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Stakeholders management of carbon sequestration project in the state – business – society system

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Prevention of catastrophic effects of climate change is one of the most pressing challenges of this century. A prominent place in the low-carbon development system today is carbon capture and storage technology (CCS). This technology can significantly reduce greenhouse gas emissions, leading to global warming. Effectiveness of technology has been proven through successful implementation of a number of CCS projects.

CCS projects are implemented in the context of national and often international interests, consolidating efforts of many parties. Sequestration projects involve government bodies, public, industrial and scientific sectors, as well as a number of other business structures. Each participant presents his own expectations for results of the project, which can compete among themselves, creating threats to its successful implementation. World experience in implementing CCS projects indicates that opposition from a certain group of stakeholders can lead to closure of a project, therefore, interaction with environment is one of the key elements in managing such projects.

This study focuses on specifics of stakeholder management in implementation of CO_2 sequestration projects. Based on the analysis of world experience, role of the state, business and society in such projects is determined, their main expectations and interests are summarized. The main groups of stakeholders of CCS and CCUS (carbon capture, utilization and storage) projects were identified, differences in their interests and incentives to participate were analyzed. It is proved that system of interaction with stakeholders should be created at the early stages of the project, while management of stakeholders is a continuous process throughout the life cycle. An author's tool is proposed for assessing degree of stakeholder interest, the use of which allowed us to determine interaction vectors with various groups of stakeholders.

***Key words*:** carbon dioxide; intake; disposal; CCS technology; stakeholders; control; sequestration projects; state; business; society; key interests

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Introduction. The global challenge of the XXI century is transition to low-carbon development of world industrial sector. The relevance of decarbonization is due to ongoing processes of climate change caused by anthropogenic emissions of greenhouse gases. In recent years, initiatives aimed at reducing greenhouse gas emissions have been systematically carried out globally, the main of which are development of the Kyoto Protocol (2005) and signing of the Paris Agreement (2015).

Today a prominent place in global decarbonization system is carbon capture and storage (CCS). This technology can significantly reduce CO_2 emissions by trapping (intake) gas from industrial sources, transporting it, as well as subsequent long-term underground disposal. A separate area in CO_2 sequestration industry is CCUS (carbon capture, utilization and storage) technologies, which include a separate stage of production chain – utilization, which assumes beneficial use of trapped CO_2. EOR-CO_2 (CO_2-enhanced oil recovery) projects aimed at improving oil recovery are the most common type of CCUS projects in the world today.

Along with oil and gas sector, projects for the use of carbon dioxide are implemented in coal industry (especially in coal-fired power plants), and carbon dioxide is also used in production of steel and ethanol, in preparation of gas, in production of mineral fertilizers, etc. The use of gas in cement is a potentially promising industry to obtain new types of products in chemical industry, as

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well as durable carbon materials [7, 10]. In addition to industrial projects, R&D projects are being implemented, which are aimed at technological development and search for new directions for implementation of CCS/CCUS technologies.

According to the Global CCS Institute, as of 2019, there are 43 large-scale projects in the world, whereas only 18 of them are in operation. The leader in the number of existing projects is North America (mainly the USA), in the number of projects in early stages of development – China and Europe [16]. CCS technologies are not applied in Russia yet, but the country has significant potential for their distribution, represented by large sources of CO_2 emissions and geological objects suitable for its storage.

Importance of increasing investment and technological efforts in the field of CO_2 sequestration is recognized on a global scale, but development of this area is limited by significant barriers. In most cases, such projects do not imply commercial effect and are aimed primarily at environmental result. Despite the fact that a number of CCUS projects are being implemented in the world, only a few of them are economically effective, since the level of capital and operating costs is quite large. Such projects are usually implemented entirely at the expense of the state or with significant support from it, or at the expense of specially created funds with participation of business, funds of international organizations and states.

At present, there is high interest in scientific environment in implementation of carbon sequestration projects, and this direction is presented mainly in foreign publications. A number of scientific and analytical works are devoted to stakeholder management in the system of CO_2 sequestration projects, which mainly consider individual stakeholders and their role in such projects, while insufficient attention is paid to issues of identification and interaction with stakeholders.

So, significant amount of work on this topic is devoted to the role of state regulation in implementation of CO_2 sequestration projects with allocation of key drivers, as well as constraining political forces; works contain a detailed analysis of existing instruments of state regulation with assessment of their effectiveness and possibility of application in certain conditions; analysis of various support schemes for such projects, etc. [1, 2, 21, 23, 25]. Publications of the authors are also devoted to the study of pros and cons of CCS projects, study of key barriers to large-scale use of CCS/CCUS technologies, etc. [3, 5, 6].

