Investment determinant of the sustainability of innovative technologies of energy supply in the agro-food system of Ukraine

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Abstract

The aim of the study is to develop a structural and logical model of the development of innovative sustainable technologies of energy supply and economic growth of the country's agro-food system. The relevance of the work is due to the need for development of innovative models of energy supply in agro-food system taking into account the world vector on sustainability development. The article considers the investment determinant of the development of innovative sustainable technologies of energy supply in the agro-food system of Ukraine. The statistical method, methods of formalization and analysis were used during the research. The characteristic of the investment determinant with the focus on the transformation of the investment process in the development of sustainable innovative products, innovative business models and business startups of the energy supply in the fields of agro-food system is formalized. The innovative activity of the branches of the agro-food group of Ukraine, the volumes and structure of investing of their innovative technologies of sustainable energy supply are analyzed. The interdependence of the investment determinant of the development innovative technologies of energy supply and economic growth countries of the world by level of income and welfare of the population is proved. A model of investment business processes in the food processing industry with the need for investment resources for development of the innovative technologies of sustanable energy supply in the agro-food system of the country is

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proposed. The coordination and combination of efforts of business structures, public authorities, and local government processes have high effectiveness. Therefore, the problem of investment by the nature of the strategic direction of the innovative business model in the agro-food industry could be successfully solved.

Key words: **innovations; innovative activity; investment attractiveness; investment process; business model.**

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1. Introduction

The sustainable development of the economy in the conditions of globalization requires active mechanisms of formation, use and increase of investment support of economic development of subjects of agro-food system. This modernization due to the internal resources of agricultural production is dominant, as the raw material base of the state allows to form the added value of products, in terms of their processing, increasing the competitiveness, efficiency and sustainability of the agro-food system. In the period of crisis for the global economy and with limited access to foreign investment, ensuring the constant formation and implementation of investment projects on innovative technologies of sustainable energy supply in the agro-food system is becoming an important implementation of the investment model of economic development (Abikenov et al., 2019; Baizakova et al., 2016; Butyrskyi et al., 2019; Hnatkovych et al., 2021; Kapitonov and Vilks, 2022; Karkinbayeva et al., 2019; Kostruba and Kulynych, 2020; Ukubassova et al., 2020).

Problems of new realities of economic development of agro-food complex, deepening of theoretical and methodological approaches to holistic and detailed understanding of the essence, evaluation of investment efficiency of development of innovative technologies of energy supply, determining investment attractiveness and capacity of agro-food industry, taking into account the influence of determinants on balance of production and export under the conditions of business partnership of the states with the EU (European Union), are covered in the works of such scientists as V. M. Cixanovska (2016), N. V. Trusova et al. (2021a), N. V. Trusova et al. (2021b), N. V. Trusova et al. (2021c), V. Xudolej and N. Paryczka (2015),

Scientific achievements in the functioning and development of the product subcomplex of the agricultural sector of the economy as a system of economic relations

aimed at providing the population with products of the processing industry have been studied by S. C. Babu and M. Shishodia (2017). In the context of the functioning of regional agro-industrial entities, from the point of view of economic parameters of their production, the possibilities of integration into other subcomplexes and functional links of the agricultural sector of the economy were studied by V. Bath (2012).

The priority of our study is to develop a structural and logical model of the development of innovative sustainable technologies of energy supply and economic growth of the country's agro-food system, which is formed on the basis of investment determinants and provided with a chain of investment process that takes into account innovative priorities of production and sales, establishes regulatory levers for the accumulation of investment resources for the introduction of innovative product.

2. Materials and Methods

Within the gravitational model the investment determinant of the development of innovative technologies of energy supply influences the development of international trade (Turylo and Zinchenko, 2009; Maralov et al., 2019; Martynyuk, 2017). At the same time, an important lever in this business model is the growth of the country's GDP. Additional levers include: mid-country price ratios; presence or absence of cultural and historical differences between countries; similarity (difference) of complimentarily of countries in terms of available factors of production, structure of output and costs; the presence of tariff and non-tariff trade restrictions; level of infrastructure development; the presence of corruption, etc. Many factors, classified as others, are formalized by constructing artificial (instrumental) variables. The general form of the gravitational model for countries i and j has the form represented in equation (Turylo and Zinchenko, 2009):

$$Inx_{ij} = \alpha \times In(Y_i \times Y_j) + \beta \times Ind_{ij} + \gamma In\tau_{ij} + \varepsilon_{ij}, \quad (1)$$

where, x_{ij}– export from i to j; Y_i, Y_j – GDP of countries i and j; d_{ij} – the distance between i and j; τ_{ij} – investment costs for bilateral trade, which include fixed and variable components for the implementation of innovations that change over time.

The gravitational model of the development of innovative technologies of energy supply for economic growth of the country's agro-food system allows taking into

account key investment regulators between countries on standard economic variables used in modeling not only GDP but also such values as: foreign trade duty, transport costs, exchange rate (Koshkinbaeva et al., 2019).

