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Methodological Justification for the Expediency of Initiating a Programme of Green Innovations in the Oil and Gas Sector

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Abstract

A feature of the modern world is the constantly increasing flow of innovation, which has caused a chain reaction of technological, institutional and social changes in all spheres of activity. Increasingly noted examples of this are the 'green' trend, the ecologisation of innovation processes and enterprises following modern trends in sustainable development. In this study, the authors developed an original methodology to risk-assess (probability of success) green innovations based on a decision tree. The authors' solution facilitates making an optimal decision on the expediency of launching projects to implement green innovations in the oil and gas sector, such as carrying out entire innovation programs, launching a pilot projects or suspending current programs, based on the expected income. In this paper, the methodological approach is tested using conditional data. The results obtained form the foundation for developing a framework for innovation activities at oil and gas complex enterprises, providing a new (green) view on solving the problems of oil and gas innovations and taking a systemic approach to the analysis of green innovations in the oil and gas sector in the Russian Federation. The findings can be used in strategic planning by oil and gas enterprises, in particular, when deciding on the expediency of initiating green innovation programmes.

Keywords: green economy, oil and gas industry, green innovations, sustainable development

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Методическое Обоснование Целесообразности Инициирования Программы Зеленых Инноваций в Нефтегазовом Комплексе

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Аннотация

Особенностью современного мира является постоянное нарастание инновационного потока, который вызывает цепную реакцию технологических, институциональных и социальных изменений во всех сферах деятельности. Все в большей степени отмечается «зеленая» тенденция, экологизация инновационных процессов, разворачивающая предприятия в сторону современных трендов устойчивого развития. На основании проведенного исследования была разработана оригинальная методика оценки риска (вероятности успешности) «зеленых» инноваций на основании дерева решений. Авторское решение данного исследования позволяет на основании ожидаемого дохода сделать выбор оптимального решения о целесообразности запуска проекта по внедрению «зеленых» инноваций в нефтегазовом секторе, а именно реализовать всю инновационную программу, запустить пилотный проект либо приостановить действующую программу. В рамках статьи апробация методического подхода была произведена на условных данных. Полученные в ходе исследования результаты создают основу для разработки основ инновационной деятельности предприятий нефтегазового комплекса, формирования нового («зеленого») взгляда на решение проблем нефтегазовых инноваций, формирования системного подхода к анализу «зеленых» инноваций в нефтегазовом комплексе Российской Федерации, результаты исследования могут быть применены при стратегическом планировании нефтегазового комплекса, в частности, при принятии решения о целесообразности инициирования программы «зеленых» инноваций.

Ключевые слова: «зелёная» экономика, нефтегазовая отрасль, «зелёные» инновации, устойчивое развитие

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1. Introduction

At the current stage of global economic development, the transition from traditional hydrocarbons to alternative energy sources, as well as energy resources with a low carbon footprint, is becoming increasingly important. The dynamics of both national and international projects aimed at reducing greenhouse gas emissions are increasing every year, due to the high priority given to this area of activity in connection with the current climate agenda at the national level.

Taking into consideration the fact that the Russian Federation occupies a leading position in the field of hydrocarbon exports, the transition to a green economy, amid the realities of the growing pressure from sanctions by the West in particular, the slowdown of technological development in the economy and the reorientation of sales markets, has become a serious challenge. In addition to existing measures, comprehensive work is required to intensify innovative activity among organisations in the oil and gas sector. This transition, based on breakthrough innovative technologies, should be supported by the state, in particular, by a system of institutional support. To date, there has been a lack of effectiveness at various stages of the innovation cycle.

An indispensable prerequisite for improving the quality and efficiency of energy-saving resources and the innovative activities of oil and gas companies in the green economy, as well as for reducing the duration of the innovation cycle, is to take a complex approach on behalf of all the interested public administration bodies. The coordination and consolidation of research findings is of particular importance in the field of energy efficiency and for reducing the carbon footprint, which has been noted in the policy documents on the decarbonisation of the Russian economy (Lagutenkov, 2022).