As regards management of stakeholders directly in the CCS/CCUS system, these issues are highlighted in the works of K.R.Jones, R.Wustenhagen, and others. Authors emphasize importance of social recognition of technology, with the greatest attention to society [9, 26]. Despite this, the authors emphasize the need to clarify circle of stakeholders, deep analysis of their expectations, concerns, as well as reasons for their indifference to CCS/CCUS.

Studies of D.E. Henriksen et al. showed that success and large-scale development of CCS projects largely depend on a clear definition of main stakeholders of the projects, establishment of their roles and responsibilities in CCS-project system [14]. In this regard, authors analyze the roles of key stakeholders (state, local authorities, industry, society) in sufficient details, while simultaneously presenting the role of various mechanisms and tools for development of CCS (legal regulation, financial schemes, etc.).

Study of society and its awareness of benefits of CO2 sequestration technologies is reflected in the works of such authors as M.Fishedik, R.Chaudhry and others, as well as in the ASG (Alliance for Global Sustainability) study [11, 18, 20]. The basis of these works is method of surveys and interviews, which resulted in analysis of opinions on CCS technologies from the main stakeholder groups in Germany, USA, Sweden. Based on the results of these studies, it can be concluded that task of raising awareness of CCS / CCUS technologies benefits is international.

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I.Chrysostomidis in the study on review and analysis of stakeholders of CCS projects, identifies two levels of interest in CCS projects – local (project/local level) and global (global level) [8]; key stakeholder groups, as well as eight priority areas that may be subject of their interests, with development of a conceptual scheme of stakeholder interaction.

Recommendations on making strategies for interaction with various groups of stakeholders are presented in the works of international environmental association Bellona, which noted the need to integrate technological and social processes in implementation of CCS/CCUS projects and identified the most significant areas of work for each of them [13]. The features of making communications with stakeholders and the main barriers were also analyzed by the World Resources Institute (WRI), which developed a system of guidelines for managing stakeholders in implementation CCS projects [9].

Formulation of the problem. In most cases economically developed countries support initiatives to reduce carbon dioxide emissions by actively initiating and implementing CO_2 sequestration projects. However, as already noted, on a global scale such projects are single, global development and application of carbon sequestration technologies is constrained by a number of factors, the key of which are related to economy, safety, public perception of long-term CO_2 underground disposal, as well as complexity and multi-level nature of such projects. These projects are complex from a technological point of view, there are a number of organizational, managerial and economic problems. CCS projects are local projects, but are implemented in the context of national and even international interests, therefore, such initiatives require coordination of participation of a fairly wide range of stakeholders, such as state, international organizations, business, society, environmental organizations, etc. [4].

In this system of deterrents and also taking into account the fact that CCS projects are not widespread on a global scale, identification and study of key stakeholders of such projects, their interests, features of their interaction, as well as assessment of their influence, importance and interest in CCS / CCUS projects are relevant.

Methodology. The purpose of this study is to identify key stakeholders of carbon sequestration projects with identification of their main interests and basic principles of interaction, as well as development of an approach to assessing the degree of stakeholder interest, taking into account the differences between CCS and CCUS projects. To achieve this goal, the following tasks were solved: analysis of stakeholders of sequestration projects in the state-business-society system was carried out with development of a matrix reflecting the basic principles of their interaction and determination of their key incentives and restrictions on participation; detailed classification of stakeholders of sequestration projects in the state – business – society system is presented and their key interests are identified; the author's approach to assessing the degree of stakeholder interest in CCS and CCUS projects, based on the proposed matrix of «interest – indifference», is proposed; the degree of interest and stakeholder needs in the results of sequestration projects was assessed. The main research method was desk research, as well as general methods of scientific analysis (abstract-logical and comparative), methods of system analysis. In the framework of proposed approach to assessing the degree of stakeholder interest, we used developed model for dependence of the level of stakeholder confidence and possibility of influencing creation of project value over time, based on the concept of project life cycle and theory of stakeholders. To carry out assessment of interest and need, we used a checklist method with a list of closed questions, as well as matrix principles for stakeholder assessment based on theoretical approaches of project management in the field of stakeholder operating.

Discussion. *Stakeholders for carbon sequestration projects in the state – business – society system.* According to international experience in implementing carbon sequestration projects, role of

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the state, business and society in such projects is different, but each of these key stakeholder groups is especially important and has certain features that will be analyzed below.