In addition, this model represents an imitation "tree" of the relationship between investment determinants and factors of economic growth through the identification of investment-active industries of the country's agro-food system. The existence of a causal link between the system and its components is dual in nature, which is manifested through the identification and evaluation of domestic investment opportunities of industries, from the standpoint of possible endogenous and exogenous changes in the hierarchical structure of agro-food system (Fig. 1).

The state, as one of the main subjects in the agro-food system in the world, is the main regulator of the state budget. Among the many indicators of budget formation and use, the following ones are selected: the share of revenues and expenditures in the structure of GDP, as well as the share of revenues from taxes and fees in GDP to determine the degree of diversification of sources of public spending investment. In addition, this model allows assessing the innovative potential of the agro-food system of the country, through: 1) increase in real GDP over a definite period of time; 2) increase in real GDP per capita over a definite period of time.

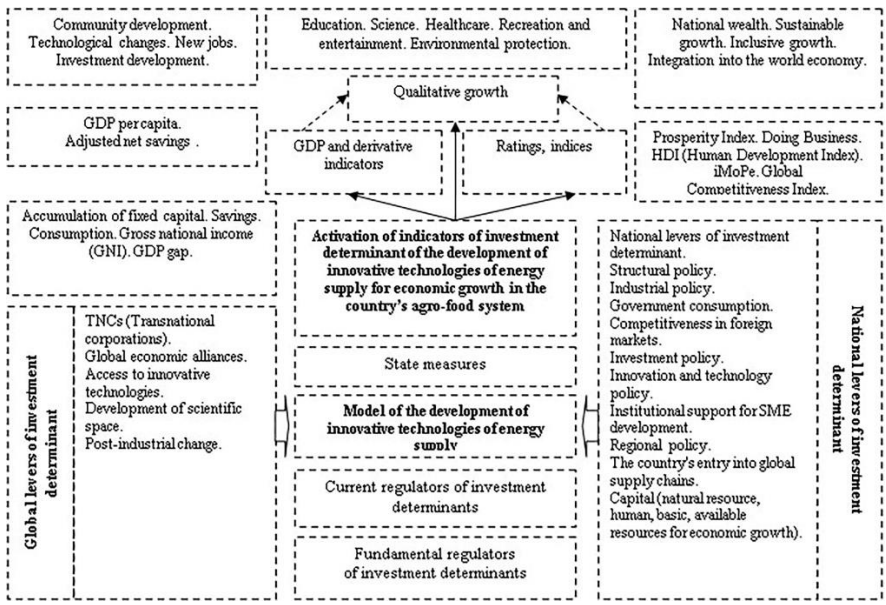


Figure 1. Structural and logical model of the development of innovative technologies of energy supply for economic growth of the country's agro-food system based on global and national levers of the investment determinant

Source: improved by the author based on (Tkalenko, 2014).

To take into account institutional factors, the list of sub-indicators of investment imbalances should be supplemented with indicators of quality of state institutions, which include index of business freedom (calculated according to the World Bank), global competitiveness index (according to the World Economic Forum) (Aizenman et al., 2013; Buribayev et al., 2015; Harust et al., 2021).

The investment climate as an integral factor is represented by a set of political, economic, legal, financial, social, cultural conditions for the formation of the appropriate infrastructure, which determines the degree of investment attractiveness of the country's economy (estimated through the rating indexes of countries influencing investment decisions); investment activity is considered as an integral characteristic of the economic development of the country, which is realized through investment potential, taking into account the existing risks (estimated through the level of international investment in the country); the state of economic growth shows an increase in production, GDP, rates of economic growth, an increase in national wealth (estimated through the main macroeconomic indicators of the country's economy) (Amandykova et al., 2016; Harust et al., 2022; Kostruba, 2021; Shartava et al., 2019; Trusova et al., 2021d; Patsuriiaet al., 2018; Vilks and Kipane, 2018).

The proposed model contributes to the transformation of the investment process on implementation of innovative technologies of energy supply and development innovative products, innovative business models and business startups. Formalized characteristics of the investment determinant are as follows:

1. transformation of the investment process aimed on implementation of innovative technologies of energy supply for development of an innovative product;

– the scale of the investment process in the development of innovative product. It is estimated from 0 point (the product is obsolete) to 5 points (a unique product);

– how much does the product affect the savings and reproduction of resources (Dikhanbayeva et al., 2019; Uzakov et al., 2021). It is estimated from 0 point (the product has a negative impact on the environment) to 5 points (in the field of agro-food

system they completely changed the technological process in favor of environmental friendliness);

– the direct contribution of the enterprise to the development of an innovative product. It is estimated from 0 point (no innovation in personnel management and business models) to 5 points (in the field of agro-food system own investment resources are invested, which generate innovations for the whole market);

2. transformation of the investment process aimed on implementation of innovative technologies of energy supply for development of innovative business models;

– manufacturability of the business model. It is estimated from 0 point (no innovation in personnel management and business models) to 5 points (all necessary investment processes in the business model of the agro-food system are automated);

– uniqueness of business startups. It is estimated from 0 point (standard business startups that have long existed in the market) to 5 points (the latest technologies of the model of the development of innovative technologies of energy supply for economic growth of the agro-food system are unique);

– the effectiveness of innovation. It is estimated from 0 point (the introduction of business startups in the model of the development of innovative technologies of energy supply for economic growth of the agro-food system has no unique characteristics) to 5 points (business startups of innovative development for economic growth of the agro-food system are regularly copied by competitors not only in the country but also in the world).

