DOI: 10.46299/979-8-89372-172-0.7

7. Methodology, main methods and algorithms of bioenergy market research

The predicted global depletion of the main fossil energy sources (oil and gas in the next 30-40 years) and environmental factors are prompting most developed countries to look for alternative non-traditional renewable energy sources (NRE). The catalyst for these searches was, in particular, the increase in world oil prices in 2005-2006. According to the materials of experts of the UN Development Program, the share of renewable energy sources in the global fuel and energy balance in 2050 may reach 50%, and according to the forecast of the World Energy Council - up to 80-90% [170]. By the end of the current century, Germany and Sweden plan to obtain 100% of their energy from renewable sources. The most real substitutes for petroleum fuels are methanol and ethyl ethers from oils (biodiesel fuel), ethanol (bioethanol), which is produced from the products of the sugar industry and starch-containing products; biogas — from crop and livestock waste; solid biofuel - from the biomass of highly productive perennial plants, as well as by-products of crop production and forestry.

Until the last decade, systematic, coordinated scientific research on the development of the bioenergy products market was not conducted in Ukraine, the Targeted Comprehensive Program of Scientific Research "Biomass as a Fuel Raw Material" was approved. At the same time, scientific research mainly concerns the production processes of bioenergy products, the raw material base of processing technologies, etc. Sales, distribution, and informational aspects of the functioning of the bioenergy products market remain out of consideration.

The study of the processes of formation and development of the domestic bioenergy market should be carried out through the prism of the possibilities of implementing the concept of sustainable development, the availability and efficiency of the national production of bioenergy products, the interaction of economic entities and service infrastructure, as well as taking into account external and internal factors of the formation of a modern bioeconomic system. The complexity of the problem of ensuring the effective operation of the bioenergy sector of the economy and the

development of the bioenergy market lies in the fact that the market transformation processes in Ukraine began without an agreed theoretical and methodological justification and the formation of systematic methodological approaches to the formation of strategies and tactics, sufficient scientific and practical experience in the dynamic and consistent transfer of the industry to functioning in the conditions of market relations [171]. In addition, the bioenergy market received significant impetus for its development later than other markets of goods and services, which was caused by a decrease in the level of energy security in the country, deterioration of the ecological balance, etc.

The Law of Ukraine "On Alternative Fuels" included among others the key principles of state policy in this area [172].

• economic stimulation of producers and consumers of biological fuels with the aim of their widespread introduction in Ukraine;

• development of regulatory mechanisms for the creation and regulation of the biofuels market in Ukraine;

• a clear definition of the prospective policy of the state regarding the production and consumption of biofuels with the aim of saving traditional types of fuel and reducing Ukraine's dependence on their import;

• reducing the negative impact on the environment;

• introduction of a step-by-step increase in the normatively determined mandatory share of the use of biofuels in the total production of motor fuels in Ukraine;

• support of investment activities in the production and use of biofuels through the application in this field of entrepreneurial activity of special tax, customs and other benefits determined by the relevant legislative acts, and the state guarantee that the determined benefits will not change during the next ten years from the date of adoption of the relevant laws or amendments to them;

• support for the development of the scientific and technical base for the production of biofuels, promotion of scientific and technical achievements in this field;

• development of international scientific and technical cooperation, wide use of international cooperation in the production and consumption of biofuels;

• informing consumers and producers of biofuels about the economic, ecological, social and other advantages of production and consumption of biofuels;

• harmonization of domestic legislation in the field of production and use of biofuels with EU legislation.

As can be seen from the law, a significant part of the specified principles and tasks belong to the field of marketing, demand stimulation, informing consumers, etc. Scientists rightly point out that the main reasons for the slow development of the bioenergy products market are the low level of environmental awareness of consumers and the lack of state support [171, p. 46].

An urgent problem in these conditions is the determination of the methodological features of the bioenergy market research and the substantiation of its development prospects, with the aim of determining the magnitude of the effects for various participants in market relations and the degree of influence on the activities of enterprises, infrastructure entities, the state and consumers.

A necessary condition for conducting a comprehensive study of the field of bioenergy and, accordingly, the bioenergy market, is the development of methodological principles of the study, the process of using and substantiating the methodological toolkit, and the construction of an algorithm for conducting such studies based on theoretical, methodological and applied provisions regarding the formation of the bioenergy market and subjects of the bioenergy production sector.

Ensuring the objectivity and informational reliability of the assessment of the state and trends of market development is currently the main task, which has a decisive influence on the management decision-making by participants of this market at all levels. In practice, various methodological approaches are used to determine evaluation criteria, a system of indicators, and methods of managing the development of market entities and actual market processes. In the conditions of cyclical economic development, global food and energy challenges, and periodic economic crises, there is an inconsistency of methodological approaches, the difficulty of choosing the necessary evaluation tools, which causes a lack of connection between scientific and methodological developments and the practical results of their application in the

activities of enterprises. The implementation of the achievements of scientific and technical progress and the maximally complete fulfillment of its practical function are largely determined by the level of methodological support of research, in particular, in the field of economics.

The reduction in the number of methodological works in the early 2000s was replaced by an increased interest in the essence and structuring of methodology, one of the consequences of which should be considered the introduction into scientific circulation of the category "paradigm", which performs a worldview function and guides the selection of the most important problems for each scientific field. The methodology has now turned into a separate modern discipline of modern economic science, which studies the practice of functioning and trends in its development, and among other things, defines its paradigm.

Today, we are talking about such a paradigm of the development of mechanisms for the transformation of market relations and their regulation, in which [173, p. 141]:

- the system of views and values is a systematic approach to market processes, phenomena, events (systemic and situational paradigm), accordingly, the system of methodological tools is based on systemic, situational and structural-functional approaches;
- the system of technical, technological and resource means is formed according to the principle of the maximum achievable technological level in domestic practice;
- the system of methodical and technical skills plays a decisive role in the process of formation and application of the mechanisms of transformation of individual markets;
- there is no systematic periodic correction of the strategic goals of development, and therefore, no review of the prospectively necessary mechanisms of market transformation and public administration;
- innovativeness is a desirable element in the development of leading industries (in particular, energy), market entities and mechanisms, the introduction of innovations on the basis of marketing determines the success of competition in the markets;

- the response to the challenges of globalization is forced rather than well-informed and based on accurate forecasting.

Taking into account the selected characteristic features of the modern paradigm of the development of market mechanisms, we will build its model, as shown in fig. 1.1.

The following can be identified as the most significant shortcomings of the given modern paradigm of the development of market relations mechanisms [173, p. 142]:

- Today, Ukraine is mainly the object of globalization influences, and not their subject, which, first of all, is determined by its insufficient contribution to the world economy, more precisely, that part of it that belongs to the IV technological order, while this primarily means the predominance quantity over quality, in particular regarding the structure of product exports;

- the reaction of the domestic system of public administration to the system of globalization influences has a forced and sometimes belated character;

- the technological base in most spheres and branches of the economy is insufficiently developed, which indicates the non-compliance with the phase of economic development based on the III-IV technological system; its replacement and/or change requires significant amounts of investment and innovations, which are interconnected, which greatly complicates their implementation;

- innovativeness of development is considered by the authorities as an attractive and desirable phenomenon, which does not yet have a real, relevant economic basis; the innovation of the economy was proclaimed by the previous government, but this ideology was not implemented either in theory or in practice of the country's economic and social development and the development of its public administration system;

- the methodological base is based on traditional systemic, situational and structural-functional approaches, which during the time of independent Ukraine received significant development and transformation in the works of domestic scientists, this methodological base contributed to the significant development of the theory and practice of strategic management; at the same time, the methodological base

of management at all levels, based on the latest marketing concepts, in particular, holistic, ecological and territorial marketing, is still practically not involved;

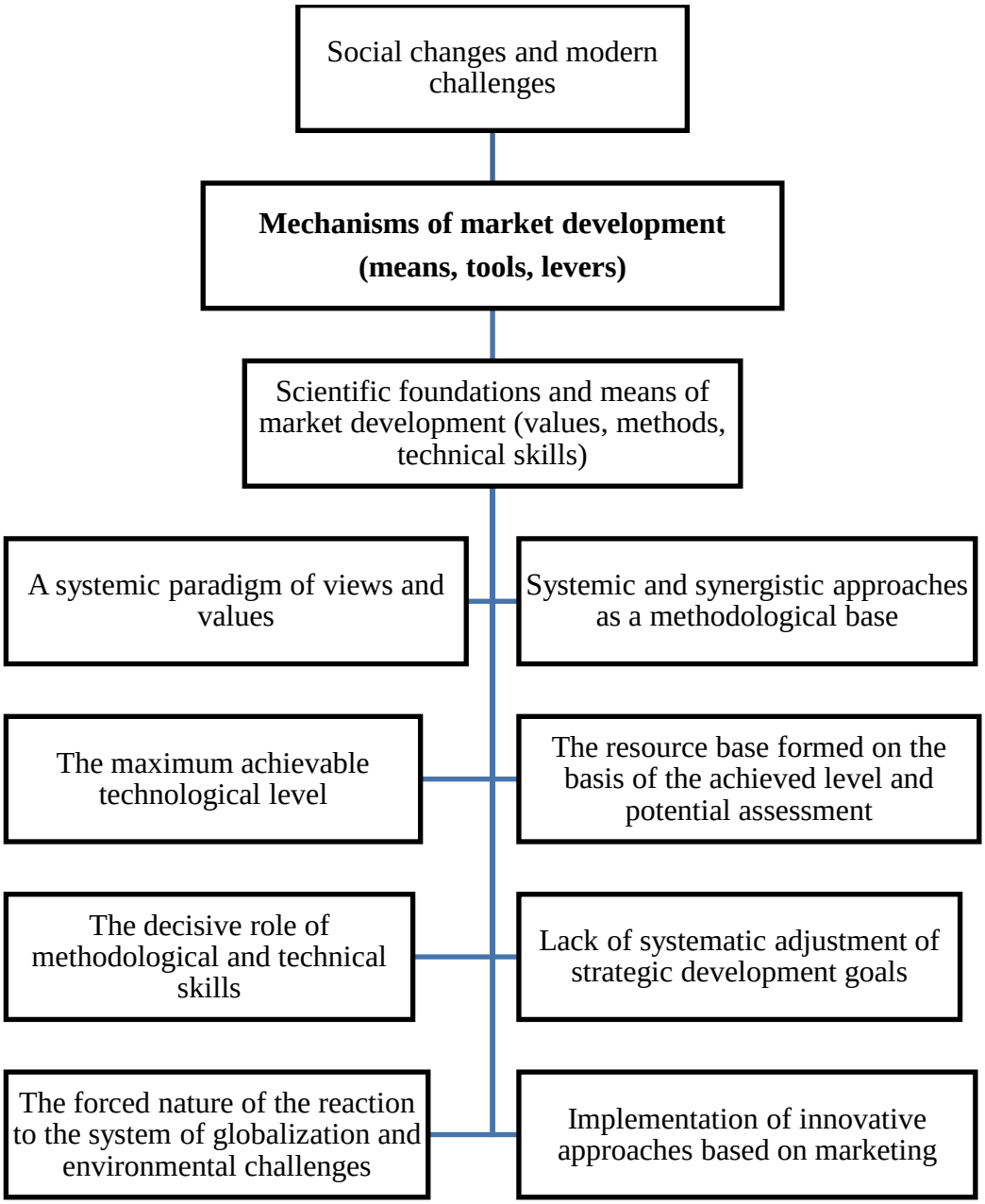

Fig. 1.1. A modern paradigm model of the development of market mechanisms

Note. Formed by the author based on [173]

- the latest methodological base complements the modern achievements of scientists in the field of market regulation, expands the possibilities of scientific knowledge and the practical implementation of management decisions at all levels of the economic system; practical development of predictive and programmatic

management solutions is still based on the existing, not promising (potential) resource base, which also contributes to innovation and technological lag;

- state target programs mostly do not contain technological and resource innovations and their bringing to the level of pilot projects, their funding is only 8-12% of the expenditure part of state budgets and are not guaranteed annually even if they are adopted by laws;

- development strategies (socio-economic, individual branches of the economy, regions, territories) are accepted and are no longer adjusted, unlike the way it is accepted in most developed countries of the world; each change of power threatens their change or termination of their implementation; in fact, for large periods of time, the country does not have clear strategies for socio-economic development;

- the development potential of certain industries and the most promising markets that meet the needs of the country and certain consumers is decisive in the country's development, but it is unstable.

It is necessary to substantiate the research methodology under the following conditions:

1) clarification of the scientific approach to understanding the category "methodology";

2) determination of the set of elements of the methodology of this study and the evaluation apparatus;

3) distinguishing general and special research methods, the sequence of their application, criteria, indicators within the defined methodology (Fig. 1.2).

In the economic encyclopedic dictionary, methodology is interpreted as "science, the basis of which is a system of the most general principles, methods and ways of learning about economic systems" [174, p. 494]. According to V. Belukha, the methodology "...is based on the peculiarities of knowledge of specific processes and is manifested in the implementation, on the one hand, of theoretical generalizations, principles of individual sciences, and on the other hand, partial methods of research" [175, p. 57].

The methodological apparatus of economic research acquires a somewhat different meaning, which is interpreted as "...a system of methodological categories that are characteristics of economic research: problem, relevance, object of research, its subject, goal, tasks, hypothesis, etc." [177, p. 140].