In the countries that take an active position on this issue, it is generally recognized that government initiatives, legal and regulatory frameworks are crucial to ensure that these projects are implemented, geological storage of CO_2 is safe and efficient, natural resources are used productively, business took an active part in such initiatives, and society recognized this technology. Thus, the state is a key participant in activation of CCS projects.

Currently, CCS projects are in most cases focused on achieving only external effects – reducing CO_2 emissions, increasing the image of the countries on the world stage and business image, as well as creating indirect socio-economic effects, such as job creation, tax revenue, etc. Therefore, the role of business in these projects is special. For companies whose goal is getting profit, in implementing such projects it is important to have additional support from the state and external investors, which means that the state has such a function as generating business interest in such technology. In general, industry around the world is aware that in the modern world it is important business should be socially and environmentally responsible. Therefore, in the countries that implement carbon sequestration projects, business takes an active position, which is also facilitated by state policy in this direction (system of incentives and restrictions). It often happens that payments for carbon dioxide emissions exceed cost of gas sequestration, in such case business is forced to participate in sequestration projects. This can be illustrated by the experience of Norway, where a CO_2 tax has been introduced, and Canada, where fees are charged for exceeding emission limits.

Carbon sequestration projects, along with the other factors, depend on public perception and their support from society. According to international experience, this may be crucial for actual implementation of such projects. As an example of the influence of public opposition on implementation of CCS projects, we can cite the Schwartze Pumpe project, which is planned for implementation by «Vattenfall» (Germany) at a coal-fired power plant. Due to public opposition, as well as through targeted action by non-governmental organizations (NGOs), this project was rejected. The carbon sequestration project at the Greenville Ethanol Plant (USA), as well as the Dutch Barendrecht project to store 10 million tons of CO_2 from «ShellPernis» refinery, were also canceled as a result of resistance from local authorities and public.

The results of studies on this topic indicate that level of awareness of CO_2 sequestration technologies remains low, while it was proved that public acceptance of this technology is growing simultaneously with increase in the amount of information about it [17, 19, 22].

Based on the studies, a matrix was developed (Table 1), which reflects the main three groups of stakeholders, summarizes their key interests, and formulates suggestions for their possible interaction.

Interests of the state are largely aimed at achieving global goals in the long term. Interest of business is largely based on acquisition of commercial benefits and image enhancement, while the growth of environmental responsibility of business can significantly expand the very vision and understanding of environmentally-friendly projects, which will contribute to its more active participation in such initiatives. Interests of society are mainly determined by possibility of obtaining open information about the project and technology, which should be provided both by the state and by companies, as well as desire for sustainable socio-economic development of the regions.

In CCS and CCUS projects incentives, roles and interests of the state and business will differ (Table 2). In CCUS projects, an economic effect is possible. This becomes a key incentive for businesses to implement such projects and can significantly weaken role of the state. As for society, here we can assume that interests will be the same. Thus, when a project moves from one category to another, transformation of interaction system and roles of key stakeholder groups occurs, with the state playing a key role in CCS projects and business – in CCUS projects.

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Table 1

Basic principles of interaction between the state, business and society in CCS projects

Participants		Participants targeted by interaction mechanisms		
		State	Business	Society
Participants implementing interaction mechanisms	State	INTERESTS Improving the country's image on the world stage, safety of sequestration technologies, reducing negative impact on environment, fulfilling obligations to reduce emissions, modernization of industrial complexes, innovative-technological and socio-economic development of the country and regions, budget revenues from projects, implementation of projects within the framework of existing legislation	Creation of favorable institutional environment for implementation of CCS-projects (system of incentives and restrictions that form business interest in CCS-technologies). Direct financing of projects or significant financial support (at all stages from R&D stage to operation). Assistance in development of research centers based on business structures and R&D. Development of industry and regional strategies to support CCS projects. Promotion of environmentally responsible business. Issuance of permits, regulation of security issues	Carrying out active state policy aimed at creating educational tools, popularizing and shaping public perception of CCS technology. Contributing to acceleration of regions socio-economic development where CCS projects are being implemented. Public involvement in CCS projects. Account of initiatives proposed by company and interests of society as a whole. Informing on regulation of technology safety issues, monitoring storage facilities, issuing permits
	Business	Provision of financial and other resources for implementation of projects, directly implementation of projects (proactive or compelled). Responsible business and project implementation. Innovative and technological development. Search for new business areas of CO_2 utilization (R&D), cost reduction. Compliance with existing strategic environmental priorities. Promotion of CO_2 reduction in industrial environments	INTERESTS Achievement of business goals, technological development of business, sustainable development and socially responsible business, strengthening partnerships with business structures and scientific organizations, accumulation of experience in participating in CCS projects	Ensuring and guaranteeing the safety of production processes. Providing open data on the progress of the project. Conducting open events in the territories of presence. Guideline for maintaining traditional way of life. Promoting socio-economic and sustainable development of the region. Promoting popularization of CCS technology in society
	Society	Issuance of a «social activity license». Openness to positive opinion on CCS technology. Dissemination of «green» culture values. Support of current environmental policies. Media coverage of environmental issues. Participation in public hearings held by government agencies and companies. Perception of educational tools that increase confidence in technology		INTERESTS Safety of CO_2 sequestration technologies, lack of impact on economic activity, possibility of employment for the jobs created within the project, socio-economic development of the region, minimizing the negative impact on environment, transparency and accessibility of project information, an open dialogue with project initiators and participants