In the current conditions of economic uncertainty, the main task of oil and gas companies, when developing innovation policy is to develop strategies, is to take into consideration this this probability and determine priority activities that should be adapted to changing operating conditions. To date, this process has not been backed by appropriate methodological support.

The relevance of the research topic is determined by the fundamental importance of the role of the oil and gas sector in the socioeconomic development of the Russian Federation, the need to increase its technological potential through the introduction of innovations in line with the existing global trends in environmental policy and the low efficiency of mechanisms regulating the activities of participants in the initiation, development and implementation of green innovations in oil and gas.

The objective of the study is to develop a programme for implementing green innovations that will contribute to the sustainable development of oil and gas enterprises in the Russian Federation. The study's scientific significance relates to using expert evaluations to refine the methodological justification for implementing green innovations in the oil and gas sector.

Another goal of the study is to methodologically substantiate the feasibility of implementing green innovations in the oil and gas sector in the context of sanction restrictions. To achieve its goals, the study embarks on the following:

A clarification of theoretical ideas about the essence of green innovation and its impact on the development of a green economy.

A description of the content of the main preparation stages and the work of expert groups.

Taking a methodological approach to develop a procedure for substantiating decisions on the feasibility of initiating programmes to introduce green innovations at oil and gas enterprises (Lagutenkov, 2022).

2. Literature review

Both the main idea for and the importance of the transition to a green economy are described in the work of Biryukov and Ryazanova (2020), with the authors noting the particular relevance of envi-

ronmental and economic issues in the context of global development aimed at the rational consumption of limited resources. The study also noted some ambiguity in the approaches taken to implement the concept of the green economy in practice. In their study, Bondarenko et al. (2018) distinguished the need to form institutions for the ecological transformation of the Russian Federation at a time when it is lagging behind world practices as a means to achieve the ecologisation of socioeconomic reproduction. Farber et al. (2002) provided a comprehensive assessment of human activities aimed at achieving sustainable development within the global ecological–economic system, the purpose of which was to achieve a balance between society and nature. A significant number of researchers and publications on this subject have called for the systematisation of the main trends and methodological approaches to the evolution of the green economy, which is necessary for studying its impact on the development of innovative activities.

Both Borkova (2020) and Zakharova and Krakovetskaya (2018) considered the influence of individual factors on the processes of development, implementation and use of green innovations, including in relation to digital technologies.

A significantly smaller number of studies have been devoted to innovative activity in the oil and gas segment, with that of Lukyanova et al. (2019) among the most interesting of these. Nevertheless, studies describing the problems of green innovation in the oil and gas segment are relatively scarce. Among them, the works of Zubarev and Polaeva (2021) and Sinkov and Cherepovitsyn (2009) integrated the experiences of implementing environmental proposals by oil and gas organisations and the requirements and conditions of the projects and focused on the challenges of the green economy.

Lagutenkov and Dubolazova (2022) stated the following: Porter and Van der Linde (1995) substantiated a new relationship between the environmental goals of an organisation and competitive advantages, proving that there had been a conflict between mandatory compliance with environmental legislation and the costs of compliance, but nowadays, competitive relations are dynamic and based on innovations. The core of the authors' strategy was cross-functional or cross-active integration.

Dorfman and Dorfman (1993) and Pearce and Turner (1990) considered the evolutionary transformation of the green economy in the context of various scientific schools and directions, the main purpose of which was to identify patterns of influence on the formation and development of green investment, affecting the transformation processes in the sectoral and regional contexts.

Analysis of the existing scientific works has enabled the formation of a comprehensive view of the essence of the green economy and green innovations and the importance of transitioning to sustainable development. Most of the existing studies are devoted to general issues concerning the green economy and the processes of modelling to introduce green innovations. There has been significantly less research on the topic of innovation activity in the oil and gas sector, and the studies in this field mainly represent the generalisation of experiences in the implementation of oil and gas companies' initiatives. More specific issues concerning the mechanism of implementing green innovations and the use of modern technologies in green oil and gas innovations have not been given proper attention in scientific research. The lack of unambiguous definitions, principles and sources of transition to green innovation in the oil and gas sector emphasises the relevance of this study.