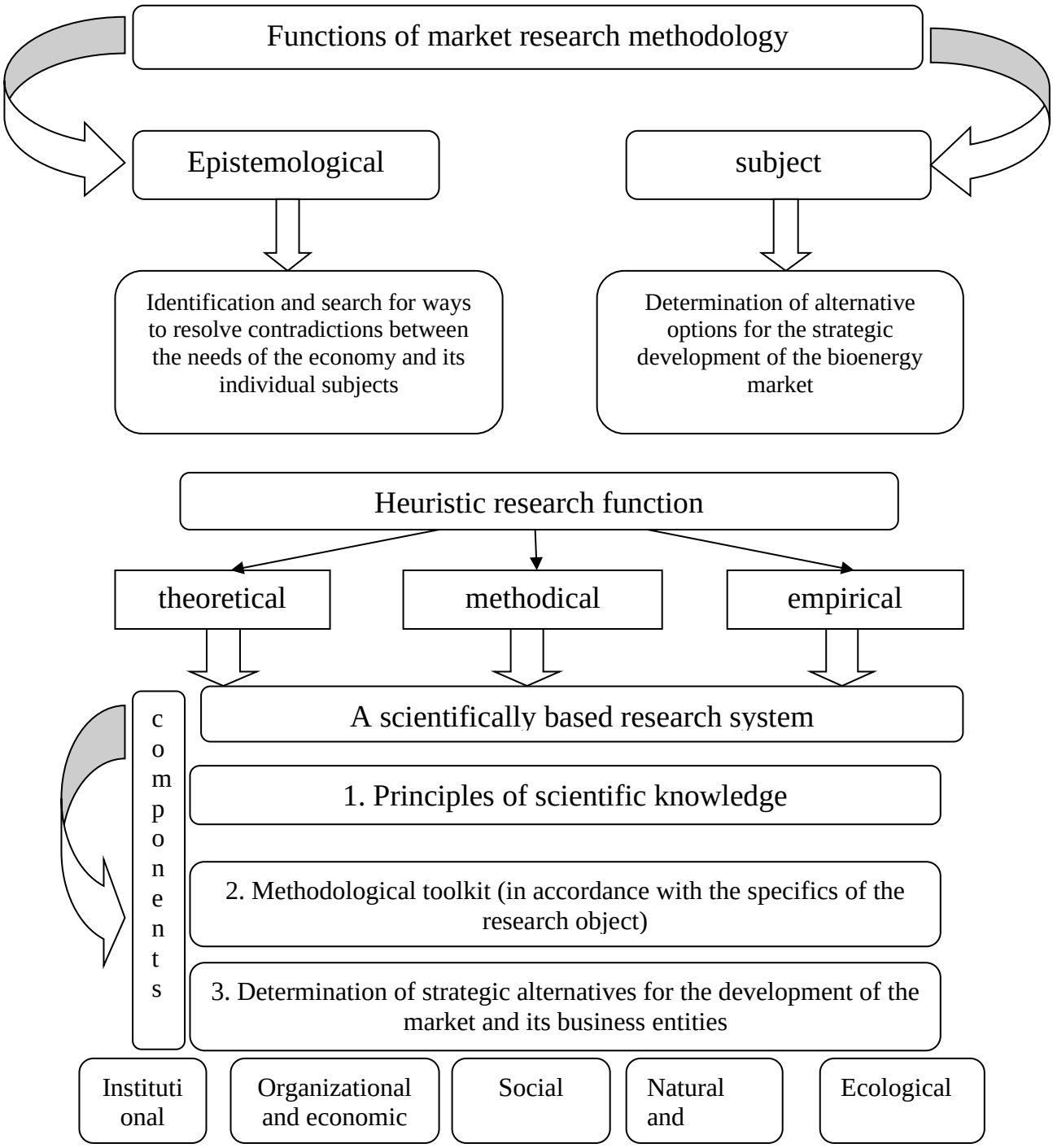

Fig. 1.2. Bioenergy market research methodology

Note. Formed by the author based on [176, p. 66]

The methodology is a specification of the methodology taking into account the specifics of a specific field and the requirements of a specific study, which transforms the latter into precise cognitive procedures and operations. In turn, "the method is expanded into a system", that is, it is used for the further development of science, the deepening of theoretical knowledge as a system, as well as its materialization and objectification in practice [171, p. 18].

The methodical approach to studying the market or such a specific field as bioenergy is not as formalized as the methodology, but it should take into account the following requirements:

1) the possibility of occurrence only in a competitive environment, which necessitates the use of a comparative approach; 2) the mandatory presence of stability, which requires taking into account all deviations from the equilibrium state; 3) duration, which can be taken into account based on the application of dynamic indicators (chain or base rates of change); 4) research at the micro level involves considering the enterprise as an open economic system (systemic) [177, p. 69]. The latter means consideration of market entities in interaction with their surrounding microenvironment.

Unlike the methodology, the research method is subordinated to the solution of specific scientific problems. It is a method of research, a tool for achieving the goal [178, p. 31]. A set of different methods of knowledge (economic, statistical, mathematical, etc.) taking into account the principles of dialectics constitutes the content of the methodology of economic research [179, p. 58].

The greatest effectiveness of knowledge of objective reality can be achieved under the conditions of effectively selected scientific research methodology. In the research of bioenergy and market processes in this area, the issue of developing a methodological toolkit of the researched area becomes especially relevant. The application of the latter varies depending on the level in relation to which the research is conducted.

In order to obtain comprehensive results when studying the bioenergy market of Ukraine, it is advisable to consider it based on the use of different groups of methods.

Taking into account the breadth of application and the presence of common parameters, they are classified into general scientific and special (Fig. 1.3).

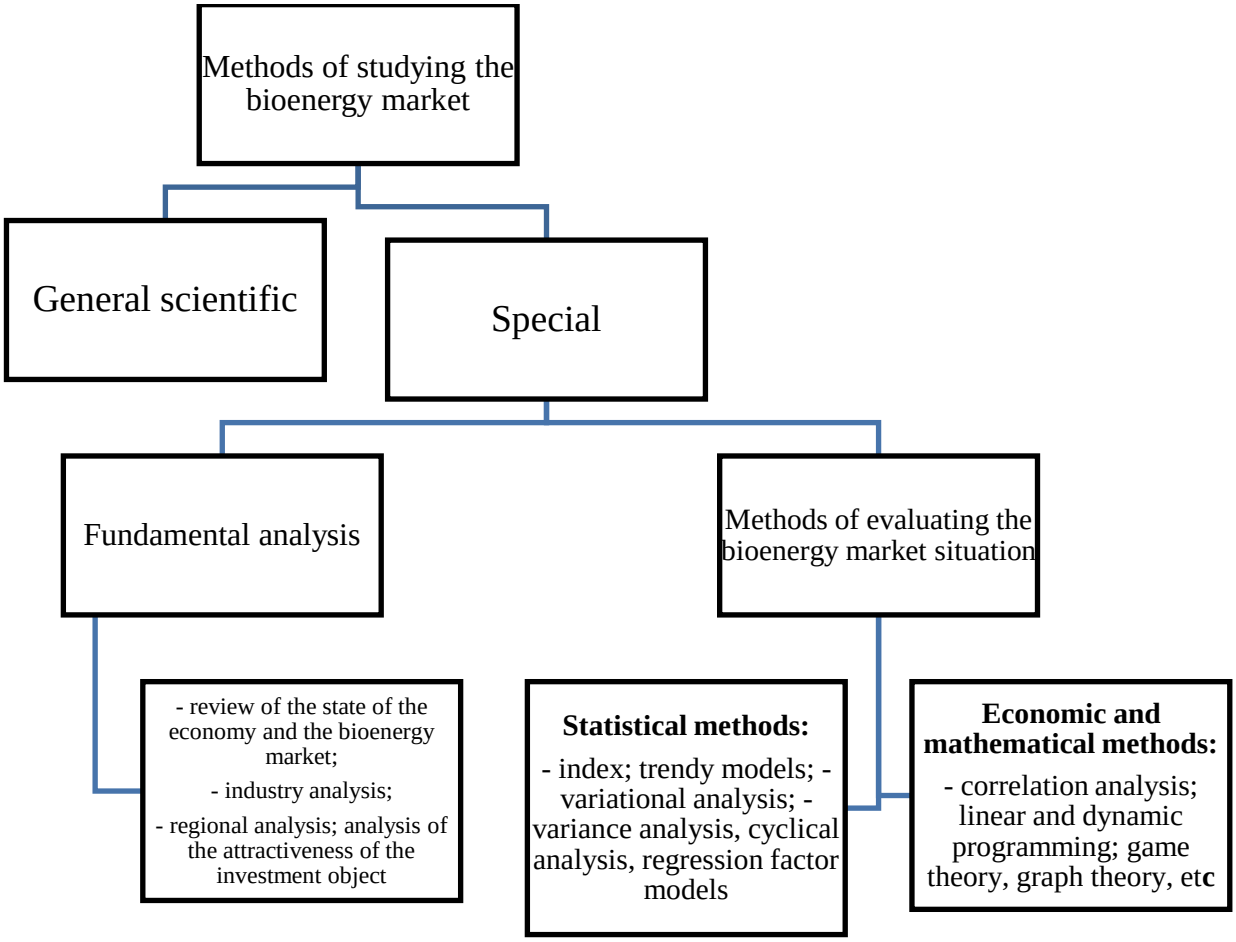

Fig. 1.3. Classification of bioenergy market research methods

Note. Formed by the author based on [180, p. 62]

The dialectical method of learning processes and phenomena remains basic for conducting scientific research on the development of bioeconomic systems (Table 1.1). The specified method and the corresponding approach make it possible to study processes and phenomena by determining the regularity of their constant development, existing relationships, taking into account the transition of quantitative changes into qualitative ones, analyzing contradictions inherent in the object of research.

I. V. Popovych notes that the systemic approach requires the identification of the essence of the phenomenon and process as independent systems of a certain order, possessing a variety of the structure of connections with economic subsystems, the system and the environment; development of synthetic and analytical indicators characterizing the quantitative side of phenomena and processes in an inextricable

connection with their qualitative determination; study of laws, regularities and trends in their development based on the selection and transformation of information; drawing up models of the development of phenomena and processes taking into account the dynamism of the economic system, with their economic justification. Such a complex approach is a characteristic feature of modern research [181]. The concept of "general systems theory" was developed by L. von Bertalanffy in the 19th century. within the natural sciences, interdisciplinary teaching was gradually transformed and is currently the leading methodology in conducting any research, one way or another related to biological processes and the study of open systems.

Table 1.1

Philosophical and general scientific methods used in market research

Methods of scientific knowledge	Characteristics of methods
Philosophical methods	
Dialectics	Position: 1. In the objective world, the creation and destruction of everything is constantly taking place, there is a mutual transition of phenomena. 2. Concepts, categories and other forms of thinking must be flexible, interconnected, united in opposites to correctly reflect the changing reality.
Metaphysics	Position: 1. In order to obtain an adequate assessment of the phenomenon, it is necessary to consider it separately from all the factors affecting it. 2. When studying general patterns, it is necessary to abstract from reality.
General scientific methods	
Empirical Observation, description, change (finding the numerical value of the measured value in accepted units of measurement), experiment.	
Methods of processing and systematizing knowledge at the empirical level Analysis, synthesis, induction, deduction, comparison, classification, comparison	
Theoretical methods Abstraction, analogy, modeling, idealization, system method, historical method, axiomatization, logical method, complex approach, program-target planning.	

Note. Formed by the author

I. V. Popovych notes that the systemic approach requires the identification of the essence of the phenomenon and process as independent systems of a certain order, possessing a variety of the structure of connections with economic subsystems, the system and the environment; development of synthetic and analytical indicators characterizing the quantitative side of phenomena and processes in an inextricable connection with their qualitative determination; study of laws, regularities and trends in their development based on the selection and transformation of information; drawing

up models of the development of phenomena and processes taking into account the dynamism of the economic system, with their economic justification. Such a complex approach is a characteristic feature of modern research [181]. The concept of "general systems theory" was developed by L. von Bertalanffy in the 19th century. within the natural sciences, interdisciplinary teaching was gradually transformed and is currently the leading methodology in conducting any research, one way or another related to biological processes and the study of open systems.

I. V. Blauberg and E. G. Yudin define the system approach as a direction of the methodology of special scientific knowledge and social practice, the basis of which is the study of complex objects as systems. This approach contributes to the adequate formulation of problems in specific sciences and the development of an effective strategy for their study. The specificity of the methodology of the system approach is determined by the fact that it focuses research on the disclosure of the integrity of the object, the mechanisms of its functioning, on the identification of various types of connections of a complex object and their reduction into a single theoretical basis [182].

It is advisable to consider the system approach as a methodology that is at the stage of transformation and renewal. Evidence of this is the formation of new paradigms within it. One of them is such a conceptual direction as synergy. The main principles of the synergetic theory were developed by H. Haken in 1969. According to this doctrine, the sum of the effects of each individual part, element of the system will be less than the total result of the effects of their interaction. Within the problematic field of synergism, the question of holism is considered - the ratio of parts to the whole [183] as a manifestation of the synergistic effect. Thus, Darlene D. Collins claims that for a reliable understanding of objective reality, it is necessary to use a holistic approach [183]. A comprehensive approach to the development of the bioenergy industry based on the principles of marketing and the development of relevant markets is contained in the modern concept of holistic marketing.