Since the main problems are economic aspects and safety issues, Table 3 presents recommendations for reducing the impact of this problematic aspect on development of CCS projects. It should be noted that economic problems, which are key constraints, can generally be eliminated or mitigated by finding new ways to use carbon dioxide, which will transfer the project into a commercial category. In this case, influence of existing state policy is weakened; commercial component is the key driver.

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Table 2

Key incentives and restrictions on CCS participation / acceptance

Stakeholder	Key limitations	Problematic field	Key incentives	
			in CCS projects	in CCUS projects
State	The need for significant funding to revitalize CCS development activities	Economy	Improving country's image on the world stage	
			Ecological effect	Innovative and technological development of production
Business	Lack of direct economic effect when implementing CCS projects	Economy	Improving image of a business	Opportunity to receive economic effect
			«Forced participation»	
Society	Lack of reliable CCS technology security information	Security	Ecological effect and development of the region	

Table 3

Recommendations for enhancing development of CCS projects

Recommendation	Potential effect
Economy	
Search for new ways to use carbon dioxide	Transfer of a project from CCS category to CCUS category with a change in principles of interaction between stakeholders and setting business's defining role
Security	
Development and implementation of educational tools at all levels of education	Potential public preparedness for carbon sequestration projects
Organization of information campaigns on CCS technologies in regions potentially suitable for project implementation	Increased awareness of sequestration technologies carbon dioxide in regions suitable for the implementation of projects
Involvement of the state in planning and implementation of the project, reputable universities, research centers, as well as independent organizations, experts and the public	Increased confidence in technology, involvedness in decision making

Stakeholder management in carbon sequestration projects. A fundamental element in building a system of interaction with stakeholders is deep analysis of external environment of the project with subsequent identification of the main stakeholders that can have both a positive impact on the project and a negative one. At the same time, given the dual nature of potential impact on the project by each stakeholder, the project team should strive to balance interests of key stakeholders in such a way as to extract as many positive effects as possible and minimize risks that arise when there are competing expectations.

Process of managing stakeholders in each case will be carried out by the project team, which, as a management entity, can be formed on the basis of a business structure, government structure, etc. depending on the type of project, its key goal, circle of initiators, etc.

It`s necessary to note the important feature of stakeholder governance in project management related to concept of a life cycle. So, degree of confidence of the stakeholder in the project increases as it approaches its completion, when the level of uncertainty decreases. At the same time, ability to influence the project value is maximum at initial stages, when concept of future asset is being formed. Accordingly, the formed project team should take a number of measures to enhance stakeholder interest in early stages of the project in order to maximize effectiveness of interaction with stakeholder in favor of creating additional project value (Fig.1).

