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Mykytenko Viktoriia

Doctor of Economic Sciences, Professor,
Honored Worker of Science and Technology of Ukraine,
Academician of the Academy of Economic Sciences of Ukraine
(corresponding author)

ORCID ID: 0000-0002-8212-9777

*Institute of Demography and Quality of Life Problems
of the National Academy of Sciences of Ukraine*

Chuprina Marharyta

PhD in Economics, Associate Professor

ORCID ID: 0000-0002-3276-4473

*National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"*

Микитенко В. В.

*Інститут демографії та проблем якості життя
Національної академії наук України*

Чуприна М. О.

*Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»*

ALGORITHMIZATION OF MANAGEMENT ACTIONS AND MONITORING TASKS: SOCIO-ECOLOGICAL-ENERGY SOLUTIONS FOR ENSURING THE STABILITY OF NATIONAL ENERGY SYSTEMS

АЛГОРИТМІЗАЦІЯ УПРАВЛІНСЬКИХ ДІЙ ТА МОНІТОРИНГОВИХ ЗАВДАНЬ: СОЦІО-ЕКОЛОГО-ЕНЕРГЕТИЧНІ РІШЕННЯ ДЛЯ ЗАБЕЗПЕЧЕННЯ СТІЙКОСТІ НАЦІОНАЛЬНИХ ЕНЕРГОСИСТЕМ

A closed algorithm of management actions has been developed to ensure the social, environmental and energy responsibility of business entities during the development and implementation of energy system projects with distributed generation elements in seven stages, which is characterized by significant advantages: systematicity and complexity; involvement of stakeholders in the implementation of a sustainable development strategy; development of procedures at the preparatory stage; development of an anti-corruption program; prediction and forecasting of likely social, environmental and economic consequences; constant monitoring and adaptation of algorithm procedures; formation of an ethical culture in the distributed generation management system in times of crisis, etc. A five-stage algorithm of management actions has been developed and proposed for use to harmonize the processes of ensuring the stability of the functioning of the national energy system with the rationalization and compatibility of the volumes and modes of electricity supply to the network from distributed generation enterprises. This allowed us to form five dimensions of the levels of management of these processes, taking into account that monitoring and control of the implementation of distributed generation energy system projects must be carried out taking into account their significance and role for the national, regional and local levels of development of natural and economic relations.

Keywords: *socio-ecological-energy responsibility, energy system, distributed generation, algorithm of management actions, monitoring and control.*

Розроблено замкнений алгоритм управлінських дій із забезпечення соціо-еколоого-енергетичної відповідальності суб'єктів господарювання при розбудові та реалізації проєктів енергосистем із елементами розподіленої генерації за сімома етапами, що відзначається суттєвими перевагами: систематизацією та комплексністю; залученням до реалізації стратегії забезпечення стійкості зацікавлених сторін; опрацюваністю процедур за підготовчим етапом; розробленістю антикорупційної програми; передбаченням і прогнозуванням імовірних соціо-еколоого-економічних наслідків; постійним моніторингом та адаптацією процедур алгоритму; формуванням етичної культури в системі управління розподіленою генерацією в кризових умовах, інше. Запропоновано до використання комплекс техніко-технологічних процедур і засобів узгодження процесів забезпечення стійкості функціонування національної енергосистеми при погодженості обсягів і режимів постачання у мережу електроенергії від розподіленої генерації та енергетичних бізнес-корпорацій і акціонерних товариств. Розроблено та запропоновано до використання п'яти етапний алгоритм управлінських дій із узгодження процесів забезпечення стійкості функціонування національної енергосистеми з раціоналізацією та погодженням сумісності обсягів і режимів постачання у мережу електроенергії від підприємств розподіленої генерації та енергетичних бізнес-корпорацій і акціонерних товариств. За кожним із етапів сформульовано комплекс завдань та обґрунтовано терміни моніторингу (періодичного, проміжного, фінального) і контролювання ефективності забезпечення соціо-еколоого-енергетичної

відповідальності у розподіленій генерації при розмежуванні за п'ятьма рівнями управління з метою активізації процесів у сфері розподіленої генерації. Розкрито узагальнений формат моніторингу та контролювання ефективності забезпечення соціо-еколого-енергетичної відповідальності енергетичних бізнес-корпорацій, акціонерних товариств та національних регуляторів енергетики задля забезпечення стійкості національних енергосистем. Зазначене дозволило сформувати п'яти вимірність рівнів управління цими процесами задля створення багаторівневої гнучкої пірамідальної структури зі сходами, яка враховуватиме суб'єктність управління, за урахуванням чого має здійснюватися моніторинг і контроль за впровадженням проєктів енергосистем із розподіленої генерації з урахуванням їхньої значимості і ролі для національного, регіонального та локального рівня розвитку природно-господарських відносин.