Holistic marketing recognizes that marketing requires a comprehensive, integrated approach. Within the framework of holistic marketing, the equivalence of

the use of the main concepts of marketing in the management of the enterprise, industry, penetration of marketing tools in all spheres of activity is achieved. At the same time, each of the interacting concepts occupies its own "niche" and interprets certain aspects of marketing activity, maintaining autonomy and being subject to slight modification [184].

According to F. Kotler, holistic marketing more holistically considers the social space in which consumers, owners and employees of enterprises are [185]. Marketing should cover not only sales channels, but also supplies, not be a separate function, but the driving force of the enterprise. In fact, F. Kotler says that marketing should not divide the market and the enterprise into parts, but perceive them as a whole.

The concept of holistic marketing can be adapted for the bioenergy industry of Ukraine. In fig. 1.4 presents such a model of holistic marketing. Complementary to it can be the concepts of ecological marketing (for example, for enterprises producing organic products, there are links in the supply chain for such enterprises, for green tourism, and, of course, for enterprises producing biofuels of various types, etc.), as well as territorial marketing . The concept of global marketing, which ensures the effectiveness of development of new foreign markets, is complementary for enterprises in the bioenergy industry with access to foreign markets.

Holistic marketing delivers results rather than the illusion of understanding and control, an approach that attempts to recognize and balance the various competencies and complexities of marketing. Synergism and holism are closely related to the category of "emergency", which in translation from English means the emergence, emergence of the new, and is interpreted as the phenomenon of the unexpected emergence of a new, higher quality that cannot be predicted based on the analysis of existing development trends or changes in the quantitative parameters of the system.

The historical method and retrospective analysis, which are quite often used in the process of economic research, deserve special attention. According to the definition of I.V. Popovich, the historical method of research is reduced to the study of all phenomena and processes in the dynamics, formation of a specific stage of the development of society [181]. There are such techniques within the scope of the

retrospective method as periodization, historical modeling, historical detailing, etc. In order to determine the reserves for increasing the efficiency of the production and sale of bioenergy products and the competitiveness of economic entities on this market, various methods of economic analysis are used: from simple ones, such as comparison, calculation of average and relative values, construction of tables and graphs, to more complex ones that give be able to investigate cause-and-effect relationships: index method, grouping, methods of elimination: by means of chain substitutions, relative differences, absolute differences, etc. [187].

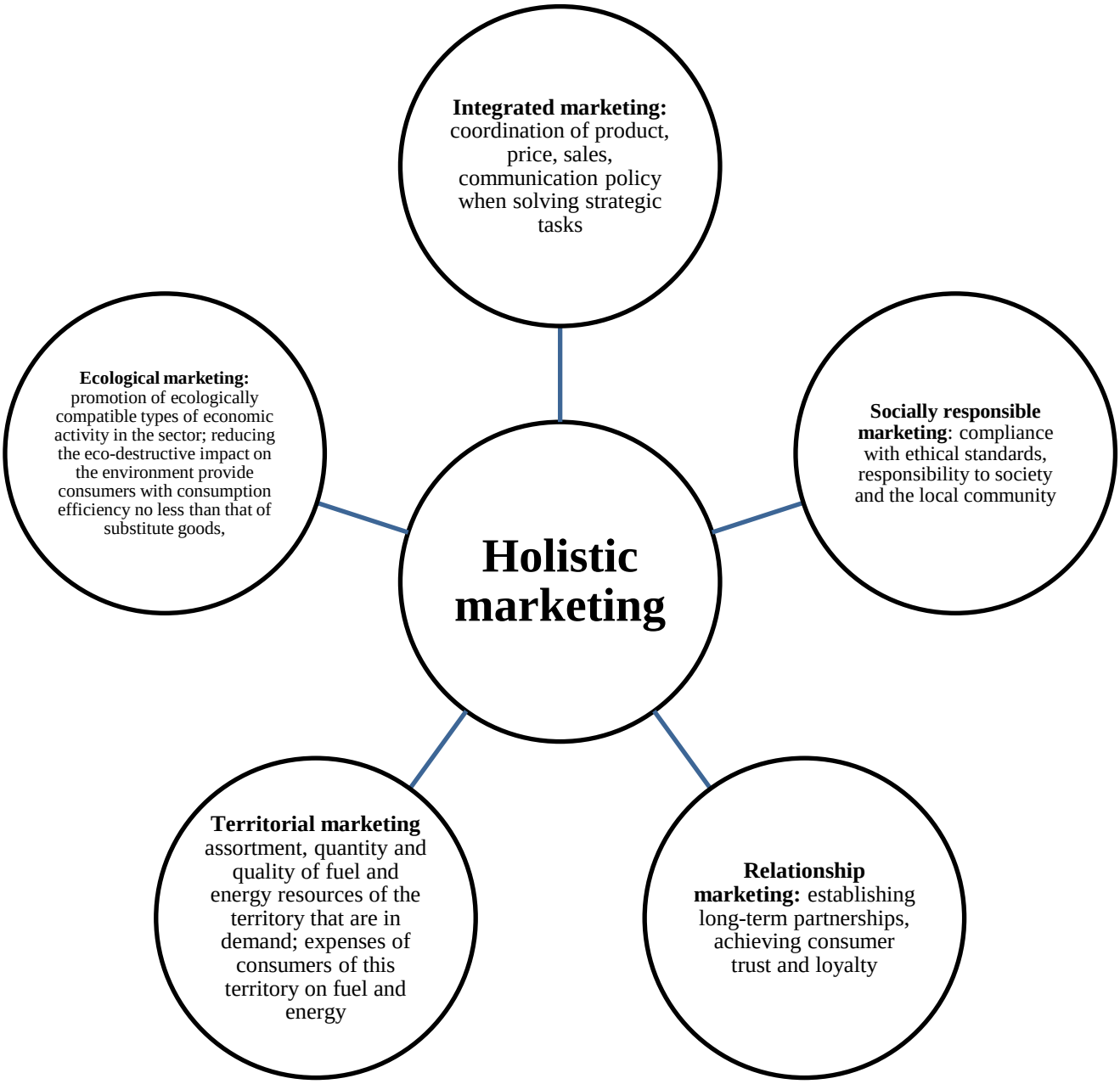

Fig. 1.4. Components of holistic marketing in the bioenergy field.

Note. Developed by the author based on: [184, 185, 186].

The formalization of research results in the more frequent use of mathematical and statistical methods. Such methods are used both in collecting the analytical base of the research and in its further analysis. These include the method of average and relative values, the method of grouping, index analysis, the balance sheet method, the method of correlation and regression analysis, modeling, etc. The assessment of patterns of market processes, relationships between factor and resulting indicators for the purpose of determining reserves is carried out using correlation analysis. In practice, correlation and regression analyzes are often combined, but it should be noted that the tasks of these methods are different. Thus, regression analysis determines the form of the connection, and correlation analysis determines the tightness of the connection [187]. The essence of correlation-regression analysis is reduced to establishing a mathematical equation or, in other words, a model that demonstrates the relationship between factors (x1 , x2 ,... , xn) and the resulting indicator (y), as well as indicators showing the tightness of connection - correlation coefficients. In the case of a linear form of the relationship, the regression equation has the form:

$$y = x_0 + a1\ x1 + a2\ x2 + ... + a_n\ x_n, \qquad (1.1)$$

where a1, a2,..., an are regression coefficients.

Therefore, with a known numerical value of the change of the effective indicator and the corresponding factor indicator, it is possible to establish the size of the influence of the latter on the value of the result [187, 188].

In conditions of general informatization and a high level of computer technology, there are opportunities to use methods of mathematical statistics, econometric modeling, etc. [188]. Economic and mathematical methods are used to solve optimization problems, which makes it possible to solve the problem of choosing the production of those types of products (for example, different types of solid biofuel, biogas, biodiesel) that have the largest growth reserves and the production of which is economically efficient and expedient in a specific region. Optimization problems, where the target function is a linear function of independent variables, and the conditions that determine the permissible values of these variables have the form of linear equations and inequalities, are classified as linear programming problems:

$z = к1\ x1 + к2\ x2 + ... + кn\ xn$, (1.2)

where: k1, k2,..., kn are constants;

x1 , x2 ,..., xn - variables;

n - arbitrary natural number.

In the optimization models of the functioning of enterprises in the bioenergy market, a single objective function is used, which is optimized taking into account technical (land areas, production capacity for biomass processing) and economic (prices, logistics costs, etc.) limitations. In contrast, in simulation and equilibrium models, the problem of simultaneous profit maximization for all competing enterprises in the market is considered [188, p. 12]. Possible options for modeling the development of the bioenergy market are listed below in Table 1.2.

Table 1.2

Possible models of development of bioenergy markets

Groups	Types	Content
Optimization	Exogenous price	The marginal cost of the system is an input parameter for the optimization problem. As a result, market revenue becomes a linear function of the firm's output, which is the most important variable in this approach. Linear programming methods can be used for the solution. Models are divided into deterministic and probabilistic
	Price as a function of enterprise decisions	Such a model examines the impact of possible production volumes by the enterprise on the price of biofuel. In such models, the amount of biofuel or bioenergy that a company can sell at different prices is an input, that is, a function of residual demand. These models can also be divided into two subgroups depending on the function used: a probabilistic representation or a residual demand function.
Models of market equilibrium	Cournot equilibrium	Biofuel companies choose optimal productivity. Their strategies are expressed in terms of quantity rather than supply curves. Therefore, equilibrium prices are determined only by the demand function and are very sensitive to the representation of demand
	Supply function equilibrium	Based on the possible residual demand curves, the producer usually expects a higher profit, expressing its decisions in the form of a supply function, which determines the price at which it offers different quantities of products to the market. The equilibrium supply function approach may be a possible research direction for the analysis of equilibrium in wholesale electricity markets
Simulation models	Simulation models dependent on equilibrium models	The model considers the maximization of the profit of the production enterprise, taking into account the technical limitations that affect the heat generating capacity. Decisions made by manufacturing enterprises are determined using an iterative procedure. At each iteration, the company changes its strategic position within the two-level decision-making process. First, each firm updates its output for each planning period with the goal of

Continuation of table 1.2

		profit maximization in which the market price remains constant and the firm's output limits are included in the constraints. Then they modify the price at which the company offers to release products in the planned period according to the rules of decline. New market prices are calculated based on these offers and the development of demand, which is assumed to be inelastic.
	Model agents	A model in which generating companies are represented as autonomous adaptive agents participating in a continuous daily market and seeking strategies to maximize their profits using the analysis of results obtained in previous operations. It is assumed that every day companies have two main goals: the minimum amount of use of their productive capital and a higher income than the previous day. The only information available for each generating company consists of its own revenues and the temporal output of its biomass energy.

Note. Formed by the author on the basis of [188, p. 14-16]

In addition to the above classification, bioenergy market models can also be divided by the degree of competition, model time boundaries, uncertainty modeling, relationships between modeling periods, transmission constraints, production systems representation, and market modeling. In the dissertation work, we consider the bioenergetics market as a fast-growing market with a defined supply, which has significant development prospects and with a demand that is just forming, and which is difficult to assess in the future.

Under the influence of strengthening integration processes, the so-called global market is being formed. The field of bioenergy is no exception. And thus, the impact of global economic processes should also be taken into account in the process of modeling the development of this market.

Therefore, the determination of the position of domestic producers of bioenergy products on the domestic and world market is important in relation to the prospects for the development of bioenergy. To achieve this goal, special methodical tools are used. In particular, for domestic researchers, it is more typical to use the conceptual apparatus of product positioning, as a result of market segmentation according to product-price or consumer criteria [189]. However, the interpretation that more closely corresponds to the purpose of researching agricultural markets is to define the position of the enterprise as a set of existing advantages of an innovative, price, production and scale nature, which allow to significantly influence in the short term the behavior of other

participants in market processes in order to obtain positive results of their activity [190].

At the same time, individual authors highlight the positive, negative and neutral position of the enterprise, being guided by the possibilities of achieving a certain level of sales activity efficiency in the short term. A positive position allows the enterprise to freely manage the volumes of product batches, vary the price of products, thereby influencing the behavior of the closest competitors and consumers. It assumes the possibility of selling all products at planned or higher than planned prices. The negative position implies the significant dependence of the enterprise on the commercial situation on the market for its products, which arises due to the lack of certain production, infrastructural or commercial opportunities and causes the threat of "non-sale" or ineffective sales, and therefore the failure to obtain profit, the planned volume of products. A neutral position is characteristic of a situation in which an enterprise, due to the presence of certain innovative or commercial advantages, does not feel the need to provide opportunities to significantly influence the behavior of competitors and has opportunities for guaranteed sales of its products at planned prices and profit [191]. In our opinion, this method of determining market positions is sufficient for bioenergy products market subjects. However, the domestic market of bioenergy products is only at the stage of formation, which makes it necessary to adapt the approach to determining the market position of the enterprise to the specifics of the functioning of the domestic industry of bioenergy and the corresponding market.

The structured factors of the formation of the market position of the producer of bioenergy products are shown in fig. 1.5. Of particular importance for the development of bioenergy in Ukraine is the development of a methodological basis

analysis of this market, i.e. intra-industry analysis.

