for efficient implementation of renewable energy practices, particularly in the areas of solar and wind power. The country has already made progress in this field, with renewable energy accounting for over 6 % of the country's total energy mix in 2020.

However, the renewable energy sector in Ukraine faces several challenges, including the lack of a clear regulatory framework, limited financing options, and insufficient grid infrastructure. These challenges have resulted in a slowdown in new renewable energy project development in recent years. Despite these challenges, there is optimism for the future of renewable energy in Ukraine. The government has made efforts to improve the regulatory framework, and it is essential to provide international financing and technical assistance to support the sector's growth. Attracting financial resources for the further promotion of the green economy in the country involves creating effective financial mechanisms that will open access to attracting investments in key sectors of the country's economy, as well as strengthening the country's energy independence.

Additionally, Ukraine's strategic location positions it as a potential energy exporter, particularly through the development of renewable energy projects. As such, there is significant potential for the growth of the renewable energy sector in Ukraine in the coming years.

Prospects for further research

Mechanisms for reducing CO₂ emissions in Ukrainian enterprises, as well as the development of steps for the adoption of energy standards in Ukrainian enterprises in accordance with the EU-Ukraine Association Agreement, could be the subject of further research on this issue to achieve net-zero emissions and adapt the Ukrainian economy to climate change.

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ЕМПІРИЧНИЙ АНАЛІЗ ДІЯЛЬНОСТІ “ЗЕЛЕНИХ” ПІДПРИЄМСТВ І ПЕРСПЕКТИВИ РОЗВИТКУ ВІДНОВЛЮВАНОЇ ЕНЕРГЕТИКИ В УКРАЇНІ

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Виконано емпіричний аналіз діяльності “зелених” підприємств, а також розглянуто перспективи впровадження “зелених” інновацій. У статті проаналізовано п’ять провідних українських “зелених” підприємств за п’ять років, зокрема: ПрАТ “Миронівський хлібопродукт” та АТ НАК “Нафтогаз”, які входять до топ-10 компаній, що впроваджують “зелені” технології в Україні, а також ПрАТ “Інтерпайп Сталь”, ПрАТ “Енергомашпецсталь” та ПрАТ “Дніпроспецсталь”, що є лідерами в реалізації технології “зеленої” металургії в країні. Отримані результати під час аналізу показників прибутковості зазначених підприємств дали змогу встановити рекомендації для потенційного напрямку розвитку змін в сфері “зеленої” економіки на українському ринку.

Ключові слова: енергетичний перехід; енергетична незалежність; “зелені” підприємства; відновлювані джерела енергії; Україна.