Ключові слова: соціо-еколого-енергетична відповідальність, енергосистема, розподілена генерація, алгоритм управлінських дій, моніторинг та контроль.

Problem statement. In the context of the military-economic and energy crisis, Ukraine is faced with the need to transform the energy sector, in particular through the development and implementation of power system projects with elements of distributed generation (DG). Ensuring the sustainability of the functioning of the national energy system is directly related to the development and implementation of an effective mechanism for ensuring socio-environmental and energy responsibility (SEER), taking into consideration not only economic, technological and energy, but also environmental, informational and social aspects of management. The lack of new SEER management models, socio-ecological innovations, inclusive business models and the refusal to take into account business-ecosystem approaches to sustainable management [1] – significantly slow down the process of reformatting the energy sector of our country. Therefore, there is a need for a systemic, integrated and innovative approach in research on the development of a new system of socio-environmental and power responsibility in distributed generation to provide its constant development (CD), management and sustainability of national energy systems.

Analysis of recent research and publications. It should be noted that the theoretical, methodological and scientific applied aspects of ensuring social responsibility in the context of ensuring sustainable management of industries are the subject of the works of many domestic and foreign scientists, including: D.L. Swanson, I.K. Bystryakov, B.G. Brintseva, O.A. Grishnova, K.P. Datsko, O.O. Karpenko, V.V. Khrapkina, etc. [1–6, 8]. Paying tribute to the theoretical and practical value of previous scientific achievements, we consider it appropriate to recognize: in the crisis conditions of hybrid war and the need for post-war recovery, there is a need to find new socio-ecological and energy solutions and mechanisms for transforming the energy sector of Ukraine on the basis of implementing a targeted algorithm of management actions and performing monitoring tasks using effective tools to increase the stability of national energy systems.

Formulating the purposes of the article. The purpose of the article is to develop and base an algorithm of management actions and monitoring tasks to ensure socio-environmental-energy responsibility (SEER) in the field of distributed generation (DG), as well as to develop and implement a set of effective tools to increase the stability of national energy systems in crisis conditions. The article is aimed at integrating social, environmental, technological and energy aspects into the process of energy sector management and control, which will ensure its stable operation, sustainability and development in conditions of constant increase of various nature of threats and risks to sustainable management (SM).

Presentation of the main research material. Defining the essence and content of socio-environmental and energy responsibility in the field of distributed generation as a set of obligations of management entities and energy market participants aimed at ensuring a harmonious combination of social, environmental, energy and economic aspects of activity in the process of energy production, distribution and consumption, we note the following: SEER in the field of DG provides for: a) minimizing the negative impact on the environment through the use of renewable energy sources (RES) and innovative technologies; b) creating social and economic benefits for local communities through attracting investments, creating jobs and supporting SM and CD; c) compliance with regulatory requirements and ensuring transparency in conducting energy activities, including reporting to the public and relevant regulators. That is, SEER covers all levels of management – from national and regional to local one is aimed at ensuring the stability of the energy system in the long term. Therefore, the created complex of system-regulatory measures to overcome obstacles to ensure SEER in the conditions of hybrid war will allow creating a harmonious environment in the DG, taking into account the financial, technical-technological, social, environmental and even psychological and medical-social aspects of the functioning of the national energy system [7]. Therefore, the development of an algorithm of management actions to ensure SEER in the DG is of urgent importance for several reasons related to the need for: 1) social legitimization: ensuring SEER allows management entities, enterprises and organizations to legitimize their activities in the eyes of the public, the scientific community and stakeholders (creates trust and support from consumers, investors, regulators and communities); 2) minimization of risks and costs: an algorithm for ensuring SEER adequate to real processes helps to avoid possible conflicts with the public, authorities or other stakeholders (an error-free algorithm contributes to the timely identification and management of social risks); 3) promotion of CM and CD: the algorithm, taking into account the principles of CM and CD, is aimed at ensuring homeostasis and harmony between economic, energy, environmental, technological and social aspects, which contributes to the long-term success of projects and the preservation of local resources and assets; 4) ensuring universality and adaptability: the development of a flexible and adaptive algorithm ensures its use in practice in the field of DG in different regions and situations due to a clear sequence, taking into account the priority and specificity of the requirements for the implementation of actions of certain types and functionalities of the SEER; 5) interaction with stakeholders: with the phased implementation of the algorithm and, to the full extent, taking into account

the interests of various stakeholders, local communities, environmental organizations, regulators, consumers, investors – all of them will support the implementation of DG projects, which is key to achieving success; 6) ensuring clear reporting and its openness: certainty in the algorithm of the complex of reporting mechanisms and openness regarding the social, economic and environmental impacts of the project with the DG will help to foresee the prospects of success and identify problems in the field of responsibility; 7) acceptability of the principles of ethics and corporate SEER will contribute to the: creation of a socially responsible corporate culture; effectiveness of strategic planning for the long-term positive impact of the

introduced projects with the DG on the development of spatial formations.