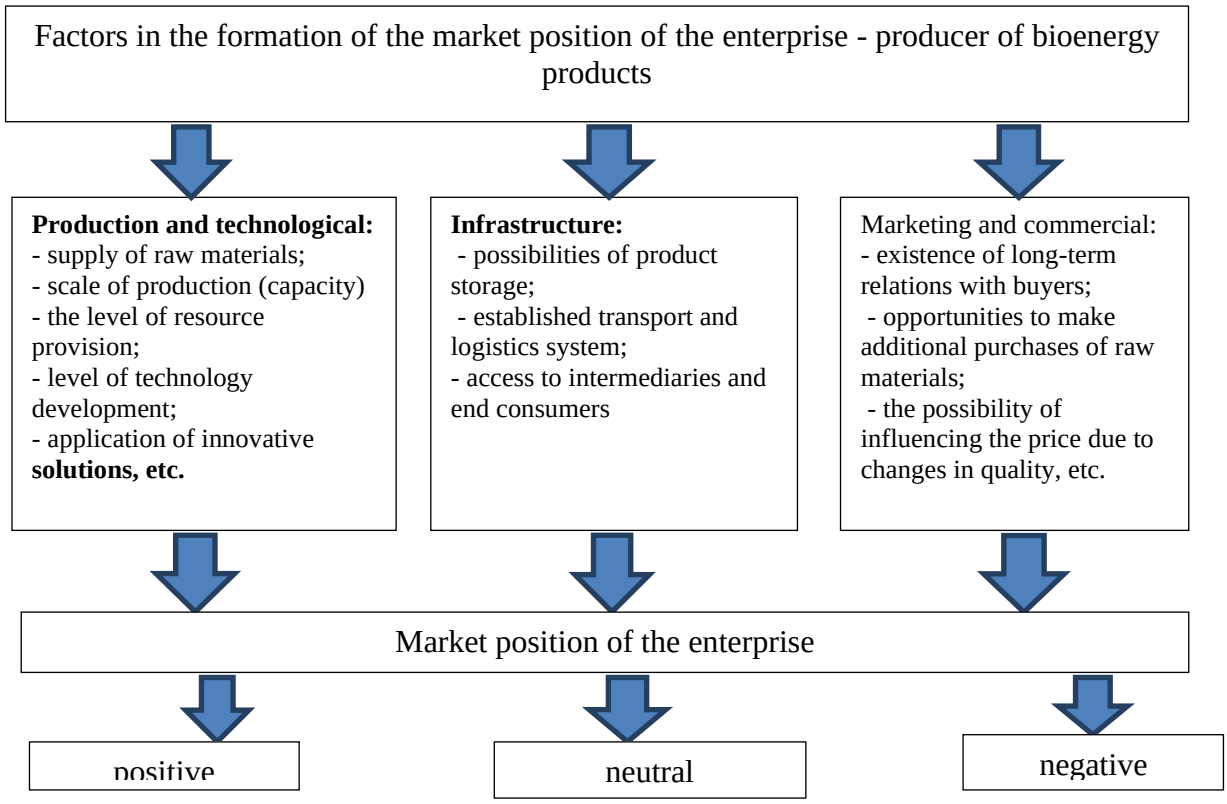

Fig. 1.5. Factors of formation of market positions of producers of bioenergy products

Note. Formed by the author based on [190]

M. Porter points out the importance of starting such an analysis by characterizing the strategy options of all major competitors in the specified strategic areas. This makes it possible to identify strategic groups in the industry, which are groups of enterprises with the same or similar strategy options. There can be only one strategic group in an industry if all firms pursue essentially the same strategy. The other extreme is that each enterprise can be an independent strategic group. However, as a rule, there is a small number of strategic groups that have significant differences in the strategy of enterprises in the industry [192]. Based on the identification of strategic groups, it is advisable to build their graphic representation in the form of a map. Also, according to M. Porter, the analysis of five competitive forces is important in order to justify and develop a strategy for subjects of market relations [193]. The transformations taking place in the bioenergy production industry and related industries are relevant to strategy if they can be traced to the factors underlying the five competitive forces. Otherwise, these changes are important only tactically.

A methodical approach to analyzing the dynamics of market processes and competitive forces consists in asking the following questions. Are there any changes in the industry to each element of its structure? In particular, is there a trend in the industry leading to lower or higher barriers to mobility; to strengthening or weakening the relative power of buyers or suppliers? If similar questions are asked in a systematic form regarding all competitive forces and the economic reasons that caused them, then as a result we will get a description of the most significant problems of the development of the industry. Such a specific industry approach is a starting stage, but it may not be enough, since it is not always clear what industry trends are taking place at the moment and what changes may occur in the future. Such uncertainty makes it necessary to forecast trends in the development of production and sales of bioenergy products.

Given the importance of forecasting development, it is desirable to have certain analytical tools that will help identify the trend of the most likely industry changes. The operating conditions of the industry from the point of view of strategic consequences are most significantly distinguished by the following main parameters: the level of concentration; degree of industry maturity; the intensity of international competition in the studied segment [194, 195]. In order to substantiate the prospects for the development of the industry and the bioenergy market, it is necessary to carry out an in-depth analysis based on the defined parameters that characterize the main types of operating conditions of the industries, for each of which the decisive aspects of the industry structure, the most important strategic problems, characteristic strategic alternatives and calculations are determined. The five most important types of conditions are selected for analysis [196].

An important, albeit somewhat subjective, method of research should be considered an expert survey, which helps not only to determine the qualitative parameters of the development of the industry or the corresponding market, but also outlines the defining directions of such development. With regard to the development of bioenergy, the expert survey method is extremely important, since the market mechanisms for the development of this industry are only being formed, and consumers are not sufficiently oriented about the advantages and disadvantages of different types

of biofuels and bioenergy. It is necessary to take into account the methodological recommendations proposed by: U. Kendall, who suggests building a matrix of answers and relying on the best ones; D. Black and A. McKelve, who consider the rule of the majority to be the dominant feature; E. Tsermelom - with an emphasis on the quality component [196].

Peculiarities of methodological market research determine strategic alternatives for the development of entities (production of bioenergy products and the bioenergy market) as a whole. For example, this applies to the use of a complex of matrix methods (Table 1.3).

Table 1.3

Basic matrix methods of market analysis and formation of market strategies

The name of the matrix method	Factors forming the basis of the matrix	Purpose of the method
SWOT analysis	- strengths; - weak sides; - opportunities; - threats	Analysis of the object's strengths and weaknesses, with the aim of identifying opportunities and threats and choosing a development strategy
PEST/STEP analysis	- political; - economic; - social; - technological factors	Analysis of the influence of macroeconomic factors (political, economic, social, technological) on the activity of the enterprise in a certain market (in a certain industry)
SPACE- matrix	- financial strength; - competitive advantages; - environmental stability; - attractiveness of the market	Strategic analysis of the external environment and assessment of the competitive position on the market with subsequent strategy selection
BCG matrix	- market share (high, medium, low); - market growth rates (high and low)	Analysis of market share and growth rates makes it possible to identify the type of product that will be appropriate to produce to achieve economic growth
Matrix "General Electric / McKinsey"	- attractiveness of the market (low, medium, high); - assessment of the competitiveness of the project	These matrices provide an opportunity to assess the current state and provide an opportunity to establish the prospects for the development of the project/industry thanks to the assessment of the attractiveness of the market and the competitive situation, as well as to determine the development strategy (prospects)
matrix Shell/DPM	- competitiveness; - industry/business prospects	
Brownie-Barth matrix (ADL/LC)	- market position (leader and follower); - stage of the life cycle of the target industry/project	Comparison of the life cycle with the position in the market makes it possible to investigate the production of which product is the most profitable and long-lasting
PIMS	- strategic variables: market share, product quality, etc.; - situational variables: market growth rate, industry development stage, intensity	based on the use of an empirical model that relates a wide range of strategic and situational variables to the magnitude of profitability and the ability of the organization to generate cash

Continuation of table 1.3

	of capital flows; amount of profit	
Five forces of competition according to Porter	- potential competitors; - competitors (existing), - substitutes, - suppliers, - buyers	allows you to assess the state of competition in the industry / on a specific market
Matrix of A. Thompson, I. Strickland	- competitive position - dynamics of market growth (fast, slow).	Allows you to choose a strategy depending on the dynamics of growth in the market for products and the competitive position of the market
Model G. Abel	- customer groups served; - customer needs; - the technology used in product development and production.	Allows you to define the business area in three dimensions. The most important evaluation criterion is the compliance of the analyzed industry with the general direction of activity, in order to use the synergistic effect in technology and marketing.
SNW analysis	Each position receives one of three ratings: - strong (Strength); - neutral (Neutral); - weak (Weakness).	analysis by which the state of the internal environment of the enterprise is assessed according to a number of positions.
Life cycle method	- sales volume on the market - change in profitability; - time	Based on the definition of strategic directions and actions for each stage of the product life cycle (development, growth, maturity, decline)
Method of learning curves	- amount of production costs; - production volumes	Reflects the influence of only internal factors, shows the influence of the "scale effect" on the size of production costs depending on the production volumes.

Note: summarized by the author based on [191, 192, 193, 194, 195]

The concept of the life cycle of the industry, which is followed by ADL specialists, in its development, as a rule, goes through four stages: birth, growth (or development), maturity, aging (decline). The main theoretical premise of the ADL/LC model is that a separate type of business of an economic entity can be at one of the indicated stages of the life cycle, and, accordingly, it must be analyzed within this stage, and then, based on the data obtained, develop a strategy development The specified provisions also apply to all other matrix methods, with the exception of the specifics of the object and the purpose of the study. In order to achieve advantages over competitors and form effective development strategies, business entities must know the market situation, assess the level of competition and the level of their own competitiveness according to objective methods.

Comprehensive market research is a system of studying the unsatisfied needs of the buyer, the conduct of which ensures the effective adoption of all types of management decisions regarding the creation of new products [196]. As a result of the analysis of the works of leading scientists, it is possible to determine the algorithm of scientific developments and highlight five main stages of their implementation (Fig. 1.6).

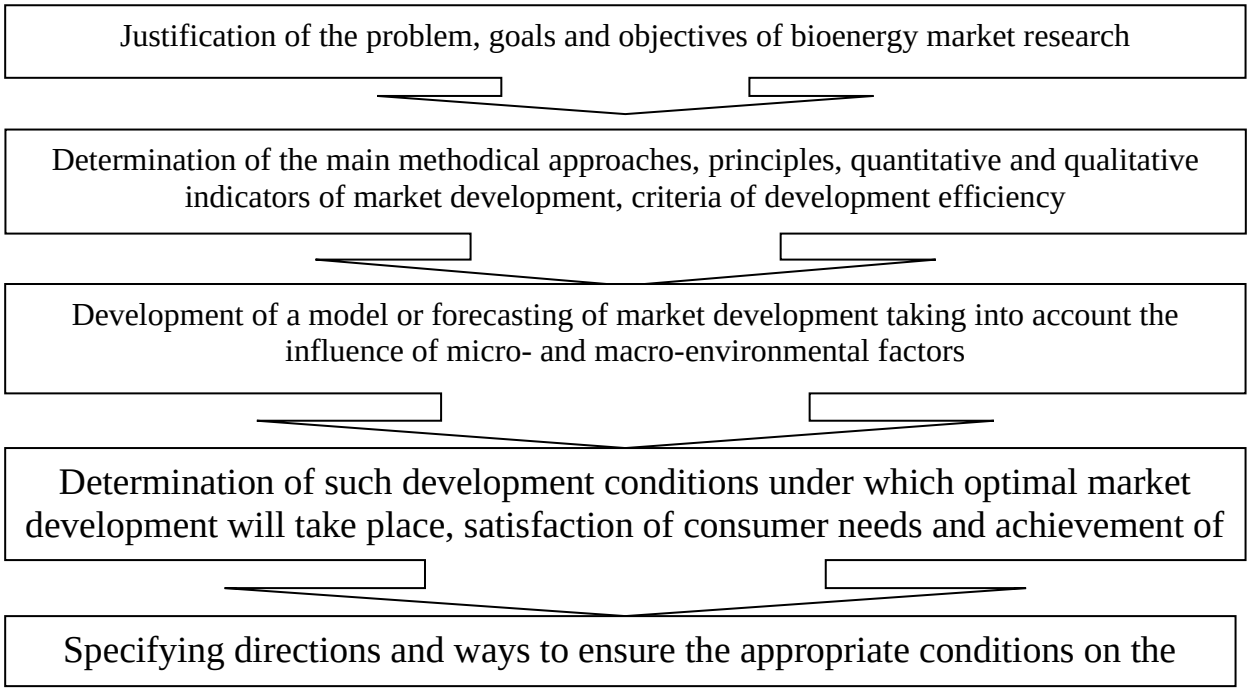

Fig. 1.6. Methodological aspect of the bioenergy market research algorithm

Note. development of the author.

The given market research algorithm can to some extent be considered a paradigm. After all, the scientist perceives the object of his research not directly, but with the help of a paradigm, as an expression of the collective consciousness of the scientific community, as well as its role in the formation of methodological standards. The reliability of the results obtained in the research process is largely determined by how the applied method meets the methodological standard. The latter acts as a kind of methodological filter.

The systematic use of the methodology of the synergy of agro-economic systems makes it possible to solve a number of acute problems of energy security and to determine the ways of development of the bioenergy market of Ukraine on the basis of marketing.

The essence of the system-synergistic approach is that the analysis of the industry or relevant market processes is carried out through a synthesized set of theoretical and methodological provisions of the general theory of systems and synergy. It is this combination that is used by many scientists to explain the interdependence of economic processes and phenomena, to understand and solve problems related to the processes of globalization and internationalization.

Synergetics studies the patterns of emergence, formation and development of systems characterized by openness, self-organization and non-linearity.