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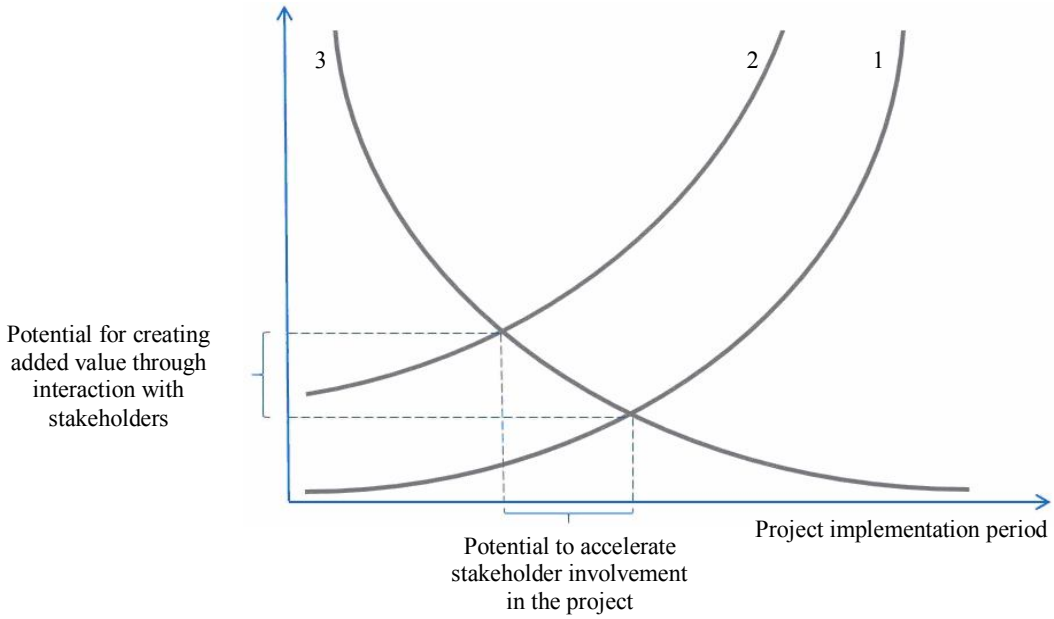


Fig.1. A model of dependence of stakeholder confidence level and possibility of influencing creation of project value over time

1 – stakeholder confidence level in the absence of stakeholder management procedures; 2 – level of potential confidence in appropriate procedures; 3 – possibility of influencing the increase in project value

In earlier studies [18], authors proposed an approach to stakeholder management in carbon sequestration projects based on the formed theoretical base in the field of stakeholder management. The author's approach included conceptual modeling of stakeholder management process, identifying the main stakeholder groups in such projects with their key roles and interests, as well as methodology for their quantitative assessment using checklist method.

However, in the course of further research, authors came to conclusion that (taking into account indicated features of carbon sequestration projects), stakeholder management system is specific, and the main incentive for implementation of CCS projects is stakeholder's interest. In addition, the degree of interest in CCS and CCUS project system will vary, due to the number of elements in production chain. In this regard, within the framework of this study, it is proposed to develop a more detailed classification of stakeholders in the state-business-society system, as well as to assess the degree of stakeholder interest in CCS projects through proposed matrix of «interest – indifference».

A unified list of stakeholders for CCS projects does not exist, since it will be individual for each specific company, region, type and size of the project. Figure 2 shows a circle of possible stakeholders (potentially identified and grouped according to the principle of state – business – society) during implementation of CO_2 sequestration projects, as well as their key interests.

Stakeholder interest is a specific category that encourages him to take part in implementation of the project. At the same time, the level of motivation for successful implementation of project largely depends on derivative interest – the need for project results. This article proposes a new tool for assessing stakeholders – the matrix of «interest – indifference», which, depending on the level of interest and the need for project results, determines vector of their potential participation (Fig.3). It is assumed that the higher values of these parameters are, the greater value for a given stakeholder can create for a project, which means that attention should be focused precisely on these stakeholders.