In the author's belief, the algorithm of management actions to ensure SEER in the DG (Table 1) should be integrated, systematic and aimed at ensuring the effective resolution of the entire complex of issues (in addition to economic, technical and technological, social, energy and environmental, as well as anti-corruption), since the functioning of the energy market in Ukraine currently has significant corruption risks. In this regard, the authors support the beliefs [8] regarding the urgency of implementing an anti-corruption complex in energy business management.

Table 1

Algorithm of management actions to ensure SEER in the DG

Content of actions	Description of procedures by stages
1	2
<i>Stage 1. Preparation. Basing of requirements for the SEER. Identification of problems and obstacles to ensuring the SEER. Development of mechanisms and regulators for solving problems.</i>	
1.1. Base of the requirements for the SEER	Carefully base the requirements for the SEER, taking into account the characteristics of the territorial entity, the specifics of the industry, local features, and international standards.
1.2. Initial analysis of conditions and scope of potential	Make an analysis of technological, economic, social and environmental aspects and, accordingly, existing assets in the context of the development and implementation of a power system project with DG elements.
1.3. Analysis of problems and obstacles	Make an analysis, identify problems and existing obstacles that may arise during the project implementation. Determine the significance of their impact on the SEER.
1.4. Identification of possible risks and costs	Assess possible risks and costs associated with the implementation of socially responsible initiatives and determine the need to ensure the necessary reserves in the budget and timeline.
1.5. Corruption risk analysis	Analysis of corruption risks specific to the energy sector and local context. To identify where and what specific risks may arise during the implementation of socially responsible projects for new energy systems in the Republic of Kazakhstan.
1.6. Identification of vulnerability areas and their value	Identifying areas of vulnerability where corrupt practices may be particularly dangerous, which may include procurement management, interaction with contractors, charity distribution and other areas of project activity, etc.
<i>Stage 2. Analysis and identification of stakeholders. Making an initial analysis of the societal and environmental aspects of the SEER.</i>	
2.1. Identification of stakeholders	Identify all stakeholders, including local communities, environmental groups, investors, etc.
2.2. Creating a stakeholder engagement plan	Identify mechanisms for interaction with stakeholders and a set of levers and regulators for reporting on the SEER and, accordingly, form an appropriate list of indicators.
2.3. Determining the scope of stakeholder participation	Establish the framework, terms, and conditions for engaging stakeholders, such as members of the public, non-profit organizations, and other groups, to identify their needs and solicit suggestions for developing anti-corruption measures.
2.4. Taking into account environmental aspects in the DG project	Ensuring, taking into account and implementing technologies and methods aimed at minimizing the negative impact on the environment and living environment in order to ensure the quality of life.
2.5. Taking into account societal aspects in the DG project	Analysis of societal needs based on the results of the expectations analysis, taking into account the needs of the community and other stakeholders. Involvement of stakeholders in the assessment of societal aspects (local communities, non-profit organizations, industry representatives) to collect their views into account. Social impact assessment with identification of the impact of the DG project and negative aspects for different social groups within the spatial formation.
<i>Stage 3. Strategic planning. Development of the SEER strategy. Creation of a stakeholder engagement plan.</i>	
3.1. Formulation and development of the SEER strategy	Develop a strategy that defines how the DG project will respond to societal and environmental challenges. Formulate the dominants of the strategy that would take into account the interests of all stakeholders: a) take into account the peculiarities of local traditions when implementing the DG project; b) provide a plan for social dialogue with stakeholders, ensuring open exchange of information and consultations; c) implement the task of promoting the involvement of various social groups in the development of the DG project; d) determine the scope of job creation and skills development project employees and the local community; e) recognize the concept of corporate culture with the development of a code; g) provide for cooperation programs with local authorities to ensure interaction and resolution of socio-ecological issues; h) develop a system for monitoring and reporting on the socio-environmental indicators to inform and ensure transparency.
3.2. Development of a set of problem-solving mechanisms	Develop specific mechanisms (levers and regulators) of the SEER strategy to solve individual and local problems and correct identified negative aspects.