3. Materials and methods

With the formation and development of the green economy, there have been a number of evolutionary changes, including those associated with the transformation of scientific and technological innovations and the emergence of new threats and challenges (Vasiltsov, 2021). These changes have led to the formation of certain provisions, according to which existing post-industrial societies have focused on the use of resource-saving technologies and placed significant responsibility on all the participants in these, regardless of the size of the available resource base and the degree of influence on management decision-making.

Of particular importance in the transition to a green economy are special innovative technologies (Potapova and Kiryushkina, 2018) and products that can be distinguished as green innovations based on their rational use of renewable natural resources, whose main goal is to ensure the sustainable development (Kuklina, 2018) and economic growth of both the Russian economy as a whole and its individual sectors and industries.

A characteristic feature of developing, introducing and implementing green innovations is its dual focus. On the one hand, the activity is aimed at preserving the existing ecological environment and supporting environmental policies pursued by both the state and individual sectors of the economy. In addition, these innovations allow for a more efficient use of the resource potential for both production and economic activities in such a way as to maintain balance between the existing ecological system and society's ever-growing need for different benefits. In this case, the source of such benefits can be those resources, the need for which up to a certain level has been minimal; thus, their reserves may be relatively high or they have a renewable nature (Polovyan and Yaluner, 2020).

According to Lagutenkov (2022): 'The choice of optimal means and tools for the statistical evaluation of both individual green innovations (Buranova, 2020) and the emerging market for this economic good at various levels (local, national and international) from a socio-economic point of view seems very difficult.'

The following important methodological aspects accompanying the innovation process in terms of the green economy and contributing to the development of green innovation activities in the oil and gas segment should be recognised (Loginova, 2018):

The identification of key types of green innovation in terms of existing classical ideas about the classification of innovations according to certain criteria most relevant to the oil and gas sector.

The formation of methodological approaches to the generalisation of basic areas of green innovation in the oil and gas sector in the context of providing interrelationships with certain selected types of innovation.

The comparison and economic evaluation of the effectiveness of various sources of financing for process of developing green innovations in the oil and gas segment.

In the Russian Federation, the current practice of forming clusters focused on the principles and requirements of the green economy is rather limited. Under the framework of stimulating the development of cluster initiatives in the field of the green economy, the development of comprehensive measures to support the innovative activity of market subjects in terms of their involvement in the clusters and the gradual introduction of green innovations look most preferable. This should allow for the regional specificity of clusters and the sectoral nature of structures; that is, there should be a gradual transition from the existing clusters in the field of environmental protection and waste processing to clusters with any sectoral focus whose participants use green innovations in their production and economic activities (Lagutenkov and Melnichenko, 2022).

On the basis of the analysis of methodological approaches to assess the level of development of green innovations, it would seem most effective to carry out assessment procedures in relation to a set of green innovations within a particular industry or group of industries that can be united in terms of common technological processes and the similarity of the material resource bases they need for the production of end-products, provided that relevant information and analytical data are collected and processed. In addition, it is necessary to take into consideration the importance of the industry to the national economy as well as the prerequisites for increasing the level of innovation activity of organisations and enterprises operating in this industry.

The decision to initiate a development project and/or the introduction of green innovations amid the great uncertainty of the external environment of oil and gas companies significantly depends on

the state of the external and internal environment of the organisation (Kuklina, 2018), the forecasts of instability and the content and effectiveness of the strategy for innovative development. In the national and international practice of project management, various management decision methods, such as SWOT-analysis, the Delphi method, analysis of financial planning on sensitivity to changes in input parameters, the analogy method, scenario forecasting, the Monte Carlo method, the PERT method and the decision tree method, are well-proven.

In conditions of great uncertainty and with a significant likelihood of the wrong choice being made concerning the trajectory of innovative development, statistical methods of management decision-making do not give reliable results. Therefore, to assess the feasibility of implementing 'green' innovations by oil and gas enterprises under these conditions, it is necessary to use methods of decision-making under uncertain conditions based on expert assessments, which will enable the use of information from experts with different competencies, and such an approach will ensure the relevance and adequacy of the decision-making, the preparation for which involves professionals in the subject areas of specific innovations (Lagutenkov and Liukevich, 2022).