The characteristics of the investment determinant in the model of the development of innovative technologies of energy supply for economic growth of the agro-food system of the country are translated into the investment index on the scale presented in Table 1.

Table 1. Scale of the index of investment

Point	Investment index	Explanation
0	0	Manifestations of the agro-food system – from an innovative product to the introduction of business startups in the model – are inefficient and outdated. The agro-food sector has no prospects for implementation of innovative technologies of energy supply for development innovative products and models economic growth
1	30	The agro-food system industry is in no hurry to follow market trends any innovative changes into the technologies of energy supply for development innovative products are implemented late, after their testing by competitors. The agro-food sector is not innovative

2	55	The agro-food industry uses innovation in the technologies of energy supply for development innovative products. However, this does not give a tangible effect or competitive advantage. The industry is not innovative.
3	75	The agro-food industry is partially innovating or actively implementing the achievements of global players in the local market technologies of energy supply for development innovative products. The agro-food sector has prospects for growth and adaptation to new market conditions, but is not innovative.
4	90	The agro-food system industry develops and uses unique innovations in the technologies of energy supply for development innovative products in the world market. The share of innovative products exceeds 50%, which are tested according to international standards. The industry uses the latest investment processes and is innovative.
5	100	The industry in the agro-food system is a leader in promoting an technologies of energy supply for development innovative product, innovative business model, implemented business startups are copied by competitors. The industry is adapted to the new realities of national and world markets, is completely innovative.

The general index of investment on implementation of technologies of energy supply in the agro-food system of the country based on innovation of their potential takes into account all five characteristics, the weight of the evaluation of innovative product is 25%, "ability of the agro-food system to change" – 15, all other characteristics – 20%. To assess the effectiveness of the use of innovations in the agro-food system, it is advisable to use a system of indicators of investment determinant (Fig. 2).

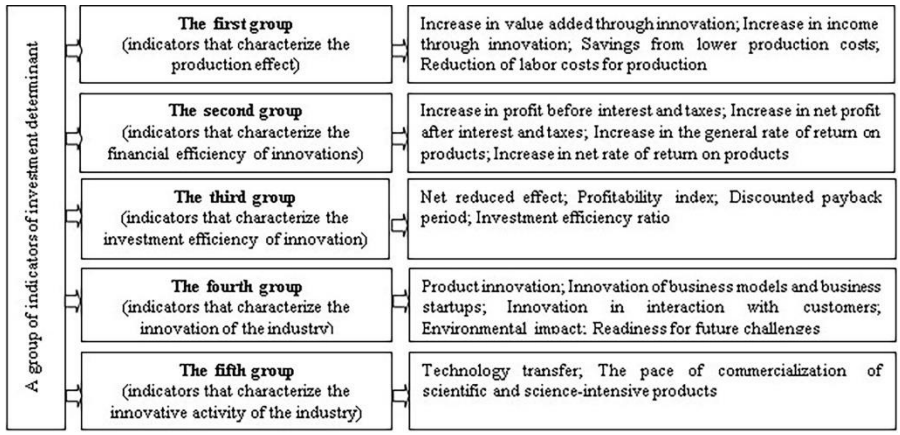


Figure 2. A group of indicators of investment determinant to assess the effectiveness of the development of innovative technologies of energy supply in and their implementation for production of innovative product in the agro-food system

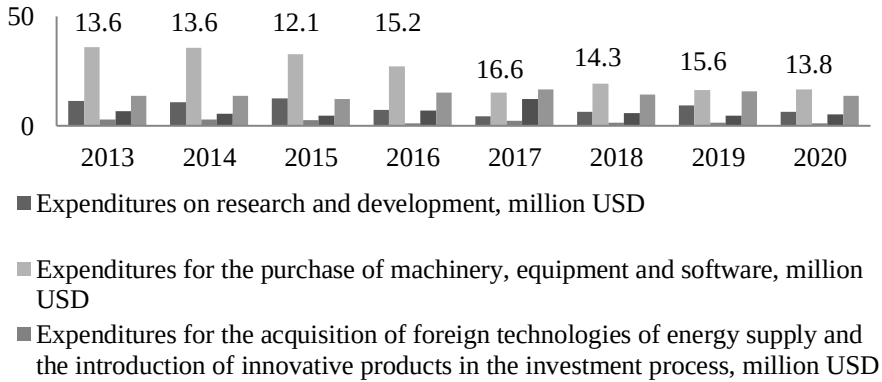
Source: improved by the author based on (Tkalenko, 2014).