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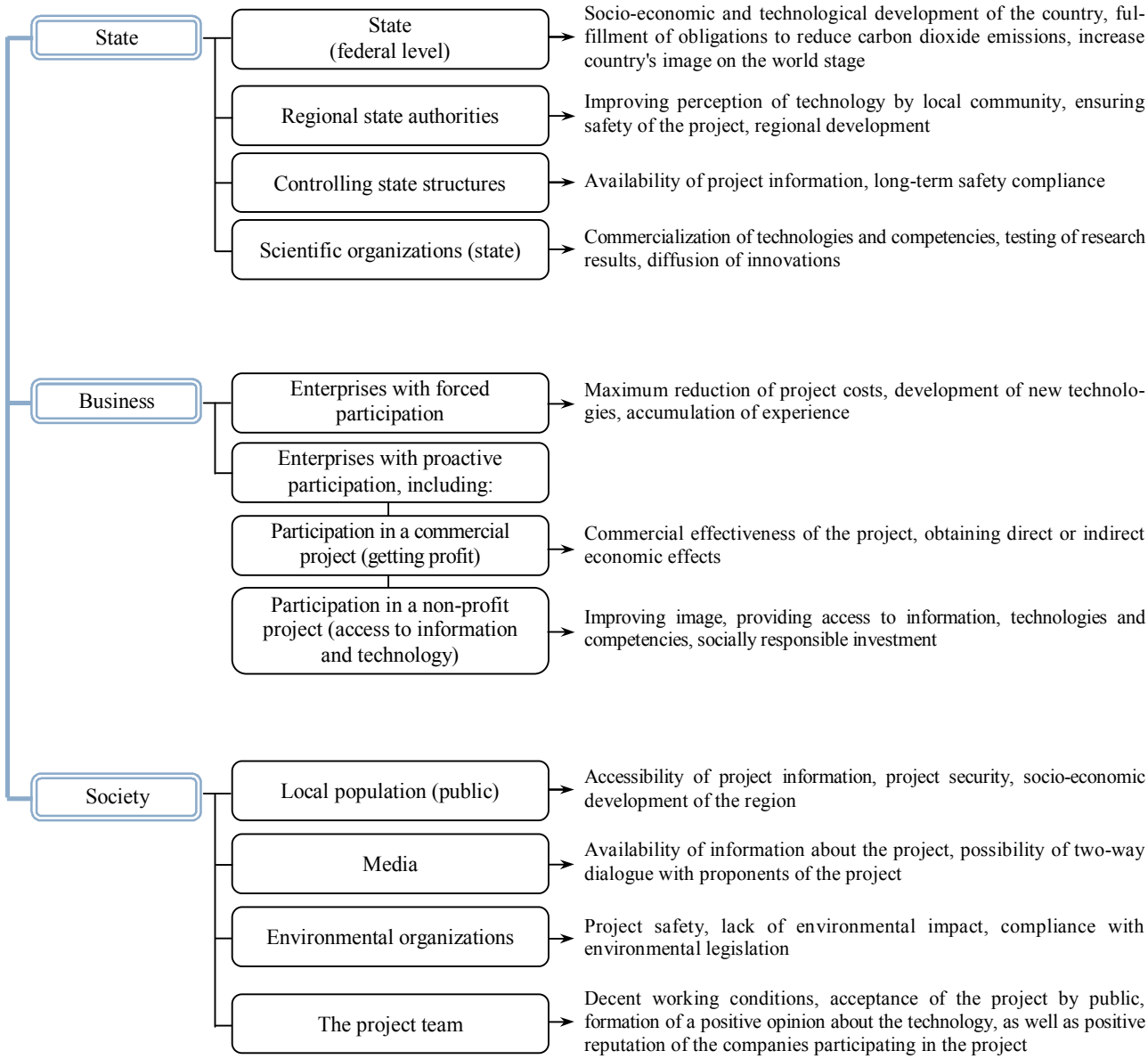


Fig.2. The main groups of stakeholders of CCS / CCUS projects and their key interests

To assess the degree of interest and stakeholder needs in the results of sequestration projects, it is proposed to use checklist method with a list of closed questions (Table 4). It is assumed that for each positive answer one point is assigned. Total score determines total value of each of the parameters. Each question on assessment of interest corresponds to a particular area of interest, presented in Table 4.

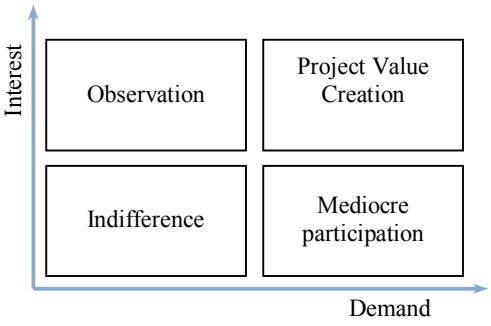


Fig.3. Author Matrix
«Interest – Indifference Stakeholder»

The results of analysis (Fig.4) indicate that state (federal level) has the highest degree of interest in CO_2 sequestration projects, due to ability of such projects to realize all the main interests of the state presented to projects. Controlling structures, the media, and members of project teams whose interest is primarily due to revenue generation have a low degree of interest. Attention should be paid to the differences in distribution of the degree of interest between CCS and CCUS projects: in the latter, business expects to receive commer-

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cial effects, as well as a positive impact on related projects, for example, an increase in oil recovery when CO_2 is injected into the reservoir.