The composition of expert groups is defined in the GOST R 57313-2016 innovation management guidelines, which were introduced on 1 June, 2017. This document establishes those responsible for activities according to their level and stage in the innovation process; these can and should be involved as experts to assess the likelihood of the success of green innovations. In this regard, a methodical approach was developed to assess the probability of success for green innovations, in accordance with what had been established in the specified GOST guidelines, as follows:

- Level of innovative project management (strategic, operational).

- Functional area (marketing and commerce, technology, legal/regulatory support, management and organisation).

- Stage of initiation and implementation of an innovative project (research, evaluation and decision making, project management, capitalisation).

- Stakeholders from the organisation who are involved as experts.

The main stages of preparation and the expert group's work are as follows:

1. Initiation of the expert survey by the head of the organisation.

2. Setting the goal of conducting an expert survey.

3. Developing a questionnaire (definition of the object of evaluation).

4. Developing methodological support for the experts (definition of the objects of evaluation, development of a questionnaire, establishment of requirements for the qualifications and experience of the experts, method of processing the results of the expert survey, methods of analysis of the information obtained).

5. Forming and approving the composition of the group of experts.

6. Organising the work for the expert group and the expert survey.

7. Processing the obtained information, interpreting the results and preparing a management decision.

In the context of this study, the purpose of the expert survey is generally formulated from the following question: 'Should a green technology implementation programme or project be initiated and implemented?' (Lagutenkov and Liukevich, 2022). To better consider the factors affecting the reliability of the answer that can be obtained, the group of experts evaluating the probabilities of the strengthening/removal of sanctions should include the top management of companies and external stakeholders, whose

composition is specified in accordance with the current GOST R 57313-2016 innovation management guidelines.

4. Results

Table 1 shows the authors' view on the comparison of assessed risks with the stages of the innovation process for which these risks are significant.

Table 1. Influence of risks at the stage of the innovation process (developed by the authors)

Assessed risk	Impact on the stages of the innovation process
Risk of not achieving the planned effect of the programme of a green innovation while maintaining or increasing sales volumes ($p_1=\alpha p_S+(1-\alpha)p_{Ap}$, $0\leq\alpha\leq1$, where p_S is the probability of the successful completion of strategic-level tasks and p_{Ap} is the probability of maintaining/increasing sales of products, work and services).	Preparation for production at the manufacturing plant Production of the innovation Implementation and promotion of the innovation Assessment of the economic efficiency of the innovation Marketing of the innovation Diffusion of the innovation
Risk of not achieving the planned effect of the programme of a green innovation in the context of declining sales volumes ($p_2=\beta p_S+(1-\beta)p_D$, $0\leq\beta\leq1$, where p_S is the probability of the successful completion of strategic-level tasks and p_D is the probability of reducing sales of products, work and services).	Research and development work Preparation for production at the manufacturing plant Production of the innovation Implementation and promotion of the innovation Assessment of the economic efficiency of the innovation Marketing of the innovation Diffusion of the innovation
Risk of not achieving the planned effect of the pilot project on the implementation of a green innovation while maintaining or increasing sales ($p_3=\gamma p_o+(1-\gamma)p_{Ap}$, $0\leq\gamma\leq1$, where P_O is the probability of the successful completion of the operational-level tasks and p_{Ap} is the probability of maintaining/increasing sales of products, work and services).	Research and development work Preparation for production at the manufacturing plant Production of the innovation Implementation and promotion of the innovation Assessment of the economic efficiency of the innovation Marketing of the innovation Diffusion of the innovation
Risk of not achieving the planned effect of the pilot project on the implementation of a green innovation in the context of declining sales ($p_4=\delta p_o+(1-\delta)p_D$, $0\leq\delta\leq1$), where P_O is the probability of successful completion of operational level tasks and p_D is the probability of reducing sales of products, work and services).	Marketing research Innovation initiation (generation and filtering of ideas)
The probability of reducing sanction pressure and access to the markets of countries that implement economic regulation of the sale of products with a high carbon footprint with the probability of (p_5)	Marketing research Innovation initiation Research and development Technical and economic expertise in projects
The probability of stabilisation of the situation (p_6)	Full cycle of the innovation process
The probability of increased sanctions (p_7)	Marketing market research Initiating the innovation (generation and filtering of ideas) Diffusion of the innovation