It should be noted that for each group of the index of investment on implementation of technologies of energy supply in the agro-food system studied, the sub-indices are calculated using the arithmetic mean, assuming the weight of the indicators at one level. Thus, the proposed structural and logical model of the development innovative technologies of energy supply for economic growth of the agro-food system based on the investment determinant is a significant way to increase the efficiency of the economy as a whole. Active implementation of investment processes is a way to implement viable innovations in the industry that ensure the ability of agro-food groups to systematically accumulate and use investment resources in the technological cycle of production and sale of innovative products, creating new jobs through targeted implementation of business startups (Baktymbet et al., 2020; Domina et al., 2018; Iskakova et al., 2017; Harust et al., 2019; Zhanabayeva et al., 2021; Khamzina et al., 2015).

3. Results and Discussion

Ukrainian agro-food system, which has significant potential for innovative development and economic growth, is able to intensify the model of public-private partnership to ensure investment attractiveness of industries and the application of investment determinants, using alternative sources of investment. At the same time, each of the participants in the interaction has its own specific and potential benefits when using the latest technologies of energy supply and sales of innovative products (Butyrsky et al, 2021; Duisebekova et al., 2017; Seidaliyeva et al., 2018). During the period 2013-2020, innovative activities in the fields of the agro-food group were carried out by 782 enterprises. At the same time, the share of enterprises that implemented innovations technologies of energy supply (the for production innovative products) in the general segment of the agro-food market of Ukraine was 13.8%.

Of the total number of innovatively active branches of the agro-food group, only

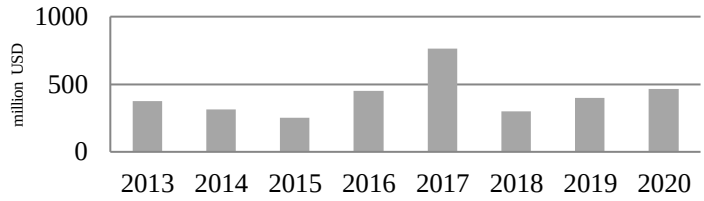


24.4% of them spent costs on internal and external research and development, on the purchase of machinery, equipment and software – 64.7%, on the acquisition of foreign technologies and their implementation in the investment process of the resources of energy supply for production innovative products – 4.5%, for other costs (implementation of business startups) – 20.6% (Fig. 3).

Figure 3. Innovative activity of branches of agro-food group of Ukraine for 2013-2020

Source: calculated by the authors according to data (State Statistics Service of Ukraine, 2020; UNECE, 2020; European Commission, 2022).

By types of economic activity, the largest share of innovation-active industries of the agro-food group is involved of the new energy supply technologies in the implementation and production of processed products – 16.8%, in the direction of reproduction of crop and livestock – 10.2%. At the same time, in 2020 the expenditure part of the state budget of Ukraine was aimed at investing enterprises of the agro-food group for processing agricultural products in the amount of 18.2 million USD (3.9%). The total amount of foreign investment in innovative development and economic growth of the agro-food group (livestock) amounted to 1.4 million USD (0.3%). 37.6 million

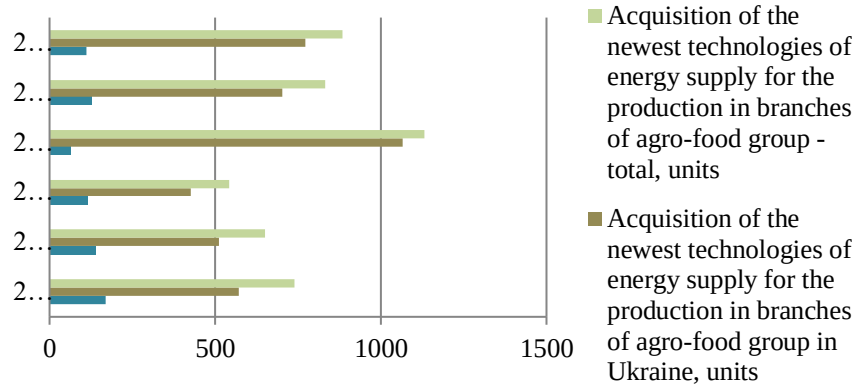


USD were allocated from other investment sources for the reproduction of innovative activities of the agro-industrial system of the state (8.1%) (Fig. 4).

Figure 4. Volume of investment of branches of agro-food group on the implementation of innovative technologies energy supply and production of processed products in Ukraine for 2013-2020, million USD

Source: calculated by the authors according to data (State Statistics Service of Ukraine, 2020; UNECE, 2020; European Commission, 2022).