The founders of the system approach were scientists P. Drucker, Y. Prigozhin, G. Simon, A. Chandler, and others. In modern scientific research, the systemic approach is organically complemented by economic synergy, which justifies the non-linear processes of social development. We use the methodology of synergetics, based on the analysis of the works of Y. Prigozhin, I. Stengers, and H. Haken. The use of a system-synergistic approach in various fields of science is analyzed in the works of domestic researchers A. Galchynskyi, M. Zgurovskyi, S. Mochernyi, H. Chornyi and other scientists.

The synergistic approach and corresponding methods of research of phenomena and processes are used to solve both specific problems arising in systems at transitional stages of their development, and general problems of qualitative transformation of economic systems. This approach is characterized by universality and a sufficiently complete representation of unstable states. The study of modern market processes requires solving the tasks of finding clear relationships and determining the mechanisms of interaction between variable factors and a relatively stable result, building models in which the evolution of the system can be presented as an organic continuation of the previous stages of its development. Synergetics technically enables the creation of such a model due to the development of relevant principles and the development of an effective methodological research apparatus.

The dynamics of stochastic processes inherent in complex nonlinear systems, which includes market processes in the field of bioenergy, is evaluated on the basis of this methodological base as a process of their evolution, as a complex process of

changing states of stability and instability, transition to a new development trajectory as a result. It should be noted that economic science began to investigate market processes and individual subsystems of the market, starting with A. Smith. The essence of the market then was the dominance of private property and the corresponding spontaneous mechanism of coordination, which in the market of perfect competition occurs through the interaction of the "invisible hand of the market" and "competition of commodity producers".

Synergetics as a science of the transformation of complex systems makes it possible to predict the development of market processes. She studies the self-organization processes of complex nonlinear systems in a state of chaos, distinguishing between its two forms: balanced and deterministic. Equilibrium chaos inherent in the elements of an equilibrium system characterizes the state of the system with the autonomous behavior of its elements. Such chaos does not lead to changes in the system, its order, is not the basis for the organization of the system, and therefore does not serve the purposes of its development. It is defined based on the principle of maximum entropy, and evaluated as fruitless chaos [197, p. 88]. It is similarly evaluated in the economy.

Deterministic chaos is the chaos of non-equilibrium systems that forms the order of the system. As for market relations, it cannot be claimed that they are in a state of chaos under modern conditions, because most market processes are in the field of state regulation. But this is quite correct in relation to a large number of structural units - participants in economic relations. Deterministic chaos is a source of order, orderly, purposeful behavior of system elements. Regardless of the nature of the elements, it is possible to determine their ability to self-organize in the event of some threats, for example, threats to economic and energy security or lack of certain resources. Synergetics examines the external effects that cause changes in the structure of systems (orderliness, purposefulness of the behavior of the system as a whole against the chaotic behavior of its elements).

Market systems can have relatively stable periods of development based on the predominance of inertial features of the constituent elements, as well as conditionally

unstable ones. The instability and chaos of the system create opportunities for it to jump to a new state at the point of bifurcation. A bifurcation point is a moment in time when an unpredictable transition of the system to one of the other states, typologically not identical to the initial one, is observed [197, p.89]. The critical state of the system, in which it becomes unstable with respect to fluctuations (disturbances), causes uncertainty: either the system becomes more chaotic, or it moves to a new, more ordered, stable state. Bifurcation is the emergence of a qualitatively new, distinctive behavior of an element due to a quantitative change in its parameters [198]. This is a situation when the choice of one of the options for further development is made either by chance or due to the slight influence of external factors or internal features of the system itself. In the process of development, the system goes through the following stages: evolutionary (or adaptation) and revolutionary (leap). Evolutionary involves the slow accumulation of quantitative and qualitative changes in the parameters of the system and its elements, according to which at the bifurcation point the system chooses one of the possible attractors for it - options, development trajectories (an attractor is a set of points or lines in space to which trajectories converge (are directed) systems development [199]) As a result, a qualitative jump occurs, and the system forms a new dissipative structure (a structure that arises spontaneously in open non-equilibrium systems) corresponding to the selected attractor (Fig. 1.7). Such a qualitative leap in the energy market of Ukraine, a turning point should be considered the rapid growth of the use of biomass as an alternative source of energy. After choosing such a trajectory, development becomes irreversible, and it is impossible to go back to the bifurcation point to choose another development trajectory.

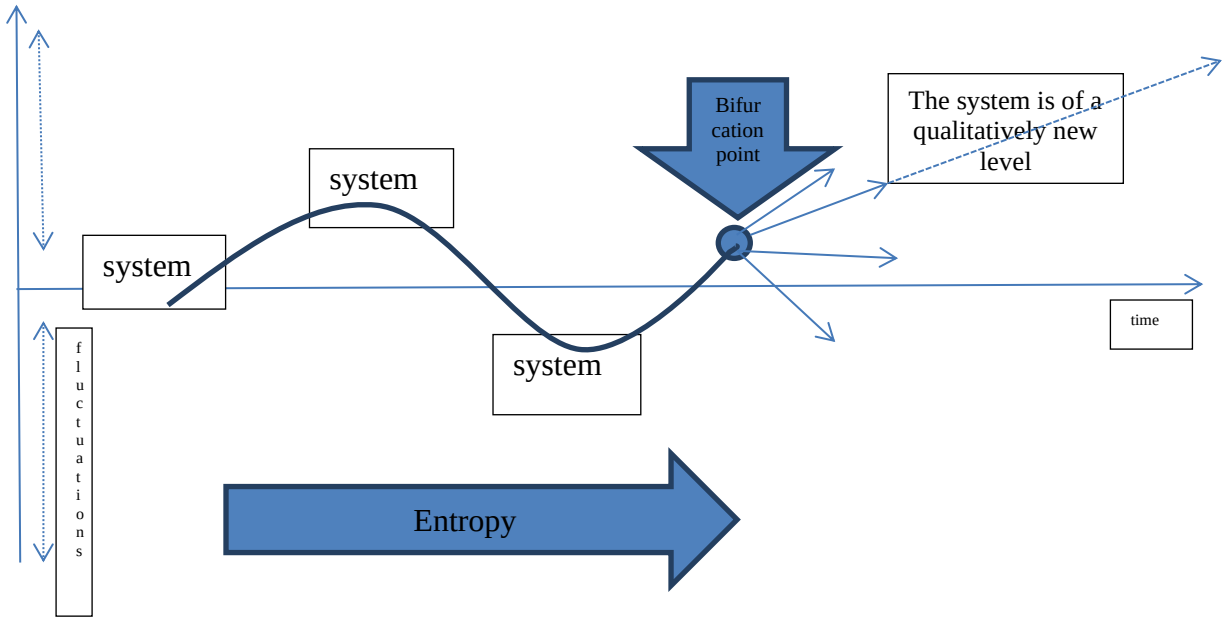

Fig. 1.7. Formation of a new dissipative structure

Note. Built by the author on the basis of [200]

The evolutionary stage of development is characterized by the presence of mechanisms that extinguish strong fluctuations (disturbances) of the system or its components and return it to a stable state. For example, the development of Ukraine's energy markets took place in an evolutionary way during the 90s of the 20th century and the beginning of the 2000s. Such development directly depends on the direction of development of the world economy. However, the various influences of external factors accumulate and lead to the occurrence of situations when due to the increase of changes in the system, its elements and the external environment, its ability to adapt decreases and instability increases. Entropy (a measure of uncertainty) gradually increases in the system. There is a sharp contradiction between the old and the new. Yes, 2008 was the most turbulent year for energy markets. The disturbance of the system was influenced by several main factors. First, average prices for all forms of primary energy increased significantly during 2008, taking into account the seven-fold annual increase in oil prices compared to 2007, the first time in the last 150 years of the oil industry. Over the past six years, there has been a sharp increase in coal prices, and accordingly, an increase in carbon dioxide emissions into the atmosphere. Interest in greenhouse gas emissions has increased as a profitable direction for the development of energy markets, in particular, the electricity market. Secondly, during 2004-2008, a

sharp increase in the use of renewable energy sources was observed (investments in this industry increased 3.5 times during the specified period).

As the parameters of the system and environment reach bifurcation values, instability becomes maximal and even small fluctuations lead the system to a qualitative jump. This point is called the bifurcation point. In Ukraine, such a point in the energy market can be considered the period after, when Against the background of the growing oil and gas deficit, Ukraine had no choice but to build energy independence on its own raw material base. At this phase, development is determined not only by internal fluctuations (the strength and direction of which can be predicted by analyzing the history of development and the current state of the system), but also by external ones. This makes forecasting extremely difficult. After the formation of a new structure, the system is again on the path of smooth changes, and the cycle repeats itself. But in fact, the development of real market systems includes not only progressive attractors, but also degradation attractors (which may change over time with progress, or may lead the system to collapse) and destruction [201]. Self-organization is manifested in the transition of the system from one state to another, the emergence of order from chaos. This is a state when the previous structure (market system) with its connections between elements disintegrates, and on its basis, the formation of other elements - economic systems of various types and levels - has begun. As a rule, there are several factors at the heart of the process of disintegration: the main one is the loss of the unifying idea of a unified state development (or the absence of justified state programs for the development of the industry), as well as changes in the ownership of means of production and natural resources (in particular, a change in the owners of energy-generating companies), differences in principles of social development, in political views [202].

Within the framework of the synergistic approach, the following patterns of transformation are distinguished: an environment saturated with energy is able to support and strengthen the processes that arose as a result of minor external or internal influences; cooperation processes are developed among various structures that make up the economic system; the hierarchy of any structures also determines the hierarchy

of cycles – the structure of a higher order adapts the structures of a lower order to its rhythms; external causes lead to real transformations in the system only in those cases when it is already prepared for this by the dynamics of its own development; the more perfect the system is, the better it determines its development in the anti-entropic direction; the more stable, stronger the system is, the deeper and more destructive changes can be; the more flexible and plastic the system is, the more likely the evolutionary version of its development will be (the less likely its revolutionary changes will be); the phase of stagnation is necessary to exhaust all the potentialities and possibilities of outdated degrading structures; creativity, intelligence are powerful factors of self-organization, overcoming the state of instability and chaos.

The application of synergetics in the research of economic development, in particular, the development of markets, showed that the main direction of movement of economic systems in most cases is evolution, the direction of which due to the nonlinear nature of connections in the system is determined by the action of minor factors, usually informational. This confirms the main methodological message of our research, which is that with the help of marketing research and further marketing informational influences, it is possible to achieve the development of the bioenergy market, focused on achieving predetermined goals, in particular, ensuring a sufficient level of energy security, socio-economic stability, etc.

Economic success in the conditions of modern markets is the result of the extent to which the economic system is able to absorb, use, and filter out unnecessary information. Moreover, the structure of this information, the importance of each component for the economic development of the system is of great importance. To obtain the necessary information, the subjects of market relations use marketing research, which ensures the receipt of primary and secondary information. On the other hand, providing information to potential consumers of biofuel and energy produced on its basis can speed up or, on the contrary, slow down the development of the bioenergy market.

Fluctuations (disturbances) of the system near the bifurcation points allow it to determine the most acceptable direction of development from the point of view of the

state of the system and the external environment. The content of fluctuations at bifurcation points consists in choosing an attractor, a vector of development [198, p. 90]. At the points of bifurcation and selection of a development option, the system begins to react strongly even to minor influences. As a result, external random deviations become decisive. This state of the system at the points of bifurcation makes it more vulnerable to external influence, which is consistent with ripe internal contradictions. This influence can determine the option of further evolution of the system, which will be very difficult to change later. On the contrary, a minor impact will not be enough to solve the problem of qualitative transformation of the system [197, p. 90]. In this case, the system better perceives some fixed fluctuations (even destructive ones) - their presence creates certain obstacles for external management influence. Thus, it is clear that implementing decisions aimed at radical changes in the destructive, unacceptable direction of movement is very difficult, and it requires extraordinary decisions. However, it should be noted that after passing through the bifurcation point system, it will be almost impossible to do this.

The current situation in Ukraine in the field of energy supply can be defined as close to the point of bifurcation, as certain contradictions in the system are intensifying, clearly destructive mechanisms of building economic relations and management in general prevail. After passing a certain stage of system evolution (bifurcation point), it is difficult to correct the situation. In this case, we mean the growing threat to the economic and energy security of the country at the macro level, regional level, and the problems of energy supply of individual subjects of the economic system (enterprises, organizations, institutions). Therefore, there is a growing need to develop and implement scientifically based proposals for improving the functioning of the bioenergy industry, the corresponding market system, and optimizing market relations between biofuel producers and consumers.

The importance of the study of bifurcation processes as processes of restructuring the structure of the system, the emergence of a new order, under modern conditions is growing extremely, because the instability of the system is equivalent to the instability of its structure (economic relations, management mechanism,

functioning of specific markets, etc.). Such studies reveal the peculiarities of the development of systems, help to determine the mechanism of development. And, accordingly, they will allow not only to regulate market processes, but, relying on the knowledge of properties, structure, features, to exercise the necessary influence on the system, to provide purposeful stimulation of a certain state of the market system in order to build its optimal structure, to determine periods of their structural optimization, one one of the main aspects of which is the improvement of the system of economic relations. In the context of our study, it is possible to provide purposeful stimulation of the development of the bioenergy market with the help of economic and legal levers of its regulation.