The choice of a particular direction of further activity in conditions of great instability, when the results of the decision depend on the consequences of a previously taken action, can be described in the current study with the help of a decision tree. This toolkit was described in detail by Prosvetov and supplemented in this study in accordance with the objective and subject of his research.

In the process of making the optimal decision on the feasibility of launching a project to implement

green innovation in the oil and gas sector, the following activity trajectories are analysed.

The first concerns launching a programme to implement a set of green innovation projects in the products/processes of an oil and gas company. The investment requirement is IC_1 million roubles.

If the number of sales is maintained or increased with probability *p1 (p1=1-(αpS+(1-α)pAp), 0≤α≤1)*, the income from the projects included in the programme of green innovation will be expected to be V1 million roubles, and the effect that the programme provides will be

$$L_{11} = - IC_1 + F_1 + V_{opt} \quad (1)$$

If the number of sales is reduced, the effect of the programme L_1 (million roubles) with probability p_2 will be

$$L_{12} = -IC_1 + F_1 + V_{pes}, \quad (2)$$

where F_1 (million roubles) is the discounted amount of savings due to the reduction of penalties for greenhouse gas emissions for all projects of the green innovation programme; V_{opt} (million roubles) is the net discounted income from the implementation of all programme projects, including income from the sale of products/works/services in new sales markets in countries not participating in the sanctions policy (optimistic estimate); and V_{pes} (million roubles) is the net discounted income from the implementation of all programme projects, including income from the sale of products/work/services in new salesmarkets in countries not participating in the sanctions policy (pessimistic estimate).

The second is to implement a pilot project that is a part of an innovation programme for the transition to a green economy and provides the implementation of an innovative technology in a separate structural unit. The need for *investment* is $IC_2 << IC_1$.

With preserved or increased sales with probability p_3, the planned effect of the project will be L_{21} (million roubles):

$$L_{21} = -IC_2 + F_2 + V_2. \quad (3)$$

With decreased sales with probability p_4, the effect of the green innovation project will be

$$L_{22} = -IC_2 + F_2, \quad (4)$$

where F_2 (million roubles) is the discounted amount of savings due to the reduction of penalties for greenhouse gas emissions provided by the green innovation pilot project and V_2 (million roubles) is the net discounted income from implementation of the green innovation pilot project, including income from sales of products/work/services in new sales markets in countries not participating in the sanctions policy.

The third is to consider the possibility of suspending the innovation programme for a period. The shorter the duration of this, the higher the degree of uncertainty, and the following three scenarios are possible:

- *Reducing* sanction pressure and opportunities to access the markets of countries that implement the economic regulation of sales of products with a high carbon footprint with a probability of p_5.

- *Stabilisation* of the situation with a probability of p_6, $p_5 + p_6 < 1$.

- *Increased* sanctions with a probability of $p_7 = 1 - p_5 - p_6$, $p_5 + p_6 + p_7 = 1$.

In the case of a favourable scenario, a pilot project or an innovation programme as a whole can be implemented; the probability of growth in sales is p_7, and correspondingly, the probability of decline will be $p_8 = 1 - p_7$.

To estimate the probabilities p_{Ap}, p_D, p_5, p_6 and p_7, it is advisable to involve head office employees

as well as specialised consultants and contract research organisations.

The feasibility of making an alternative decision *X* in this situation is based on determining the cost effect, which can be defined as the mathematical expectation of the cost effects of the results of these decisions *M(X)*:

$$M(X) = \sum p_{xi} * C_{xi}, \quad (5)$$

where p_{xi} is the probability of obtaining the ith gain in the result *I* from the implementation of solution *X* and C_{xi} is the profit (gain) projected to be obtained when obtaining the result *i* from the implementation of solution *X*.