In addition, the intensification of the investment process in the country's agro-food system over the past two years (from 2019 to 2020) has increased volume of the Ukrainian technologies of energy supply – to 773 units of facilities (Fig. 5).



Because of the growing role of services in the world economy, since 2016 the OECD (Organisation for Economic Co-operation and Development) has changed the method of dividing economic activities by technological sectors depending on the intensity of scientific costs (OECD, 2016). Accordingly, the distribution of the modal structure of economic activity (GVA) by scientific technological developments is as follows: high-tech sector of agro-food groups with a share of spending on science should be more 20% of GVA, medium-high-tech – 5-20%, medium-tech – 1.8-5%, medium-low-tech – 0.5-1.8% and low-tech – less 0.5%.

Figure 5. The number of acquired in Ukraine and abroad the latest technologies of energy supply for the production in the field of agro-food group for 2015-2020, units

Source: calculated by the authors according to data (State Statistics Service of Ukraine, 2020; UNECE, 2020; European Commission, 2022).

The science-intensive segment in the agro-food group of Ukraine in 2018-2019 added the same share to GDP – 5.7% (in 2016 it was 5.82%). According to the recommendation of the European Union, the distribution of value added by science-intensive foreign trade in the agro-industrial sector is carried out according to production costs. Thus, in 2020 the share of science-intensive high-tech sector of the agro-food system of Ukraine compared to 2018 had a tendency to increase (+1.26%), but the share of medium-high-tech and other three science-intensive sectors decreased by 0.6%, 1.28%, 2.9% and 3.8% (Fig. 6).

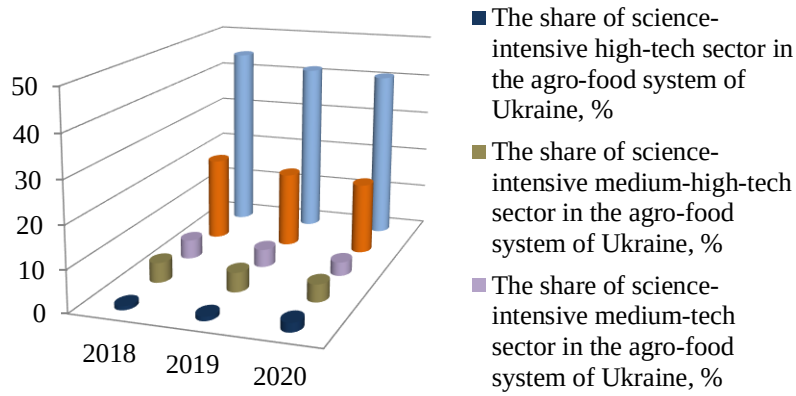


Figure 6. The share of the contribution of gross value added of science-intensive technological segments of agro-food system in the GDP of Ukraine for 2018-2020, %

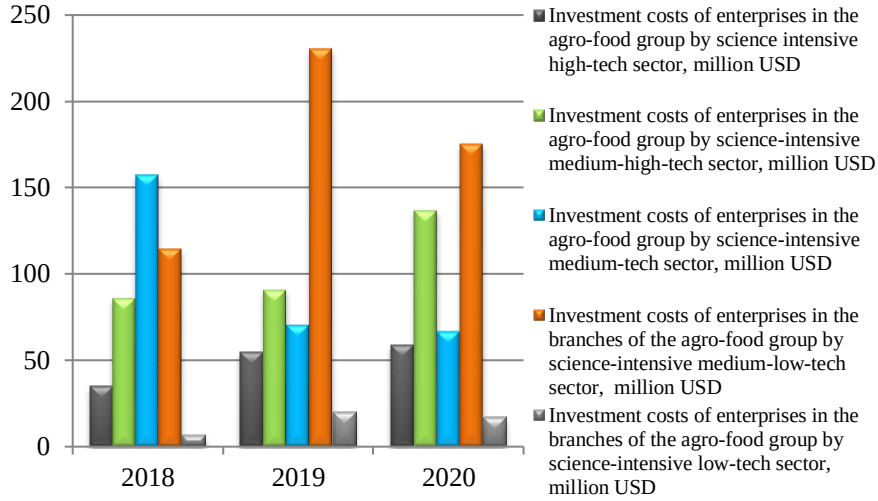
Source: calculated by the authors according to data (Eurostat, 2022; National Bank of Ukraine, 2022).

In the world market in 2019 science-intensive technological segments of the agro-food complex increased world GDP by 11.1%, including due to science-intensive high-tech sector – by 4%, including due to science-intensive high-tech sector – by 7.1%.

The science-intensive segment in the agro-food system is the undisputed leader in investing in Ukrainian R&D and accounts for 86.2% of the total domestic expenditures on research and development. Total investment costs for research and development in the agro-food system of Ukraine (at enterprises of meat and meat products processing, production of flour and cereals, production of bread and flour products, production of fruits and vegetables, production of vegetable oils) during 2019-2020 nominally increased by 15.8 million USD and reached 565.7 million USD.