System studies show that the determining condition for the optimal behavior of complex economic systems is their unbalanced self-organization, functional stability in unbalanced states. Disequilibrium ... allows to determine the free choice of the optimal development path from many alternatives. If the equilibrium state is a necessary condition for the stable functioning of economic systems, then the non-equilibrium one represents a significant moment of transition to a new qualitative state, during which the economic system acquires a higher level of organization and productivity. When the economic system loses its functional stability, new effective structures are formed [203]. It is clear that the direction of development adopted by the system can be both progressive and regressive. Under certain circumstances, the interaction of external factors is possible as well as the development and regression of systems. The chosen direction of development will depend on the features of the system, its interaction with the external environment and coordination mechanisms. Synergetics connects the possibility of system development with the state of their instability as with the possibility of choosing development options, an attractor. Based on this, most experts, using the example of the global financial and economic crises of, note that crisis phenomena cause not only great losses, but also open up great opportunities. However, it should be noted that the instability of the system over a long period of time means its degradation.

It should be emphasized that the importance of the influence of the internal and external environment, contradictions on the development of systems is assessed differently. According to systems theory, complex systems are subject to continuous internal and external influence, while random external influence plays a decisive role in their development (determines the direction of development, and the intensity of interaction with the external environment - its pace). Economic theory assigns a decisive role in the development of the economic system to internal contradictions. Synergetics clarifies that the system begins to perceive external influence only in a state of stable imbalance, while the balanced system does not react to it in the vast majority. First, internal contradictions are the main ones - they shape the quality of the system, its structure. But their origin can be caused by external factors [198, p. 91]. Secondly, external influence on a stable system leads to quantitative changes in the system, the accumulation of which can lead to qualitative changes, that is, external influence can stimulate the emergence of internal contradictions. Thirdly, external influence on an unstable system changes its qualitative characteristics [198, p. 92]. The loss of stability of systems and, as a result, the ability to rapidly evolve, are always due to internal causes, properties of elements and subsystems, and internal contradictions. The effect of external influence on the system, the occurrence of random deviations is related to the readiness of the system for such changes, which can occur even under minor external influence. In practical terms, the synergistic approach allows the use of effective methods of solving many urgent tasks in the field of optimal management of economic structures in the conditions of the transitional period of the development of economic systems [204].

The methodology of managing unbalanced economic objects (in our study, this is the bioenergy industry and bioenergy markets) is based on the principles of the theory of automatic regulation, which characterizes the ability of complex systems to restore and maintain a normal functional state or to independently choose options for a new, optimal state and move to it. Self-regulation leads to an increase in the organization of non-equilibrium objects as a result of the selection of optimal states on the way to their improvement. This is clearly manifested in management systems with

biological components (for example, an agricultural enterprise, a bioenergy cluster), in which the growth of stability and adaptability to the external environment is inextricably linked to the growth of their organization.

The synergistic analysis of complex market systems shows that the influence parameters do not directly regulate the behavior of the object of management, but form an internal mechanism of its self-organization. As for economic processes in market systems, the subjects of management here are, for example, the state, corporations, associations, individual producers and consumers. A synergistic approach makes it possible to find effective ways of managing and coordinating the development of the bioenergy industry, relevant markets and their individual components.

Nowadays, the increasing complexity of the organization of economic systems is accompanied by the acceleration of their development processes. The analysis of the above-considered effects and trends accompanying the processes of evolution and transformation of economic systems, properties of stability and instability of systems makes it possible to substantiate the general signs of the development and efficiency of the market system as a whole. The main factors causing the instability of market systems in the conditions of globalization are the acceleration of the international movement of capital, the acceleration of Scientific and technical progress (innovative component), deepening of environmental problems, strengthening of the consequences of decisions made by international organizations, deepening of integration processes. Management of market processes should be carried out taking into account the specified trends. Synergetics makes it possible to assess the interrelationships of individual economic systems in the economic space, including manifestations of the controlled effects of the external environment.

As mentioned above, an integral property of the development of the modern economy is its innovative orientation. As a result of scientific and technological progress, the world received a powerful impulse that stimulates the replacement of technologies and scientific developments in material production. The latest technologies are a powerful tool for achieving a stable position of enterprises in a competitive environment, which is associated with both reducing the cost price and

providing products with an appropriate level of consumer value [205, p. 339–348]. The theoretical justification of these changes was reflected in new approaches: the theory of economic growth, the theory of business cycles and synergy. A synergistic approach in the study of economic processes leads to the development of effective models of the economy's exit from a crisis state, which enables the search for universal principles of self-organization and evolution of complex economic systems (formulation of the laws of self-preservation and evolutionary development) [206, p. 110].

The new economic theory forms a representation of the essence of economic processes based on non-linear dependencies and the loss of equilibrium states [207]. Modern research highlights the development of the transformation of innovative industries and market processes, based on the processes of self-organization and openness. This approach is based on the fundamental works of I. Prigozhin, H. Haken, I. Lukinov, S. Mocherny, M. Moiseev, and others. [205, 208, 209, 210], whose studies substantiated the main stages of development and the formation of development trajectories of open systems through evolutionary changes. Studies have shown that complex systems, which include market economic systems with the characteristics of self-organization and openness, are dissipative structures capable of reproducing their actions and further development on the basis of internal potential, the realization of which requires certain conditions created naturally or as a result of regulatory actions. Researchers focus on considering the behavior of systems at points far from the equilibrium state and the system's ability to be in a transition state for some time, as a result of which the system itself shows sensitivity to possible development options and makes a choice in favor of the trajectory with the best characteristics. The obtained results formed a powerful basis for further research in the field of economic science using the methods of synergy, among the main issues of which are elements of evaluation and determination of components during the formation of economic mechanisms as a holistic concept of transitions between equilibrium states and maintaining positions of sustainable development; search for synergistic potential in the internal structure of economic processes and the possibility of its reproduction due to external disturbances; the formation of the nature of factors that counteract in the

economic space, as a result of which the market system acquires the characteristics of nonlinearity and instability, etc.

The study of the problems of the development of market processes in the field of bioenergy based on a synergistic approach makes it urgent to solve the following tasks: 1) summarizing the components of the synergistic concept and identifying the features of the development of market processes based on a systemic approach; 2) assessment of the existing market development potential in the bioenergy industry, primarily biomass potential and production potential; 3) identification and consideration of the needs of market participants (producers and consumers) on the basis of marketing by conducting segmentation and determining the characteristics of target consumers; 4) clarification of marketing actions and components of the innovation-investment process as sources of synergistic effects, as a result of which the prerequisites for the potential of self-organization of the market, taking into account the levers and tools of state regulation, arise.

Taking into account the key provisions of the general theory of systems (a system is an integrity represented by an interconnected set of some parts), the main properties of a complex market system (in our case, we are talking about the bioenergy market) are listed in the table. 1.4:

Table 1.4

The main properties of the bioenergy market as a complex economic system

Property	**Content**
Heterogeneity	The presence of subsystems with different functional properties (component elements are producers, intermediaries, consumers, regulatory bodies, etc.)
Emergency	The ability of the system as a whole to acquire properties that cannot be reproduced by its individual element
Hierarchy	the presence of several levels of subordination due to the corresponding functions and methods of goal realization
Aggregation	a combination of several elements of the system as part of a higher level
Multifunctionality	the ability of a system that has a specifically defined structure of connections and elements to implement a sufficiently large number of functions
Flexibility	the ability to change the purpose, methods and mechanisms of functioning in accordance with changes in the internal structure and external conditions
Adaptation	changing the purpose of functioning due to adaptation to external conditions

Continuation of table 1.4

Reliability	the ability to realize a defined goal based on defined quality parameters
Security	the ability not to have an irreversible destructive impact on the environment as a result of one's own actions
Stability	the ability to adhere to the set parameters of actions when the influence of the external environment changes
Self-organization	the ability to revive and transfer one's own structure to a higher level due to the requirements of the external environment

Note. Formed by the author

The traditional approach in the analysis of economic processes and systems determines the combination of components according to the principle of linearity, which means determining the dependencies of input and output indicators of market development based on a proportional relationship. The direct proportional dependence determines the consideration of the main processes and their changes based on systems of differential linear equations, the solution of which is based on the use of the apparatus of mathematical analysis and is obtained depending on the initial conditions in real and complex values. We note that market systems are in constant development and are formed as a result of the evolution of society and the social order, the basis of which are property relations, methods of production, technologies and management.

In this regard, the classical approach to the analysis of linear systems in the market economy mostly causes complications:

1. Identifying the forms of dependencies that determine a certain trend. The modern market economy is increasingly dependent on risk factors and the unpredictability of situations, which leads to violations of sustainable development proportions, increased entropy, and increases requirements for the quality and relevance of information both in the system itself and from the outside.

2. The scarcity of resources and the impossibility of their constant renewal creates delays in development, as a result of which their restoration or accumulation takes place. If we talk about the energy market, the loss of stability encourages the search and more active use of new, alternative energy sources, including those based on used biomass.

3. The expansion of production and technologies is associated with an increase in scale and capacity building. In the conditions of globalization, the movement of capital and labor becomes important, which leads to the formation of complex integration production structures capable of merging and absorbing less stable economic objects. From the point of view of the development of bioenergy markets, our research should pay special attention to, first, integrated companies and their role in the formation of biomass potential; secondly, the possibilities of creating bioenergy clusters.

4. Market systems are characterized by complex relationships in a hierarchy, the structure of which is determined by both direct and feedback relationships. Their existence over time can lead to aggregation into new forms (cooperation, integration, coalition) and the formation of connections with a stronger potential. Taking into account the identified features of development, it is possible to use the principles of a synergistic approach to analyze specific market systems (for example, regional ones) with the subsequent formation of clusters.

From the point of view of synergy, market systems are represented as a collection of many subsystems, characterized by incomplete information and the following features: non-linearity (loss of the property of additivity in the process of development); instability (loss of equilibrium states in the process of evolution); openness (exchange of resources with the external environment); subordination (functioning and development are determined by processes in subsystems). Time plays a decisive role in synergy, despite the fact that most system characteristics are static [207, p. 40].

From the point of view of synergy, the state of the market and its individual parameters in dynamics is subject to assessment, which is determined by the combination of possible forms and market structures, determined by a specific number of measurement indicators. According to the synergistic approach, the dynamics of the development of market systems corresponds to the evolutionary development of dissipative structures. Dissipative structures are characterized by irreversible

development processes described in [211, p. 65] corresponding to the evolution equation:

$$\partial x_i/\partial t = Fi\ (x_1, x_2, x_3 \ldots x_n,\ r, t \ldots) \qquad (1.3)$$

where $\partial x_i/\partial t$ – is the change in the state of development of the process in the time space t;

Fi – function of connection of system parameters x_i (of any complexity);

xi – system parameters;

r – space dimension coordinates;

t – time variable.

When time is reversed in such a dissipative system (t = -t), development inertia is observed, that is, one of the functions Fi will have a component in time for the formation of feedback and will support the movement of the system in the opposite direction, as a result of which there are significant counteractions and loss of equilibrium characteristics . Exit from the state of inertia and evolution in economic systems is provided by self-organization. The process of self-organization is characterized by the formation of order in the economic system, which arises due to the connected (cooperative, integrated) relations of elements according to the previous history, which leads to a change in the spatial, temporal and functional structure. The processes of self-organization are reflected in the restructuring of existing and the formation of new connections between elements of the system, which have a probabilistic component and a distinctive feature of which is purposefulness. Self-organization of modern markets is determined by the presence of society as the main element capable of developing projects of expected events. In reality, the course of events does not always meet expectations, so the question arises of obtaining a development trajectory that is closest to the expected conditions [211, p. 275–278].

Self-organization is a process during which the organization of a complex dynamic system is created, reproduced, or improved. The process of formation of order in the system, which arises due to the cooperative relations of elements according to the previous history, leads to a change in the spatial, temporal and functional structure. Self-organization processes are possible only in systems with a high level of

complexity and a larger number of elements, the connections between which are not rigid, but probabilistic in nature. Properties of self-organization are revealed by objects of different nature: organism, population, biogeocenosis, ecosystem, human collective, society, etc. The processes of self-organization are reflected in the restructuring of existing and the formation of new connections between system elements. A distinctive feature of such processes is their purposeful, but at the same time natural, spontaneous nature: these processes, which take place during the interaction of the system with the environment, are to one degree or another autonomous, relatively independent of the environment.

There are three types of self-organization processes:

1. Self-genesis of the organization, i.e. the emergence from a certain set of integral objects of a specific level of a new integral system with its specific regularities.

2. Processes thanks to which the system supports a given level of organization in case of changes in external and internal conditions of its functioning.

3. Development of systems capable of accumulating and using past experience. At the same time, development represents an irreversible, directed and natural change in the state of the system, which may result in its new qualitative composition and structure. Development can take the form of progress and regression, evolution and revolution. Revolutionary development occurs through: leap, phase transition and catastrophe. The search for a form of development occurs through chaos

Within the synergistic approach, it is necessary to define categories: attractor, bifurcation, fractal, deterministic chaos [211, p. 39-42].

The goal of evolutionary development is shown by attractors. The attractor reflects a relatively stable state of the system, around which a set of specifically given development trajectories with different initial conditions can be formed. The point of the trajectory, from which the branching of evolutionary development paths begins, is defined in synergy as a bifurcation [209, p. 183]. For the most part, the bifurcation points are determined by changing the parameters of the external environment in which the system exists. Therefore, simulating the way of changing external parameters, it is possible to obtain a set of bifurcations. In the structure of nonlinear systems, there are

fractals - objects that have the property of self-similarity. That is, the structure of a fractal, even in a small form, can be similar to a larger object [209, p. 184]. In the process of evolution, the economic system, having lost its equilibrium, can return to chaos. The internal organization of such a system is not subject to a clear hierarchical classification and can only sometimes reflect a similarity to ordered forms. In a state of chaos, system elements with self-organizing properties generate an internal source of energy to rebuild structural connections.