From the alternative solutions *X1, X2, ..., Xn*, the one that gives the maximum value of *M(X*)* is chosen:

$$M(X^*) = max\ (M(X_1), M(X_2), ..., M(X_n)). \quad (6)$$

For the decision tree shown in Figure 1, the choice of alternatives is determined by the following conditions:

$$M(A) = p_1 * L_{11} + p_2 * L_{12},$$

$$M(B) = p_3 * L_{21} + p_4 * L_{22},$$

$$M(C) = p_1 * L_{11} + p_2 * L_{12},$$

$$M(F) = p_3 * L_{21} + p_4 * L_{22},$$

$$M(G) = p_3 * L_{21} + p_4 * L_{22},$$

$$M(H) = 0,$$

$$M(D) = 0,$$

$$M\ (2) = max\{M(E), M(F)\},$$

$$M\ (3) = M(G),$$

$$M(C) = p_5 * M\ (2) + p_6 * M\ (3) + M(D),$$

$$M\ (1) = max\{M(A), M(B), M(C)\}.$$

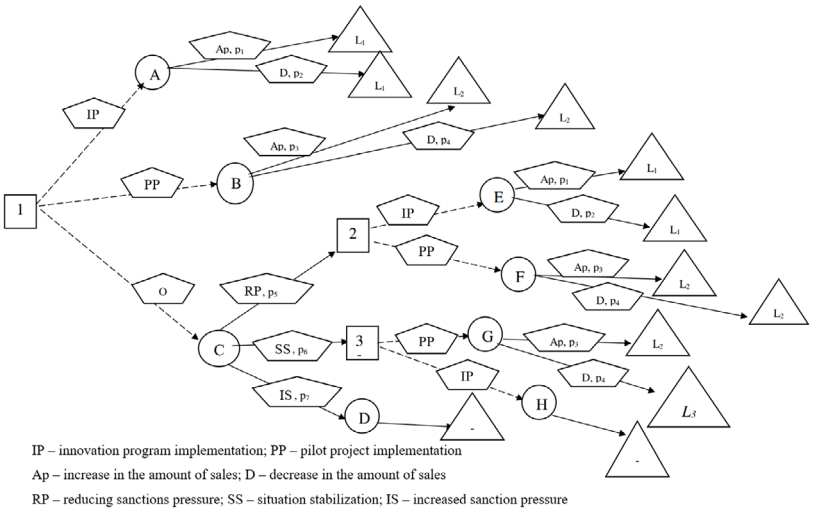

Figure 1. Decision tree for implementing green technologies under sanction pressure (developed by the authors)

Determining the maximum value of the projected income from the implementation of alternatives A, B or C, one of following three innovation strategies is selected: implementation of the entire innovation programme that ensures the transition to green technologies, a pilot project from the list of projects included in the program or the suspension of the program. (Lagutenkov and Liukevich, 2022).

The methodological approach outlined above was tested with conditional data.

In the conditional example, it is assumed that each unit is represented by one expert, and the opinions of the experts are assumed to be equivalent, so the final probability for each question posed to the experts is calculated as the unweighted arithmetic mean. Situations of increasing and decreasing sales are also considered equally probable. The results of the calculations are shown in Table 2.

Table 2. Testing of the model of probabilistic assessment of the effect of the programme and the pilot project of green innovation (developed by the authors)

Model parameter	Unit of measurement	Parameter value
IC_1	(million roubles)	500
p_1		0.606
P_2		0.606
p_S		0.712
P_O		0.817
p_{Ap}		0.5
p_D		0.5
F_1	(million roubles)	30
V_{1opt}	(million roubles)	800
V_{1pes}	(million roubles)	600
L_{11}	(million roubles)	330
L_{12}	(million roubles)	130
IC_2	(million roubles)	100
p_3		0.659
P_4		0.659
F_2	(million roubles)	5
V_{2opt}	(million roubles)	120
V_{2pes}	(million roubles)	105
L_{21}		25
L_{22}		10
p_5		0.2
p_6		0.4
p_7		0.4
A		0.5
B		0.5
Γ		0.5
Δ		0.5
M(A)	(million roubles)	285.78
M(B)	(million roubles)	23.065
M(E)	(million roubles)	285.78
M(F)	(million roubles)	23.065
M(G)	(million roubles)	23.065
M(H)	(million roubles)	0
M(D)	(million roubles)	0
M (2)	(million roubles)	285.78
M (3)	(million roubles)	23.065
M(C)	(million roubles)	66.382
M (1)	(million roubles)	285.78