Continue table 1

1	2
3.3. Development and implementation of an incentive system	Consider the possibility of using economic incentives for those who actively participate in socially and environmentally responsible initiatives under the DG project.
<i>Stage 4. Implementation of a system for monitoring and reporting on the results of the implementation of SEER tasks.</i>	
4.1. Development and implementation of a monitoring and reporting system	Develop and refine monitoring system procedures to track the implementation of socio-environmentally responsible initiatives and a reporting system to inform stakeholders. Identify a set of economic and statistical indicators to develop an effective monitoring system and conduct periodic assessments of the effectiveness of anti-corruption measures and make adjustments according to the results.
4.2. Implementation of reporting mechanisms	Develop and implement a monitoring and reporting system for environmental, technological and social indicators.
4.3. Implementation of safety and environmental standards	Application of high safety and environmental protection standards during work and operation of the power system with DG elements.
<i>Stage 5. Interaction with stakeholders. Involvement of the local community and cooperation with non-profit organizations.</i>	
5.1. Development of a communication strategy	Develop a cognitive-informational communications strategy that includes effective mechanisms for communicating with stakeholders and the public, especially when identifying and disclosing negative aspects and attempting to resolve them.
5.2. Involvement of the local community	Promote the participation of local communities and the public in decision-making processes and the development of the energy system of the Republic of Kazakhstan.
5.3. Cooperation with authorities and non-profit organizations	Identifying means and methods of strengthening cooperation with: a) government and legislative bodies to identify and punish corruption violations; b) non-profit organizations and public initiatives to ensure objective assessment of social initiatives.
5.4. Organization of training events	Providing regular training events for staff on maintaining the principles of anti-corruption activities, as well as ethical norms and responsibilities.
<i>Stage 6. Development of an anti-corruption program. Analysis of corruption risks and identification of vulnerability areas. Development of an anti-corruption policy and action plan.</i>	
6.1. Development of an anti-corruption policy and action plan	Development of a specific anti-corruption policy and action plan that takes into account all identified risks and problems. Formation of a set of mechanisms for preventing, detecting and resolving corruption cases.
6.2. Creation of internal control mechanisms	Development of a set of internal control mechanisms that will help identify and eliminate corruption risks (regular audit and reporting systems, other mechanisms and means of strict control).
6.3. Development of proactive measures	Development of proactive measures to prevent corruption (staff training, development of a code of ethics, establishment of effective mechanisms for identifying conflicts of interest, etc.).
<i>Stage 7. Monitoring and evaluation of the effectiveness of the DG project and the implementation of anti-corruption measures. Adaptation and improvement of the stages and content of the algorithm.</i>	
7.1. Monitoring the implementation of the plan	Regular monitoring of the implementation of the SEAE plan and adjustment of the content of measures if necessary (including anti-corruption measures).
7.2. Evaluation and results of project implementation	Assess the impact of the project on the social, economic, and environmental aspects of the development of the spatial entity, prepare reports, and make adjustments for the future.
7.3. Algorithm adaptation and update	Clarification of the content of the stages and adaptation of the algorithm in accordance with changes in the internal and external environment of the operation of power systems and taking into account the experience gained in implementing the relevant type of projects. In case of significant deviations, return to Stage 1 (Preparation).

Source: Developed and substantiated by the authors, as detailed in [9; 10]

The closed algorithm of management actions with the SEA is proved by seven stages: I) Stage 1 – Preparatory: basing of the requirements for the SEA, identification of the problem and obstacles to its implementation, development of a set of mechanisms and regulators for solving the problem; II) Stage 2 – Analysis and identification of stakeholders: conducting an initial analysis of the social and environmental aspects of the SEA; III) Stage 3 – Strategic planning: development of the SEA strategy and mechanisms, creation of a plan for interaction with stakeholders; IV) Stage 4 – Implementation of a monitoring and reporting system for the results of the implementation of SEER tasks; V) Stage 5 – Interaction with stakeholders: involvement of the local community and the public, cooperation with non-profit organizations; VI) Stage 6 – Development

of an anti-corruption program with an analysis of risks and vulnerability zones; VII) Stage 7 – Monitoring and evaluation with clarification of measures by stages and establishment of the level of cardinality of deviations (in case of low performance – return to Stage 1 – Preparatory). It should be noted that the closed algorithm may include other additional steps that will help to systematize and detail the content of procedures both at the preparatory and monitoring and evaluation stages, providing for the solution of problems specific to a particular spatial formation and the elimination of obstacles in the context of ensuring SEER of economic entities during the implementation of new power system projects with DG elements.