Based on works and fundamental research in the field of synergy, it is possible to single out the main components of the theory of synergistic development of economic systems [199–200]:

1. There are elements in the structure of economic systems that are constantly fluctuating.

2. Individual cases of fluctuations (bifurcation points) can be so strong that they lead to a loss of balance.

3. Due to the lack of information, it is impossible to predict in which direction the economic process will develop after the bifurcation point: chaotically or creating a new, improved form (a higher order of existence).

4. Economic systems are capable of reproduction or renewal through transitional processes, have a large resource and energy potential, therefore they can be classified as dissipative structures.

5. In states far from equilibrium, even very weak disturbances can be amplified, as a result of which there is a resonance of the action of factors, which can lead to significant scales of system development. Synergetic processes in the economy are inextricably linked with reproduction and entering a sustainable development trajectory. The transition from one state to another is possible due to technological or price changes. This is a very important conclusion regarding the development of the field of bioenergy, it means that technological factors (for example, the development of 2nd generation biofuels) not only cause a change in the volume of production of this group of goods, but also encourage society to move to a higher quality level of consumption. In turn, price factors lead to a change in the demand for goods, as a result

of which both progress and regression in the development of bioenergy or its individual directions can be observed. In addition, the creation of modern production structures through cooperation, integration, formation of clusters, etc. is a logical process of evolutionary development and survival in conditions of limited financial, material and energy resources.

Of particular interest are the processes of mergers and acquisitions, which must meet the criterion requirements of operational or financial synergy:

1. The restructuring process, aimed at the effect of operational synergy, requires cost savings and the formation of the potential for accelerated, relatively sustainable growth.

2. The restructuring process, aimed at obtaining the effect of financial synergy, provides for the optimization of the tax burden, the ability to pay off debt obligations, and cover the shortage of monetary resources. Such processes usually require additional funds, investment.

Therefore, investment decisions are directly linked to the assessment of the synergistic effect. Assessment of synergy processes by investors mainly requires solving the following issues: determination of funding priority; calculation of the amount of investment in the reconstruction process (or a new project); determination of the investment mechanism. To determine the size of investments in integration processes, one of the most important elements of the assessment is the possession of specific resources, which primarily include innovative solutions, projects, know-how, innovative developments, etc. [209, p. 184]. From the point of view of investment, investments in innovative developments should first of all satisfy expectations for possible benefits and profits. Potential opportunities for innovative development are sometimes associated with the threat of non-return of investments. This is because research organizations have difficulty estimating and capitalizing costs. At the same time, there are problems of non-viable products, which do not go into production and sale, despite the fact that the project is financed.

Market volatility reflects the dispersion of expected cash flows. Investing in new projects is associated with the risk of non-return of investments, which, in turn, reduces the level of expected cash flows [214, p. 108].

Taking into account the fact that in recent years in Ukraine the amount of state funding of scientific research has been significantly reduced, the formation of a private investment system is of particular interest, which in Ukraine has certain regulatory restrictions and is unable to attract the necessary amount of investment in the development of high-tech business. In the field of bioenergy, this is connected with the presence of countervailing factors, in particular, insufficient legislative initiatives, mistrust of citizens and enterprise managers in bioenergy projects, etc.

The use of a synergistic approach in the field of energy security research is of particular importance. Ensuring the country's economic and energy security is the most important function of the state, aimed at protecting national economic interests, effective economic development and improving people's well-being. System-synergistic analysis allows us to consider the system of ensuring economic security of the national economy as relatively separate, one that has synergistic connections between different subjects at different levels of the system hierarchy.

The application of a system-synergistic approach to the study of energy security requires clarification of the concept of "system". Scientists distinguish two fundamentally different approaches to its definition - descriptive and constructive [219-222]. According to the descriptive approach, the system is isolated from the environment and its functioning is explained by the structure and connections between the elements of this structure. According to the constructive approach, on the contrary, the structure of the system corresponding to it is constructed based on the given function. The goal of the system under the conditions of a constructive approach arises from a problem situation that must be solved. In this case, the system is a means of solving the problem. In our research, we will use a descriptive approach, as we will separate the system of ensuring energy security from the environment of managing the national economy.

To be effective, the energy security system must be organized, dynamic, manageable, and controllable. Organization is considered by researchers as the

arrangement of parts and elements in order from higher to lower. In the system of ensuring economic security, there is a division of management and decision-making functions between state authorities of different levels. This makes it possible to focus the solution of strategic tasks at the highest levels of management, where their solution is most effective. Tactical tasks, depending on their complexity and required resources, can be solved at lower levels, which ensures promptness of decision-making. In the energy security management system of the national economy, the organization of interaction of both state bodies with each other, and organization of interaction with non-state entities takes place. Connections between subsystems of different levels are vertical, and between subsystems of the same level - horizontal.

Dynamism is the ability of the energy security system to maintain essential characteristics of its existence under the influence of external and internal influences. External influences include changes in the geopolitical situation, changes in foreign market conditions, etc. Internal influences occur within the country and are caused by changes in current legislation and the state of the economy. Such a situation forces the management body of any level to restructure and adapt to new conditions.

When studying systems that have their own management bodies, the goals set for them are also considered. This makes it possible to exclude duplication in the activities of state authorities and to identify issues and problems that have remained outside the necessary managerial influence. The purposefulness of the energy security management system involves the actions of authorities in a certain territory, aimed at providing market subjects with fuel and energy, raw materials for their production, balancing the interests of economic subjects and protecting national economic interests in the field of energy with the help of regulatory acts, instructions, orders. According to the goal, current economic interests are distinguished, which are related to solving problems of the functioning or development of the economic system and eliminating threats at the current stage, and strategic ones, which express the goals of economic policy, including ensuring energy efficiency for the future.

Manageability presupposes the presence of an economic security management entity that helps manage the activities of the entire system and its individual

components. He is responsible for the implementation of all management decisions, organizes feedback and system optimization in accordance with the assigned tasks. At the same time, the subject of economic security management of a specific level must possess the necessary competence, and the working conditions must enable the performance of certain assignments. Failure to comply with this requirement leads to subjective management decisions and may lead to neglect of national interests and advocacy of one's own corporate goals.

Controllability implies the exercise of control over the state of the subject of management, without exerting managerial influence on it. Such a mechanism is democratic civil control, intra-departmental, inter-departmental, branch and inter-branch control. The presence of direct and feedback links in the system is ensured by clear regulation of the activity of the management apparatus for receiving and transmitting information during the preparation of management decisions.

Management is essentially systemic, because management decisions made at one level of the system affect decisions at other levels. The components of the system approach are the principles of: 1) integrity, when each object in the process of its research is considered as a large and complex system, and at the same time as an element of the overall system; 2) hierarchical, that is, the presence of two subsystems - the controlling and the controlled; 3) structuring, which allows analyzing system elements and their relationships within a specific organizational structure. In general, the system of ensuring economic security corresponds to these principles. But the "control = desired result" scheme takes place only when the controlled system is in equilibrium with the environment and internal processes. When the system is in an unbalanced state, it begins to obey laws of a non-linear nature, which are studied by synergy. The task of public administration in a situation of uncertainty is to try to maintain the stability of the system while simultaneously searching for new alternatives for its development.

With a developed economy and a formed legislative and regulatory framework, developed monitoring systems and mechanisms for balancing the interests of all market participants, the main role of the state is to provide control and supervision and legal

means of economic and energy security by establishing certain rules, criteria and standards. For a developing economy, state intervention should be more active and effective, because it is simultaneously aimed at developing the market and ensuring economic security. Energy security manifests itself as an emergent property of the economy, due to the presence of synergistic relationships between various entities at different levels of the system hierarchy, reflects economic relations in the production, sale and consumption of all types of energy, as well as protection of the interests of economic entities in conditions of uncertainty and risk.

Researchers identify the following methodological guidelines for economic analysis within the framework of a synergistic approach: 1) openness of economic systems; 2) imbalance of market processes; 3) irreversibility of evolution; 4) non-linearity of economic transformations; 5) ambiguity of economic goals [183].

The market system of Ukraine is open. In such systems, prerequisites are created for the implementation of a self-organizing process in them, which involves evolutionary development with transformation into a new, more efficient structure. Different mechanisms of functioning of closed and open systems require different approaches to forecasting possible ways of their development. In the conditions of globalization, excessive openness of the economy can create problems for the national producer and lead to predatory use of resources. Therefore, in order to ensure economic and energy security, the state must find the optimal balance between the openness of the economy and the protection of economic interests.

With the help of integration of the methodological apparatus of synergy and marketing, it becomes possible to study the anticipatory nature of ensuring energy security by preventing threats. Within the framework of the model of unsustainable development, real threats and their adverse consequences are considered. The model of sustainable development should have a threat prevention system. Synergistic aspects of ensuring energy security are related to the problems of economic development.

For a deeper understanding of the synergistic aspects of ensuring the energy security of the national economy, it is necessary to clarify the concepts of "development" and "sustainability".

Development is a complex and contradictory process in which positive and negative factors interact, and periods of progress can be replaced by periods of regression. Synergistic effects can be both positive and negative. Not every development meets security requirements. So, if high rates of development are achieved at the expense of "production for the sake of production" without ensuring the level of well-being necessary for the population, then such development is more likely to pose a danger to a socially oriented market economy. When there is no economic development, the ability of the national economy to counter internal and external threats deteriorates sharply.

The stability of the national economy reflects the strength and reliability of its elements, vertical, horizontal and other connections within the system, the ability to withstand external and internal influences. The synergistic effect in the economy is the result of the cooperative interaction of the elements of the economic system, which leads to a change in the qualitative composition of the economy and its retention on a stable development trajectory, despite exogenous shocks and endogenous fluctuations [224]. According to the Methodology for calculating the level of economic security, approved by the Order of the Ministry of Economy No. 60 of 02.03.2007, the components of economic security of the national economy are defined as: macroeconomic, financial, foreign economic, investment, scientific and technological, energy, production, demographic, social and food security [216]. The state of each of these components affects the development of the national economy. We consider energy security to be one of the most important.

Synergistic analysis enables the transition from a static understanding of economic security (the theory of functioning) to a dynamic approach (theory of development). The system of providing economic security is characterized by movement, therefore it must be considered on the basis of a dynamic approach, using the categories "attractor" and "point of bifurcation", which was discussed above.

Among the theoretical aspects of economic security, the definition of its hierarchical decomposition occupies an important place. We distinguish the following hierarchical levels of energy security: global, international, national, regional, subject

of economic activity. The development of bioenergy contributes to solving problems and happy challenges at all levels. Each structural level of energy security is in a non-linear relationship with other levels. Economic changes at one level can affect the stability of the system, which will lead to instability and can provoke the emergence of economic threats.

Thanks to synergistic analysis, socio-economic development is described through two models: evolutionary and bifurcation. The evolutionary stage of development assumes the constancy of system quality and predictable linear changes. But it is here that an increase in internal imbalance (crisis) occurs, due to which the system is approaching a bifurcation moment. At the bifurcation point, the system branches out and becomes very sensitive to external and internal actions. The choice of one or another path at the point of bifurcation depends on the factor of randomness, realized through the activities of specific people (the government). A synergistic approach requires not only an analysis of reality, but also opportunities, a choice situation, a point of bifurcation of the economic process.

The goal of the socio-economic development of Ukraine is to achieve the modern socio-economic and technological criteria of an industrialized country. Realization of this goal in an evolutionary way requires a lot of time and resources, which makes it practically impossible. At the same time, accelerated economic and technological development or an economic breakthrough, in modern conditions, requires taking into account the factors of the global environment, which will be organically combined with internal factors and will be based on the concept of balanced development.

Balanced (sustainable) development of society (BDS) is considered as a complex synergistic process of balanced integration, interaction of social, economic, ecological systems, spheres of life of society. In the conceptual structural model of the synergistic methodology of the BDS, the key elements are the thematic methodologies of socio-natural synergism: socio-natural co-evolution, development of the noospheric state of society; systemic environmentalization of productive forces, institutions of society, etc. [227, p. 24]. Systems of integrated management of balanced development: local,

regional, sectoral, corporate, state are considered as mechanisms for the implementation of synergistic methodology, adequate models of the BDS. In the context of this dissertation research, such a methodology receives additional content if it includes market research methodology and modern marketing concepts.

The theory of balanced development of society (BDS) as an extremely complex process of integration of ecological, social, and economic systems with the formation of a new balanced socio-natural integrity with an ecological economy is based on the fundamental synergistic foundations of development [227]. At the same time, the theory of BDS is a symbiotic theory, covering the theories of the noosphere, dynamic equilibrium, balances, systems development processes, etc. This is also a kind of synergy of theoretical systems of development, on which the synergistic methodology of BDS should be based. Therefore, the methodology of balanced development of society as a synergistic process of integration of ecological, social, and economic aspects of development is also a synergistic methodology in its essence. Synergy, synergism are concepts of natural or ecosystemic origin, related to the synergistic phenomenon of nature's creativity, synergistic processes, mechanisms of self-development, self-organization of natural systems, ecosystems. In the first decade of the 21st century, the concept of synergism was extended to socio-economic systems [197, 199]. Synergetics is becoming a new field of scientific research, the purpose of which is to identify inter-environmental integration patterns of self-organization of the development of complex non-equilibrium systems of different functional roles in nature and society. It explains complex processes, mechanisms of self-organization, self-development of not only natural, but also social and economic open stationary systems capable of maintaining homeostasis in the conditions of a competitive life environment, systemic market crises. Currently, the fundamental foundations of development based on the synergistic theory of self-development, self-organization of the transition from a disordered (unstable) state to an ordered (balanced, stable) state due to cooperation and joint action of the development potentials of various systems have been developed [197, 199].