Table 4

Checklist for quantifying interest

Questions	Area of interest
Interest rating	
1. What is direct commercial interest in the project (income generation)?	Commercial
2. What is social and public interest in the project (job creation, improving living standards, socially responsible investment)?	Socio-social
3. What is infrastructure interest in the project (development of infrastructure framework in the region)?	Infrastructural
4. What is strategic interest in the project (impact of the project on other projects)?	Стратегический
5. What is innovative and technological interest in the project (development and implementation of new technologies, accumulation of experience)?	Innovative technological
6. What is environmental interest in the project (CO_2 reduction)?	Ecological
7. What is image interest in the project?	Image
Needs assessment	
1. Is this project the only way to obtain the main benefits (realization of interests) in current future?	
2. Does the stakeholder need to accelerate launch of this project (for example, challenge from production activities)?	
3. Does stakeholder's interest in the project depend on the place of its main implementation?	

Results of the analysis are important in the context of distribution of interest areas (Fig.5). So, stakeholders of sequestration projects primarily expect commercial benefits and social development of the region of presence.

High demand for project results is noted among regional authorities and local population, since implementation of large projects significantly affects regional development, as well as business, as new areas of activity are associated with new development opportunities and synergies for existing assets. Low demand is observed among controlling structures, the media, and environmental organizations – the result of project will not have a strong influence on these stakeholder groups, as well as on federal authorities whose interests can be satisfied by another large-scale project.

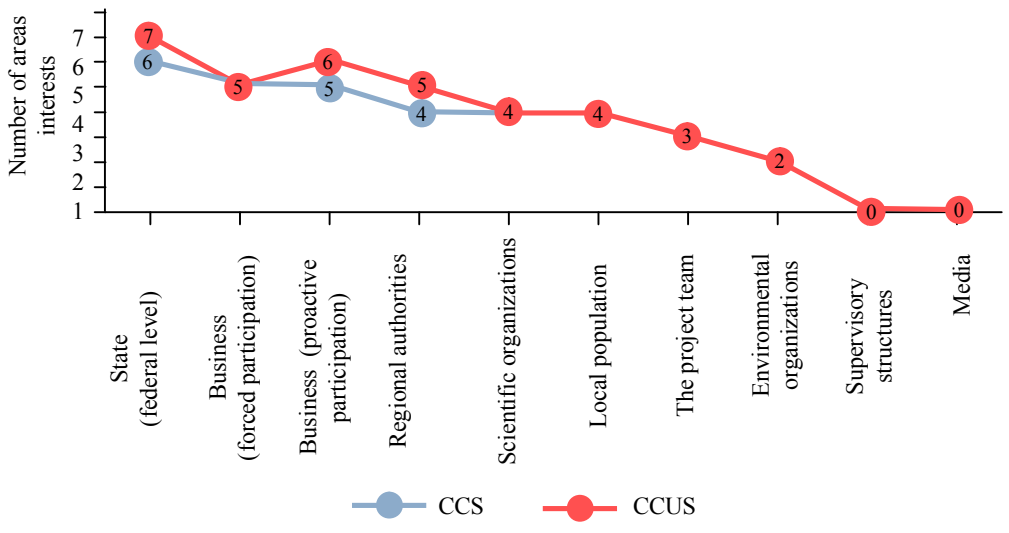


Fig.4. Quantitative assessment of stakeholder interest in CCS / CCUS projects

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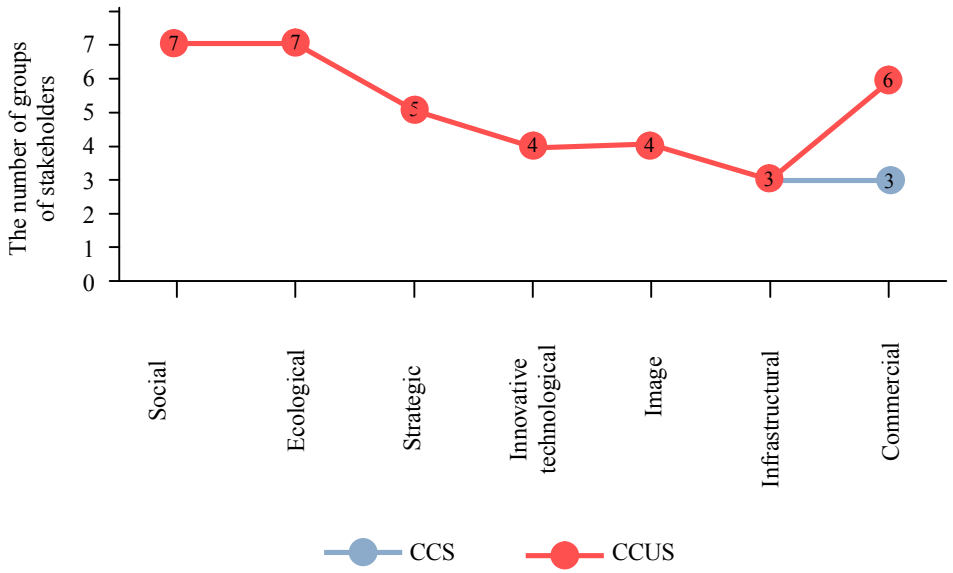