The proposed algorithm has several significant advantages compared to previous developments of

scientists and practitioners in terms of the content and sequence of solving the SEER task. And, namely:

I) systematization and complexity: the algorithm includes steps and stages that allow: a) to systematize various aspects of SEER management; b) to adjust and manage comprehensively, covering all necessary aspects of ensuring CM and CD in the context of ensuring the quality of life of the population;

II) involvement of stakeholders in the implementation of the SEER strategy: the algorithm procedures focus attention and localize efforts on involving stakeholders, including the local community and public organizations, which allows for broad participation and consideration of different views on SEER;

III) elaboration of procedures at the preparatory stage: the detail of developments at this stage allows for predicting possible problems, determining strategies for their solution, and taking into account financial, technological, and technical aspects of DG provision;

IV) the development of the anti-corruption program: the allocation of a separate stage for the development and implementation of this program helps to focus attention on an important area of management, which will contribute to the prevention of corruption risks and increased transparency in the energy sector;

V) the prediction of environmental consequences: taking into account the environmental aspect in the algorithm recognizes the priority of taking into account socio-ecological and economic factors in ensuring the SEER, which is extremely important at the post-war stage of the restoration of the national economy;

VI) constant monitoring and adaptation of algorithm procedures to new conditions – allows you to adapt the SEER management strategy to changes in the external and internal environment and take into account the experience gained by management entities from already implemented DG projects;

VII) the formation of an ethical culture in the DG project management system, which is important for the development of societal and environmental practices.

We should pay attention to stage “VII” of the algorithm (monitoring and control), which is intended to be carried out by management entities at five levels (Table 2): I) state authorities; II) local authorities; III) independent audit organizations and institutions; IV) public organizations and associations; V) investors and customers of DG projects.

Ensuring the suitability of the functioning of the national energy system and the volumes and compatibility of supply modes in the electricity network requires the use of a systemic and integrated approach by DGs and business corporations and, accordingly, the use of various technical and technological procedures and cognitive and informational means of coordinating supply modes and volumes, including those listed in Table 3.

Taking into account the above developments, the algorithm of management actions for coordinating the processes of ensuring the stability of the functioning of the national energy system with the rationalization and coordination of the compatibility of the volumes and modes of electricity supply to the network from the enterprises of the DG and energy business corporations and joint-stock companies should provide for the implementation of five stages of organizational and economic procedures and measures [14], and within their framework – the solution of a set of tasks, which is given in Table 4.

We consider it appropriate to point out that for the successful implementation of the V (fifth) stage of adjusting the content of the coordination strategy of processes and regimes, it is important to ensure: a) participation of all stakeholders, including state authorities, energy companies, distribution system operators and the public; b) transparency and openness of the process of specifying, improving and adjusting the coordination strategy. Therefore, we emphasize the following:

1) the above five stages of the algorithm can be supplemented and specified taking into account the specifics of the national energy system and the needs of market participants (it is important to ensure constant coordination of actions of all stakeholders when

Table 2

Tasks for monitoring and controlling the effectiveness of ensuring socio-environmental and energy responsibility in the DG

Management entities	Main tasks in the field of providing SEER
I. State authorities	Ministry of Energy of Ukraine: responsible for the overall coordination and monitoring of the implementation of energy policy, including SEER for DG projects. It establishes general assessment criteria and benchmarks, reporting regimes. State Agency for Energy Efficiency and Energy Saving of Ukraine: monitors and controls DG projects that affect energy efficiency, including SEER
II. Local authorities	Regional and local councils: should monitor the implementation of DG projects at the local level, in particular in terms of compliance with social standards, taking into account the specifics of a particular region, territory, etc. Local governments: should monitor the implementation of projects within their territories.
III. Independent audit organizations and institutions	Independent audits of the indicators under the SEER of DG projects should be commissioned and carried out by specialized companies with experience in the field of environmental, technological and social auditing.
IV. Public organizations and associations	Public initiatives and expert communities should participate in monitoring and controlling the levels of SEER of projects with DG through public hearings and submitting appeals to authorities.
V. Investors and project customers	Investors and project developers should be required to independently monitor the SEA, adhering to the requirements established by state and local authorities.
Monitoring and control terms: I) periodic monitoring – annually or according to the DG project implementation plan; II) interim monitoring – during key stages of the project implementation; III) final monitoring – upon completion of the project implementation to assess the overall effectiveness of the implementation of the SEER tasks. Note: depending on the scale of the DG project implementation and legislative requirements, the terms of monitoring may vary.	