The share of innovation-active enterprises that introduce science-intensive technological developments in the agro-food group has increased by 12%. Their investment expenditures on innovation in 2019-2020 increased both in nominal terms (from 399.6 to 454.6 million USD), and as a percentage of GDP – from 0.34% to 0.36% (Fig. 7).

However, in the branch enterprises of the agro-food group with a low-tech sector almost half of the investment resources were directed not to the development of innovations technologies of energy supply and production of the innovative products,



but to the purchase of ready-made equipment and software for the investment process.

Figure 7. Investment expenditures on innovations by technological sectors of the agro-food system in Ukraine, million USD

Source: calculated by the authors according to data (Eurostat, 2022; National Bank of Ukraine, 2022).

The remaining funds in this segment were spent on marketing and advertising, the share of which in costs increased. Insignificant funds in the amount of less than 0.5% of the total investment costs of this segment were spent on the purchase of foreign equipment. However, the number of branch enterprises of the agro-food group that sold innovative products decreased in all technological sectors (Fig. 8).

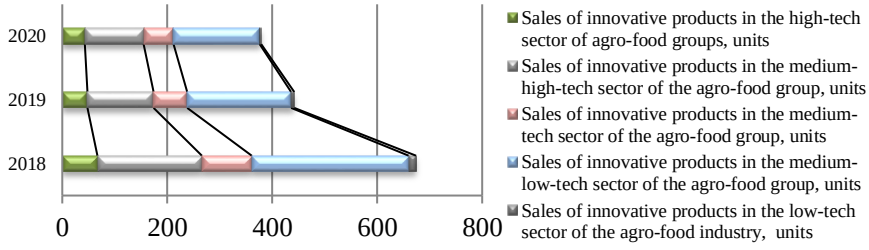


Figure 8. Sales of innovative products in Ukraine by technological sectors of the agro-food system in 2018-2020, units

Source: calculated by the authors according to data (Eurostat, 2022; National Bank of Ukraine, 2022).

The dialectical interaction of the investment determinant of the development of innovative technologies of energy supply and economic growth of the country's agro-food system, which is presented in Table 2, clearly demonstrates the dependence by level of income of the population.

Table 2. Interdependence of the investments

Investment determinant of the development of innovative technologies of energy supply and economic growth of the agro-food system in the group of countries with high incomes, 49 countries	Investment determinant of the development of innovative technologies of energy supply and economic growth of the agro-food system in the group of world countries with average income, 37 countries	Investment determinant of the development of innovative technologies of energy supply and economic growth of agro-food system in the group of countries with below average income, 29 countries	Investment determinant of the development of innovative technologies of energy supply and economic growth of the agro-food system in the group of low-income countries, 16 countries
1. Switzerland (1) 2. Sweden (2) 3. USA (3) 4. United Kingdom (4) 5. The Netherlands (5) 6. Danmark (6) 7. Finnland (7) 8. Singapur (8) 9. Germany (9) 10. Korea (10)	1. China (14) 2. Malaysia (33) 3. Bulgaria (37) 4. Thailand (44) 5. Romania (46) 6. Russia (47) 7. Montenegro (49) 8. Turkey (51) 9. Mauritius (52) 10. Serbia (53)	1. Vietnam (42) 2. Ukraine (45) 3. India (48) 4. Philippines (50) 5. Mongolia (58) 6. Moldova (59) 7. Tunisia (65) 8 Morocco (75) 9. Indonesia (85) 10. Kenya (86)	1. Tanzania (88) 2. Rwanda (91) 3. Nepal (95) 4. Tajikistan (109) 5. Malawi (111) 6. Uganda (114) 7. Madagascar (115) 8. Burkina Faso (118) 9. Mali (123) 10. Mozambique (124)
Income per capita, thousand dollars USA			
> 32.000	< 32.000	< 15.000	< 6.000
Top-3 of the most innovative economies by region			

Latin America and the Caribbean	North America	Europe	Southeast Asia, Oceania	North Africa and West Asia	Sub-Saharan Africa	Central and South Asia
Chile Mexico Costa Rica	USA Canada	Switzerland Sweden United	Singapore Korea Hong Kong	Israel Cyprus UAE	Mauritius Kenya Tanzania	India Iran Kazakhstan

		Kingdom	China			

Source: generated by the authors according to data (López-Claros and Mata, 2011; EBRD, 2019; European Commission, 2020).

Among 131 countries of the world, Ukraine by 45-th among the group of countries with below-average income (less than 15 thousand US dollars per year). The leaders of the development of innovative technologies of energy supply in the investment process for the production of products and economic growth of the agro-food system are Switzerland, Sweden and the United States.