Testing of the model on conditional data (Table 2) proved its fundamental efficiency and suitability for choosing the green innovation strategy in conditions of high uncertainty. In the given example, such a strategy is a variant for implementing the innovation programme as a whole.

It should be noted that the application of this model in practice requires the careful selection of experts in accordance with the nature of the initiated innovation programme and the requirements of regulatory documents governing the management of the innovation process.

The proposed approach to modelling the feasibility of initiating programmes for introducing green innovations at oil and gas enterprises, based on the procedure for experts to assess the strength of sanctions and opportunities to access the markets of countries that implement the economic regulation of sales of products with a high carbon footprint based on a decision tree, will expand the methodological basis of strategic planning in the field of green innovation and complement the methodological tools of project management for the innovative development of economic systems.

5. Discussion

For the development of green innovations under conditions of sanctions, it is necessary to improve the innovation infrastructure of the oil and gas sector and to create a single information and resource centre for green innovations in this field in Russia (electronic platform of innovations). Attracting state financing is possible within the framework of creating a state fund to support green innovation in the oil and gas segment. In addition to the fund, venture funds with the participation of banks and companies operating in the oil and gas industry and investment from external investors under the framework of public–private partnerships, credit institutions and companies' capital invested in innovative projects can be considered as investment resources. To make decisions on an investment, it is necessary to assess its feasibility.

The proposed algorithm for assessing the development of green innovations and the model that was developed to assess the feasibility of implementing green innovations are recommended for broad practical application in strategic planning for enterprises' innovation activities.

Further research could involve substantiation of the prospects of implementing green innovations in the context of there being increased risk of a negative external impact on the economy as a whole. The transition to the green economy requires a special approach, taking into consideration all the specific aspects of management, especially in the oil and gas sector of the economy. On the one hand, significant financial resources are allocated at the Russian government level for the construction of large infrastructure projects, but on the other hand, this process will require significant investment transfers from the companies themselves. Taking into consideration the current situation in the international market of oil products and energy resources, with increasing supply and demand instability, unpredictability and the current refusal of foreign countries to buy Russian hydrocarbons, the process of implementing green innovation may be inactive for an indefinite period. This requires the study of possible tools and mechanisms to level the risks as well as the use of green innovations themselves as a factor contributing to the effectiveness of economic activity.

Further research could also involve the substantiation of directions and mechanisms of cooperation of the state and businesses in the process of developing, initiating and implementing green innovations in the oil and gas segment under the framework of developing public–private partnerships by determining characteristics of the infrastructure and institutional environment of the interaction between government and business entities in the implementation of green innovations in a negative external environment.

6. Conclusions

In accordance with the goals of this study, the following results and conclusions were obtained:

1. Theoretical aspects of the nature of green investment and its role in the development of the green

economy were specified.

2. The main stages of preparation and the work of an expert group to assess the probability of successfully implementing green innovations were considered.

3. An algorithm for managing green innovations in the oil and gas sector was developed and tested in terms of assessing the feasibility of implementing innovations based on expert interviews, a decision tree and the assessment of probabilities of outcomes; namely, a methodology was formulated to assess the choice of optimal decisions on the feasibility of launching a project to introduce green innovations in the oil and gas sector based on an expert assessment of sanction pressure and potential access to the markets of countries that conduct the economic regulation of energy-intensive products based on a decision tree, which makes it possible to complement the methodological support of strategic planning processes of green innovations and expand the tools for designing the innovation activities of economic entities.

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