Source: Formulated and systematized in tabular form by the authors

Table 3

**Means of coordinating processes to ensure the stability of the functioning of the national energy system
with the coordination of the compatibility of volumes and modes of electricity supply to the network from DGs
and energy business corporations and joint-stock companies**

№	Technical and technological procedures and cognitive - information tools
I	Implementation of a smart energy management system (EMS), which allows coordinating and optimizing the work of all its components (both DGs and business corporations). EMS provides control over the production and distribution of electricity taking into account demand and network conditions. After all, the constant increase in energy prices, carbon tax, high competition in the market, outdated equipment and the lack of modern energy consumption control systems significantly affect the margins of enterprises. At the same time, an increase in cost leads to a decrease in demand, competitiveness and consumer loyalty, which negatively affects profits
II	Implementation of smart technologies and energy management system (EnMS), which, based on the results of the EMS energy management system (online monitoring of all types of energy resources consumed), transmits information on consumption to the Energy Brain cloud platform. EnMS allows: a) to analyze the resources used by individual nodes, production mechanisms and, thus, find the most expensive ones, which should subsequently be replaced; b) to reduce the amount of carbon emissions and thus increase the profitability of the product
III	Demand forecasting methods – the use of electricity demand forecasting algorithms and technologies allows planning the production and distribution of electricity, which contributes to the sustainable functioning of the power system
IV	Implementation of network integration devices: allow for effective management of decentralized energy sources and their inclusion in the overall balance of the power system, as well as regulating electricity production depending on changes in demand and network conditions
V	The use of energy storage and accumulation technologies (in particular, such as battery systems) allows for the storage of excess energy for use during periods of peak demand or in the event of outages of other sources
VI	The use of remote monitoring and control by operators allows power system operators to monitor the condition of equipment and optimize its operation in Real-Time mode
VII	Technologies for standardizing activities and ensuring mutual compatibility of technical and technological solutions require the establishment of standards and regulations for the activities of business corporations and enterprises of the DG, since standardization regulates the interaction between various components of the national energy system and will help ensure the compatibility and stability of its functioning
VIII	The development and implementation of contingency plans and emergency scenarios to eliminate violations of energy supply regimes allows for advance planning of actions in the event of unforeseen situations and will ensure a rapid response to possible emergency/crisis situations, etc.

Source: Defined and systematized in tabular form by the authors according to [11,12], which is detailed in [13; 14]

coordinating activities and technological processes, since the successful implementation of the algorithm will require significant resources and political will);

2) special responsibility for the implementation of stage “V” (to clarify, improve and adjust the coordination strategy) – should be assigned to the Ministry of Energy of Ukraine – it is the main body of state power in the energy sector, has the authority to develop and implement the energy development strategy, has access to the necessary resources to implement this stage;

3) we should also clarify the timing of the implementation of the fifth stage – they should be determined taking into account the following influencing factors: the complexity and scope of work on coordinating technological regimes and processes; the scale of available resources and reserves; the need to involve stakeholders.

Individual joint-stock companies and business corporations are responsible for: the balance of production and electricity consumption of electricity and capacity in the power system in real time; operation and development of main and interstate power networks; parallel operation of the power system of Ukraine with the power systems of neighboring countries; technical feasibility of exporting/importing electricity. But, they do not fully fulfill the target functionalities assigned to them. This prevents the stable provision of consumers – therefore, in order to ensure the performance of SEER functions and control, state administration entities should: a) conduct an analysis of the activities of managers, assess their compliance with the assigned tasks and the performance of work duties;

b) clarify responsibility, clearly define the roles of managers for preparing power systems and performing repair work for the winter period; c) approve reporting systems that would require managers to regularly and objectively report on the progress of tasks and the achievement of set goals; d) determine rewards and punishments for failure to fulfill tasks; e) involve independent experts and necessarily audit firms to evaluate the activities and identify shortcomings in the work of managers of energy facilities; g) adapt the existing system of discussion and feedback, as well as create mechanisms for obtaining feedback from employees and stakeholders on the performance measurements of managers and taking measures to resolve identified problems; h) exercise public pressure and public reaction to discuss the activities of managers, which may affect their responsibility and actions.