Clustering and ranking of countries according to the Index of Investing of the Innovative Potential of the Agro-Food Systems of the World Countries has a natural tendency to invest resources in innovation and modernization of the economy. There is a directly proportional relationship between the dynamic development of the investment determinant in the energy supply of innovation potential and the growth of gross national income (GNI) per capita. It should not be forgotten about the inversely proportional relationship between the increases in investment in the innovation potential of the agro-food system by the amount of venture investment in energy supply of order to reduce unemployment (Derevyanko et al., 2018; Miklovda et al., 2020; Misiuk et al., 2020; Kostruba, 2019). Thus, the identified patterns are confirmed by the research of the Boston Consulting Group (BCG), which examines the economic parameters of 50 global leaders, the most innovative agro-food companies in the world and their new opportunities for democracy (Table 3).

Table 3. Index of investing the innovation potential of the world, 2020

	High income: GNI per capita: > 11906 USD			
	full democracy	imperfect democracy	hybrid regime	authoritarian regime
	Australia, Austria, Denmark	Croatia, Estonia, Hungary	Hong Kong, Singapore	Bahrain, Great Britain, Saudi Arabia, UAE
A1	10%	15%	20%	20%
A2	10%	15%	20%	20%
A3	20%	20%	20%	20%
A4	30%	25%	20%	20%
A5	30%	25%	20%	20%
	Average income: GNI per capita: 3856-11905 USD			
	Costa Rica, Mauritius,	Argentina,	Lebanon, Russia,	Algeria,

	Uruguay	Botswana, Colombia	Turkey	Kazakhstan
A1	25%	25%	25%	25%
A2	25%	25%	25%	25%
A3	20%	20%	20%	20%
A4	15%	15%	15%	15%
A5	15%	15%	15%	15%
	Income below average: GNI per capita: 976-3855 USD			
		Bolivia, El Salvador, Ukraine	Ecuador, Georgia, Iraq, Pakistan	Angola, Azerbaijan, China
A1	25%	25%	25%	25%
A2	25%	25%	25%	25%
A3	20%	20%	20%	20%
A4	15%	15%	15%	15%
A5	15%	15%	15%	15%
	Low income: GNI per capita: < 975 USD			
		Bangladesh, Senegal, Zambia	Afghanistan, Chad, Vietnam, Yemen	
A1	-	30%	30%	30%
A2	-	30%	30%	30%
A3	-	20%	20%	20%
A4	-	10%	10%	10%
A5	-	10%	10%	10%

Source: calculated by the authors according to data (López-Claros and Mata, 2011; EBRD, 2019; European Commission, 2020).

The leader in the ranking of innovation is the company *Apple,* which designs modern software and online services for the agro-food industry. On the second step there is *Alphabet/Google,* which develops the latest biotechnology for agro-food enterprises in the fields of flour and cereals, fruit and vegetable production, vegetable oil production. The third place is occupied by *Amazon,* which is a virtual Internet service for the sale of products in the processing industry of mass demand (López-Claros and Mata, 2011).

The use of investment determinants in innovative technologies of energy supply and their combination with digitalization and the material aspect of production are of great importance to increase competitiveness at the level of industrial enterprises of the agro-food group and the state as a whole. In the agro-food system of Ukraine, the largest part of the total capital investment falls on agriculture and food processing (in the acquisition of tangible and intangible assets) (Fig. 9).

Figure 9. Capital investments in the agro-food system of Ukraine for 2013-2020, billion USD

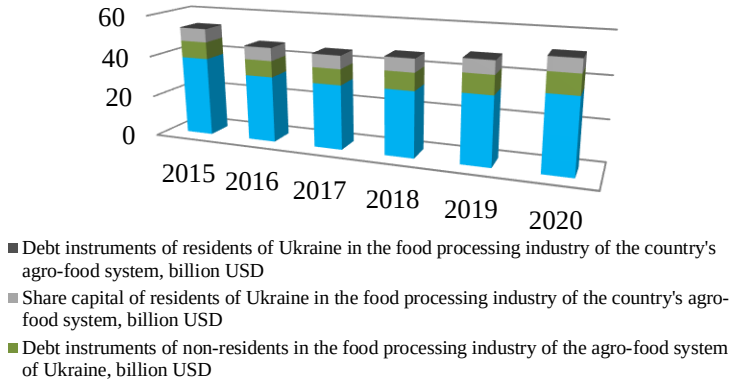
Source: calculated by the authors according to data (State Statistics Service of Ukraine, 2020; OECD, 2021).

In the structure of the food processing industry, the largest share of capital investments is directed to the innovative model of interaction with the crop, livestock and vegetable industries. From 2014 to 2019, the volume of investment in this area has grown rapidly – almost 2.0 times. At the same time, due to the development of negative trends in the distribution of business interests between mega-companies in this area, investment processes in the food processing industry in 2019-2020 are partially suspended for economic growth and innovation development.

This is clearly seen in countries with emergent economies, where emergent properties are approximated at the meso- and micro levels.