Fig.5. Analysis of distribution of stakeholder interest groups in CCS / CCUS projects

Figure 6 shows distribution of stakeholder groups of sequestration projects in accordance with their levels of interest and need for project results. Therefore, it is impractical to involve controlling structures, media and environmental organizations in the project, whose interest is limited mainly by their specialization. State bodies of federal importance are of high interest, but prioritization of a particular sequestration project at the state level may be low, therefore, their participation will be reduced to active monitoring. The project team is dependent on the results of project, which it is involved in, but since its interest comes mainly to obtaining commercial benefits, its degree of interest is assessed as low. Therefore, this category of stakeholders takes an active part in the project, but vector of its actions is directed towards the realization of mainly economic interests. Regional authorities, scientific organizations, business and local population have the same high interest and need to implement a specific sequestration project, which means that interaction with this particular category of interested parties will provide the greatest number of benefits, since their interests affect not only internal commercial results, but also consequences of the project in external environment.

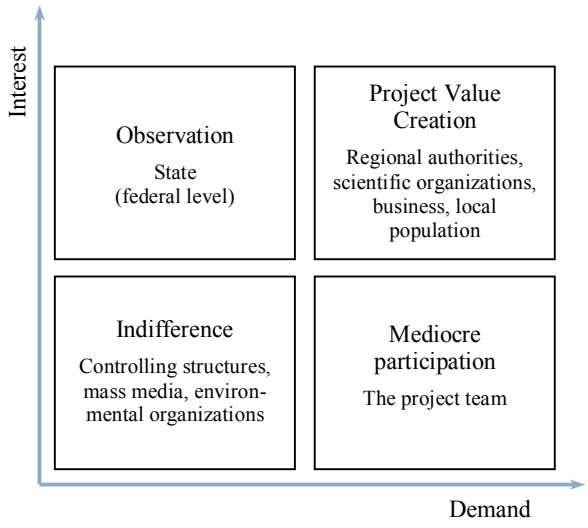


Fig.6. Classification of sequestration projects stakeholders by areas of their potential participation

Conclusion. Thus, we can conclude that development of sequestration projects requires systematic actions in this direction with direct participation of business, government, science and society. The specifics of each particular project determines the key role of a particular stakeholder – initiator of the project (business or government), and to a greater extent this depends on the presence of a commercial component in such projects, as well as government regulation measures that can be aimed at forced business participation in CCS and CCUS projects.

In general, development of sequestration technologies requires the following basic steps: 1) recognition and dissemination of environmental

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values by state, business and society on a national scale; 2) direct financing by the state and creation of necessary institutional conditions for development of CCS technologies (state programs for support and popularization of technologies); 3) increase of business interest in CCS projects (search for new business opportunities, active R&D, formation of a carbon market, state co-financing of projects).

In Russia, there are no existing carbon sequestration projects, but there is a rather serious potential for their implementation. State policy in this direction, despite Russia's readiness to participate in global efforts to reduce greenhouse gas emissions, is still fragmented. Russian business is beginning to recognize the importance of such events, but so far, no concrete actions have been taken in this direction. The results of foreign studies show that level of public awareness of advantages of technology in foreign countries (even those that implement CCS projects) remains low. As for Russia, such studies have not been conducted within the country, but it can be assumed that the level of awareness is extremely low, it entails a number of concerns regarding Russian projects planned for implementation.

The system of effective interaction with environment of CCS-project is an important element in its management throughout entire life cycle. The circle of stakeholders in CO_2 sequestration projects is quite wide; their identification and forecasting of expectations is a complex task. Stakeholders can influence the value of the project; therefore, initiators face the task of developing a strategy for involving stakeholders in the very early stages, when a general project concept is created. In this study, using authoring tools, the main groups of stakeholders have been identified, participation of which will bring the project additional benefits associated with implementation of external effects.

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