The global strategy of sustainable development focuses on preserving the creative potential of nature, supporting synergistic mechanisms of self-organization of ecosystems by achieving socio-natural integrity, socio-ecological and economic balance of society's institutions, its socio-natural components - territorial communities. In the context of the balanced development of society, socio-natural synergy can be considered as a coherent process of joint development (coevolution) of territorially integrated social and natural systems, which is characterized by the transition of the social system to a noospheric state and a higher form of self-organization. This ensures the preservation and reproduction of the creative functions of natural systems with the achievement of a consolidated synergistic effect of improving the quality of life and the natural environment, maintaining socio-natural homeostasis through the coordination of laws, mechanisms of self-development of nature and society, and preservation of the socio-natural gene pool. This definition and characteristics of socio-natural synergism are based on taking into account the experience of countries that embarked on the path of balanced development and achieved a significant synergistic effect of the quality of life and the natural environment. These are Japan, Canada, Sweden with a high level of self-organization, self-development of territorial socio-natural systems (communities) and development of the "green" economy, harmonization of public institutions.

There are many factors preventing reformation, modernization of spheres of life and life support of society, consolidation of its institutions based on the principles and synergistic mechanisms of balanced development. One of these key factors is misunderstanding (or lack of perception) by persons responsible for making strategic decisions, the dominant role of laws, mechanisms of nature, the ecosystem in preserving a healthy, high-quality human habitat, supporting the vital forces of society, man. Such a state prevents the overcoming of the tendencies of the consumerist attitude towards nature in society, the transition to a balanced development, a "green" economy. The development and dissemination through training, education, propaganda, provision of marketing information, oriented towards balanced development, of a holistic synergistic methodology of balanced development of society as a territorial

aggregate of socio-natural systems (territorial communities) should contribute to the awareness and perception of new values of life based on respect for nature, knowledge of the laws of its self-organization and self-development and the understanding of the need to harmonize the laws of being with them, to reject the consumerist philosophy of being, which is destructive in relation to the nature of behavior.

The synergetic methodology is based on a system of ideas about the common world, its socio-natural essentiality, integrity; balance of spheres of life activity and life support of society; a system of knowledge of laws, mechanisms of joint development (coevolution) of society and nature, achievement by society of a noospheric state capable of preserving the creative potential of both nature and society in the interests of present and future generations.

The synergistic worldview promotes the search for common ways of consolidating society, its institutions, and socio-economic structures in the interests of balanced development, achieving synergy of the quality of life and the natural environment for current and future generations. The implementation of the synergistic methodology in the full range of its social, ecological and economic aspects should ensure the synergistic stability of the national economy and society in the conditions of global crises: ecological, social, economic. Synergetic methodology is a rather complex, symbiotic "system of systems" that integrates numerous thematic methodologies, oriented towards goals, principles, and the theme of balanced development. Some of these thematic methodologies were developed by both domestic and foreign specialists. These are, for example, methodologies of ecological adjustment of macroeconomic indicators, integrated management, optimization of balanced nature use, modeling of the integrated (socio-ecological-economic) system of the region, territorial innovation clusters, transformation processes, institutional modeling of nature use, etc. [197, 199, 207, 209]. The integrated multifaceted structure of the synergistic methodology of the balanced development of society and its socio-natural systems (territorial communities) with integral development potential can be presented in the form of a conceptual structure (Fig. 1.8).

The task is to adapt such a conceptual model to each object of balanced development of society: enterprises, settlements with their infrastructures, rural areas, industrial and economic complexes, public institutions, etc. Such a task should be carried out by appropriate systems of integrated management of the balanced development of various objects with personnel prepared according to new interdisciplinary programs, oriented to the acquisition of synergistic competence and the involvement of scientists who have the methodology of balanced development of society and management of market processes on the basis of marketing.

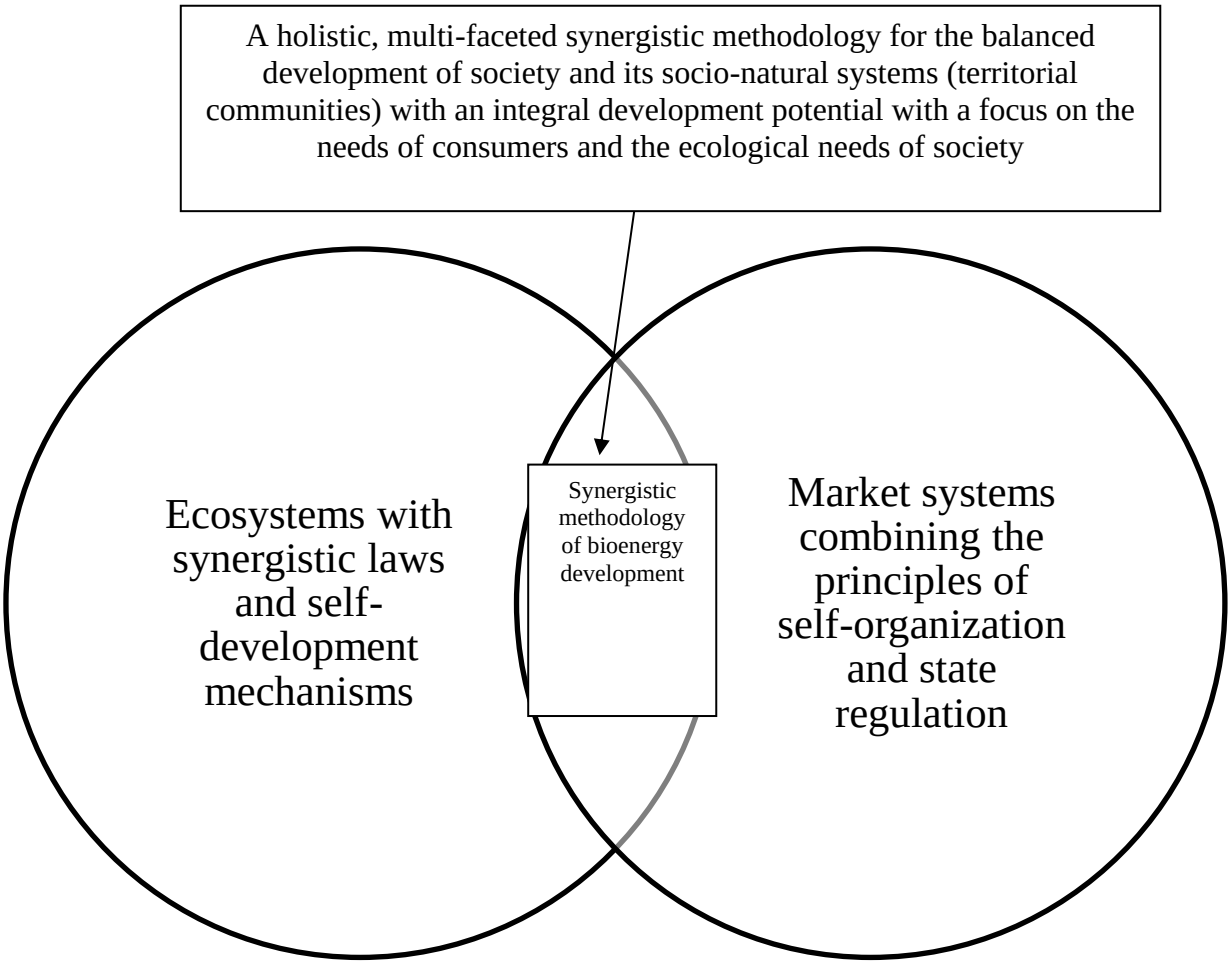

Fig. 1.8. Basic model of formation of synergistic methodology of balanced development of society.

Note. Formed by the author

Taking into account the above, it is necessary to form a research methodology for the development of the bioenergy market. Such a method, developed by the author on the basis of system-synergistic methodology and consistent application of the above methods, taking into account the specifics of the agrarian industry, is shown in Fig. 1.9.

At the first stage, it is expedient to carefully investigate the prerequisites (economic, legal, demographic, natural) of the development of bioenergy in Ukraine. In particular, it is necessary to analyze the formation of modern forms of agrarian formations, the sequence of transformational processes in the agricultural sector of Ukraine, to determine the key trends in the development of the industry, the dynamics of the number of agrarian formations of various types, the dynamics of the growth of acreage for crops whose waste can be raw materials for the production of biofuels, the dynamics of the number of bioenergy objects.

Next, it is necessary to analyze the efficiency of the use of resources of agricultural formations, calculate and forecast the amount of agricultural production waste, calculate the potential of biomass that can be used for processing into biofuel and its ratio by region, etc.

At the next stages of the research, it is necessary to segment the bioenergy market by solid biofuel and biogas sectors, evaluate target segments, and form portraits of target consumers (individuals and legal entities). The definition of the target market will be the basis for the development of marketing activities according to the elements of the marketing complex, including the price policy in bioenergy, distribution policy and logistics costs, as well as marketing communications, that is, their focus on the target and perspective consumer. Such approaches will help determine the possibilities of choosing a certain strategy for bioenergy market participants.

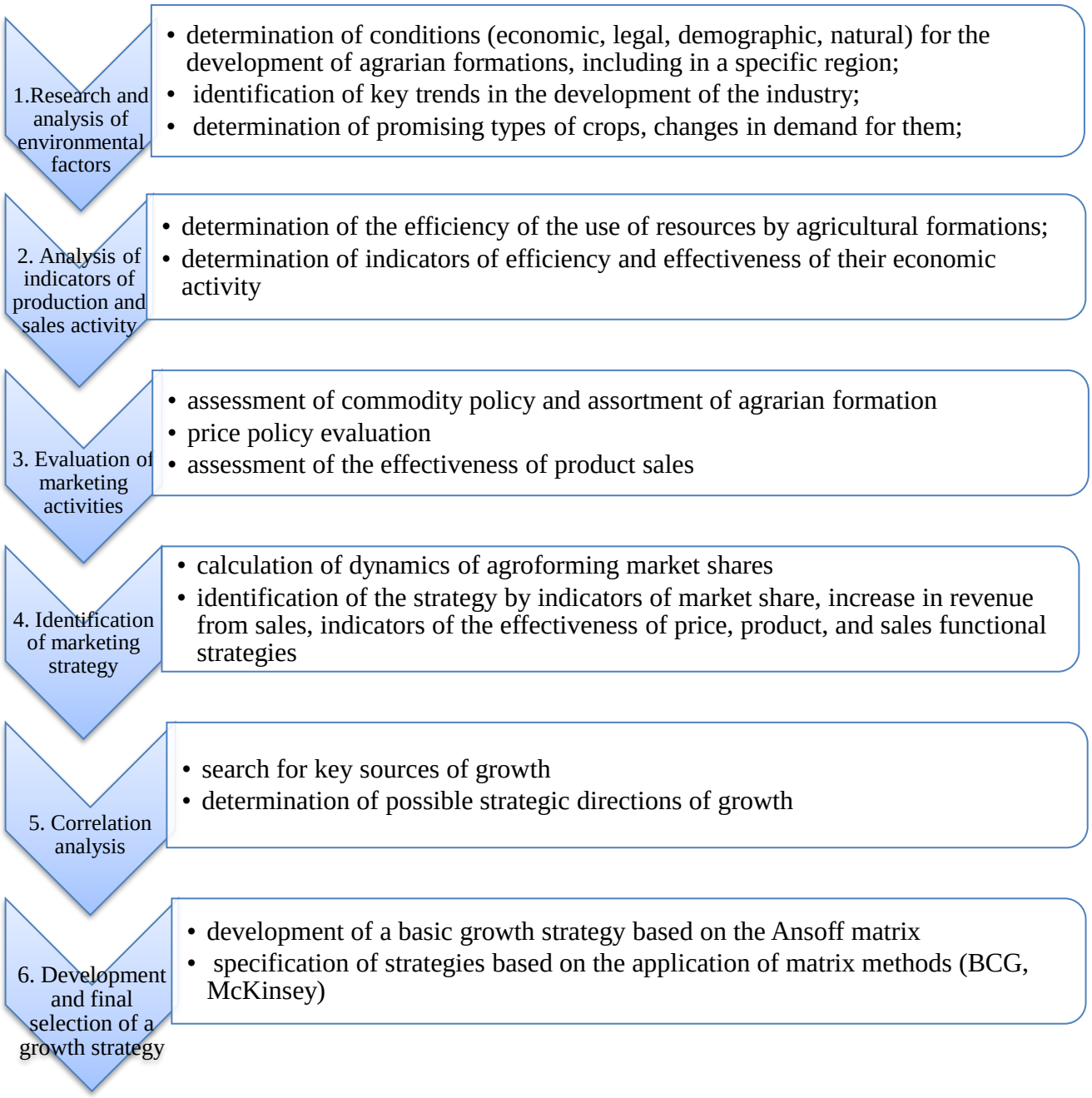

Fig. 1.9. Bioenergy market research methodology*

Note. Developed by the author

The last two stages of the research include the identification of strategic directions for the growth of the industry, forecasting of production and consumption volumes of various types of biofuels, development of proposals for improving state regulation of this industry.