The emergent state of the agro-food system is assessed as a set of properties that it can possess only in the condition of the integration of certain components and their interaction with each other. A characteristic feature of this system is the activity of its elements (financial, innovative, integration, social, environmental, etc.). Each active element (economic agent) has its own target trajectory of functioning and interaction with other elements. Emergence is manifested through the factors of interaction and effectiveness of the system in a certain composition of active ingredients. Achieving qualitative changes in the system is called emergent's, and quantitative changes – results (Gurochkina, 2019; Berikbaeva et al., 2020).

Realization of the potential of the country's food processing industry and activation of the emergent properties of innovative development depends on the volume of investment and investment attractiveness of the industry. In this context, Fig. 10 presents the dynamics of foreign direct investment (FDI) as an important source of funding for



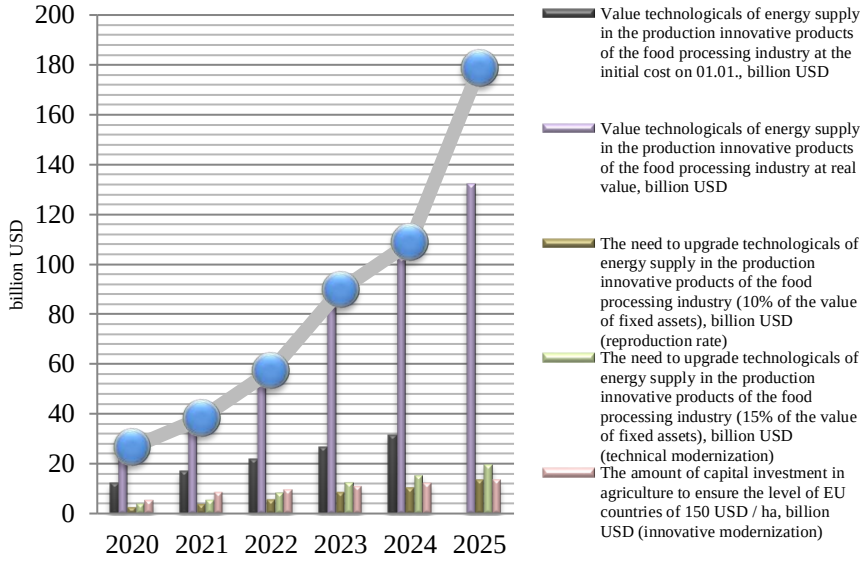
the industry.

Figure 10. The volume of direct investment (equity and debt instruments) in the food processing industry of the agro-food system of Ukraine for 2015-2020, billion USD

Source: calculated by the authors according to data (State Statistics Service of Ukraine, 2020; OECD, 2021).

In 2020, the accumulated foreign share capital in the processing and food industry of the agro-food system of Ukraine amounted to 45.3 billion USD, which compared to 2015 decreased by 3%. However, its slight decrease and fluctuations during 2015-2020 do not have a negative impact on the innovative state of the industry. At the same time, the study period is characterized by the gradual accumulation of debt instruments, i.e. debt on loans and borrowings, trade credit liabilities and other liabilities to direct investors. The largest investor in the processing and food industry of the agro-food system of Ukraine is Cyprus, whose investments amount to 5.94 billion USD. In the second place of the priority direction of investing the Ukrainian capital of the enterprises of the agro-food group is the Netherlands in the amount of 8.3 billion USD, the third place belongs to Germany with the amount of 1.8 billion USD of attracted investment.

At the same time, for the economic growth of the food processing industry there is a need for capital investment in innovative modernization of agriculture in the amount of



5.4-13.24 billion USD, which at the EU level is 150 USD per 1 ha (Fig. 11).

Figure 11. Model of investment business processes in the food processing industry

Source: calculated by the authors according to data (State Statistics Service of Ukraine, 2020; OECD, 2021).

4. Conclusions

Thus, to strengthen the investment determinant in the model of development innovative technologies of sustainable energy supply for production of innovative products of food processing industries in the agro-food system of country is necessary the effective restore investment resources.

The combination of quantitative changes in innovation potential in related sectors of the agro-food group leads to the transformation of the investment process to introduce newer technologies, which are a stimulating factor in the quality of investment attractiveness and food security. The necessary increase in capital assets into innovative technologies of sustainable energy supply due to the trajectory of the investment process, as the current increase in the value of innovation, because of long-term

production activities, helps to determine the part of income for the previous period that was not used for consumption.

Accordingly, in the economy of the agro-food system, all investment operations when changing the portfolio of tangible and intangible assets should create a real value of fixed capital investment to introduce new types of products. At the same time, it is necessary to take into account the institutional impact of economic sectors on the innovative business model, which has a certain effect on the investment process in the short, medium and long term and leads to qualitative changes in innovation in the logistics sector. High efficiency of coordination and combination of efforts of business structures, public authorities and local governments, solves the problem and priorities of investment by the nature of the strategic direction of the innovative business model in the agro-food industry as a whole.

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