Conducting an audit of the activities of DG enterprises and energy corporations in order to eliminate corruption actions is most appropriate at:

1) Stage II “Development of a strategy for harmonizing processes and regimes” – the priorities and goals of DG development are based and determined, mechanisms for stimulating its development are developed (the audit helps to identify and eliminate corruption risks associated with these processes);

2) Stage III. “Implementation of a harmonization strategy” – standards are developed and regulatory acts are adopted, DG development programs are implemented, and infrastructure is created to connect DGs to the national and European energy system. Since, audit can help in

Table 4

Algorithm of management actions for coordinating the processes of ensuring the stability of the energy system with the rationalization and coordination of the compatibility of the volumes and modes of electricity supply to the network from the DG and energy business corporations and joint-stock companies

Stage	Task	Responsible	Duration
I. Analysis and basement of requirements	I.I. Collection and analysis of data on: a) the structure and dynamics of development of distributed generation (DG); b) volumes and modes of electricity supply from DG and energy business corporations (EBC); c) technical capabilities of the power system; d) demand for electricity. I.II. Substantiation of requirements for volumes and modes of electricity supply to the network from DG enterprises and energy business corporations and joint-stock companies. I.III. Forecasting the significance of the impact of DG activities on the stability of the functioning of the national power system.	Ministry of Energy of Ukraine (MEU), National Commission for the Regulation of Energy and Utilities of Ukraine, Distribution System Operators (DSOs)	3 months
II. Development of a strategy for harmonizing processes and regimes	II.I. Development of a strategy for coordinating processes and regimes: a) ensuring the stability of the energy system; b) rationalization and coordination of the compatibility of volumes and regimes of electricity supply. II.II. Determination of priorities and goals for the development of the national DG II.III. Development of mechanisms for stimulating the development of DG in Ukraine or a specific region.	Ministry of Energy of Ukraine, NEURC, DSO, experts	6 months
III. Implementation of the alignment strategy	III.I. Development and adoption of standards and regulations. III.II. Implementation of DG development programs in territorial entities. III.III. Creation and verification of balance and reliability функціонування infrastructure for connecting DG to the power system. III.IV. Informing, monitoring and training market participants.	Ministry of Energy of Ukraine, NEURC, DSO, energy companies	12 months
IV. Monitoring and Evaluation	IV.I. Monitoring the impact of the DG on the stability of the national energy system. IV.II. Assessing the effectiveness of the implementation of the coordination strategy. IV.III. Developing recommendations for adjusting the coordination strategy and clarifying the content of regulatory acts.	MEU, National Commission for Energy and Utilities of Ukraine, DSO	Constantly
V. Refining, improving and adjusting the alignment strategy	V.I. Analysis of the results of monitoring and assessment of the impact of DG on the stability of the energy system. V.II. Identification of problems and shortcomings in the implementation of the strategy. V.III. Development and implementation of measures to eliminate problems and shortcomings. V.IV. Updating the strategy taking into account changes in the market and technologies. V.V. Amendments to existing regulations. V.VI. Development of new programs to stimulate the development of DG. V.VII. Implementation of programs to stimulate innovative activity, the implementation of new technologies and innovations. V.VIII. Advanced training and information of market participants.	Ministry of Energy of Ukraine, NEURC, distribution system operators, energy companies, the public, etc.	6–12 months Stage V is a continuous process, the procedures of which must be updated, improved, and adapted to the changing conditions of the internal and external environment

Source: It is substantiated and systematized in tabular form by the authors, partially taking into account the sequence of implementation of procedures, which is detailed in [9; 13; 14]

controlling the use of investments and budget funds, as well as in ensuring transparency of decision-making processes. In particular, the above applies to: checking financial documentation of energy enterprises and energy corporations; analysis of procurement procedures; assessment of corruption risks; checking compliance with legislation; monitoring of conflicts of interest; surveys and interviews with employees. We are convinced that external audit should be comprehensive and cover all aspects of the activities of energy enterprises, and its results should be made public to ensure transparency. And, taking them into account, measures should be developed and implemented to eliminate corruption risks, which is an important condition for ensuring the stability of the functioning of the national energy system and rationalization of energy development.

As for the controlling activities of economic entities themselves, they should conduct internal audits to

identify violations and shortcomings and factors that impede the performance of tasks. An important part of the SEER process is ensuring transparency and openness (to prevent corruption schemes and prevent conflicts of interest). Therefore, the subjects should (Table 5): a) DG – ensure the implementation of a number of tasks aimed at the: balanced functioning of the energy system and taking into account the interests of various social groups: accessibility and reliability of energy supply; economic efficiency; development of DG infrastructure and technologies; safety and occupational health of workers associated with the operation of the energy system; b) stationary sources of energy generation, shareholders and business corporations that ensure the operation of the national energy system – they must achieve: stability and reliability of energy supply; energy efficiency and optimization of production; support for innovation and

Table 5

Generalized format for monitoring and controlling the effectiveness of ensuring the SEER of energy business corporations, joint-stock companies and national energy regulators in the context of intensifying the implementation of DG projects in Ukraine

Monitoring and control format	Main tasks for monitoring and controlling the effectiveness of the provision of SEER
Framework standards and indicators	Development and implementation of standards: creation of clear framework standards for assessing SEER (ISO 26000 standards or other international guidelines and EU Directives on ensuring accountability). Establishment of key performance indicators (KPIs): definition of KPIs for monitoring the social impact of projects (indicators on employment, environmental effects, community support and other socio-environmental aspects).
Audits and reports	Conducting audits by independent organizations to assess compliance with a sufficient level of SEER. This should cover all stages of the implementation of DG projects, including planning, construction and operation. Preparing and publishing regular reports on the results of SEER activities (should be available to everyone, including investors, civil society organizations and regulators).
Monitoring by public organizations	Participation of civil society organizations and associations: involvement of civil society organizations in the monitoring and control process in the context of intensifying the implementation of DG projects. They can conduct independent research, surveys and analyze the impact of projects on local communities. Public consultations to obtain feedback from local residents and communities that can influence the intensification of the implementation of DG projects in practice.
Integration of digital technologies	Real-time monitoring systems: use digital platforms and technologies to collect data in real time and space. These systems should automatically monitor key indicators and promptly identify problems and obstacles, taking into account the possibility of alarming about errors and obstacles. Analytical tools and artificial intelligence should be used to analyze large volumes of data and identify trends in changing parameters of the SEER.
Cooperation between management entities	Inter-sectoral cooperation: interaction and collaboration between various government agencies, local authorities, business corporations, public organizations and investors for joint monitoring, assessment and information exchange. Formation of advisory councils, which include representatives of various stakeholders to discuss monitoring results and determine further actions.

Source: Defined and systematized in tabular form by the authors, as detailed in [14]

technological development; sustainable cooperation with regulators and the public.

Therefore, we note: monitoring and controlling the effectiveness of ensuring the SEER of energy business corporations, joint-stock companies and national energy regulators (a set of procedures for stage “IV”) in the context of intensifying the implementation of RG projects in Ukraine should be carried out in the format represented in Table 5. The format of monitoring and controlling the effectiveness of the implementation of SEER tasks by energy business corporations, joint-stock companies and energy regulators in the context of activating projects with DG will ensure complexity and contribute to their successful implementation and increase efficiency based on the creation of a multi-level flexible structure that will take into account five levels, at which total monitoring and control will be carried out. At the same time, the significance and role of the implementation of DG for the national, regional and local levels of development of natural and economic relations when performing tasks to ensure SEER, will be taken into account for each level.

Conclusions. Thus, based on the results of the study, a closed algorithm of management actions to ensure SEER during the development and implementation of energy system projects with DG elements has been developed, which is characterized by significant advantages: systematization and complexity; involvement of stakeholders in the implementation of the strategy; elaboration of procedures at the preparatory stage; development of an anti-corruption program; prediction and forecasting of probable environmental consequences; constant monitoring and adaptation of algorithm procedures; etc. The development focuses on important aspects regarding: a) defining and disclosing a generalized format for monitoring and controlling the effectiveness of SEER provision in energy business corporations, joint-stock companies and national

energy regulators (a new methodological basis and system for assessing and controlling processes has been created); b) forming a toolkit and substantiating approaches with the definition of framework standards and indicators, audit and reporting methods, participation of public organizations in monitoring, integration of digital technologies and cooperation between management entities; c) creating a multi-level monitoring system – a five-dimensional pyramidal structure with stairs, which takes into account different levels of management and their role in the development of the DG, which helps to better understand the complexity of SEER functionalities; d) integration of the constructed monitoring and control system into natural and economic relations, taking into account the significance and role of this structure for their development at different levels, which is revealed by using a systemic and integrated approach to ensuring sustainable development and management.

In the future, promising areas of deepening research in the field of ensuring SEER in the field of DG, taking into account the probable achievement of a certain level of social stability and CM, may include: 1) building new models of SEER management; 2) developing a complex of social innovations and inclusive business models; 3) stimulating greening and sustainable management; 4) improving financial mechanisms for supporting SEER with the prospect of introducing tools: financial support for DG projects that include elements of integrated responsibility (“green” bonds, grants, subsidies and other financial innovations); analysis of opportunities for attracting private capital to implement DG projects with high societal and environmental impact through the development of socially oriented investments, etc. This research will help develop and strengthen existing systems of socio-environmental and energy responsibility in distributed generation, contributing to its sustainability, improving the quality of life of the population, and social stability in Ukraine.

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