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Stakeholder Management: An Approach in CCS Projects

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Abstract: Currently, a prime position in the global emission mitigation and power transformation system is taken up by CCS technology (carbon capture and storage), proven by the successful realization of a number of CCS projects around the world, not only for CO_2 storage, but also for its deployment in industry. CO_2-utilizing technologies are circular business models connected with the usage of emissions to provide added benefits throughout the value chain, with their value being part of a response to end the era of cheap mineral resources and materials, as well as their ability to contribute to the transition to a low carbon economy. At the same time, one of the main problems they face lies in the engagement and interaction of stakeholders, as well as public perception of these projects. The purpose of this research is to explore the main stakeholder groups in CCS projects and offer an approach for their management. The methodology of this study is based on case studies, stakeholder management tools, and a checklist method, which were adapted to the specific area of CCS projects. The results of this study amounted to the identification of stakeholder groups with interests and respective roles in CCS projects, as well as proposing a new approach for their assessment through the created checklist method.

Keywords: carbon dioxide; emission; capture and storage; CCS projects; stakeholders; public perception; circular economy; circular business model; checklist method; stakeholder assessment

1. Introduction

The concentration of carbon dioxide (CO_2) in the atmosphere surpassed the 410 ppm mark (parts per million—CO_2 particles on one million particles of air) in June, 2018 [1], and by the end of this century, it is expected to double [2].

The problems of greenhouse gas emissions leading to global climate change are of immediate interest. In 1988, under the aegis of the United Nations Environment Programme (UNEP, United Nations) and the World Meteorological Organization (WMO) for the assessment of risks of global warming, the Intergovernmental Panel on Climate Change (IPCC) was established, and in 1992, the Framework Convention on Climate Change (FCCC, United Nations) was adopted. In addition to the FCCC, the Kyoto Protocol came into force in 2005. This document ensured that each country would ratify certain quotas for their greenhouse emissions. In 2015, the Paris Agreement, which deals with greenhouse gas emissions mitigation, was signed.

Russia is one of the largest sources of greenhouse gas emission in the world; however, it holds a leading position for rates of emission reduction as well [3,4]. Russia's share of global CO_2 emissions was 4.7% in 2016 [5].

In 2013, Russia approved a national purpose to decrease greenhouse gas emission by 2020 to the level of 75% (as compared to 1990) [6]. According to expert opinions, Russia can play a key role in the implementation of international programs for global warming prevention [7].

Despite the steady growth of solar and wind power, a competitive alternative to traditional technologies of combustion of hydrocarbons doesn't exist. At the same time, reduction of energy consumption and deep re-engineering of power industry are long-term, capital- and knowledge-intensive activities, which do not solve the climate change problem [8].

One of the promising ways of reducing greenhouse gas emission is through Carbon Capture and Storage technologies (CCS) [9]. They are estimated to be crucial for the control of temperature growth on the planet—up to 1.5–2 °C by 2050 [2]. According to expert opinion, we face an unprecedented challenge in achieving climate objectives. Without CCS, this challenge becomes infinitely greater [10].

The CCS technological chain includes the separation of CO_2 from the gas stream formed in industrial and power sources (capture), its compression, transportation, and injection into geological formations for long-term storage [11]. As geological formations desalt and saline is formed, depleted oil and gas reservoirs, and undeveloped coal layers can be used. Additionally, CO_2 injection can be directed both to storage, and to increase fluid recovery [12]. CCS projects can be integrated to include a full technological cycle "capture-transportation-injection", but can also be based on separate processes of the CCS technological chain (Figure 1).

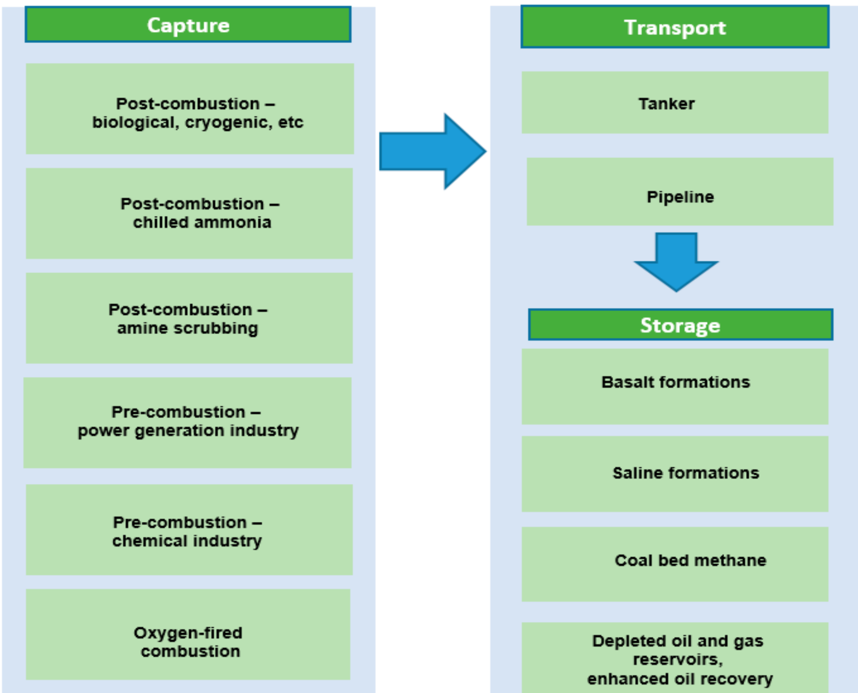

Figure 1. CCS technological chain.

Despite the novelty of this technology, there are a number of successful pilot CCS projects around the world (mostly in the U.S. and Canada, as well as in Australia, Germany, Norway, Algeria, Brazil, etc.). In 2017, there existed more than 20 largescale integrated CCS projects in the world, which are in operation or under construction [10].

Today CCS projects are being implemented in the oil and gas industry, coal industry, steel production, gas processing, etc. A promising direction for CCS technology usage is the cement industry [13]. Besides industrial CCS projects, there are a number of R&D projects aimed at technological development and search for new modes of use of CCS technology. No CCS projects are currently running in Russia; however, according to experts, it has a huge potential for CO_2 storage and increased oil and gas recovery [14].

CO_2-enhanced oil recovery (CO_2-EOR) has emerged as a major option for productively utilizing CO_2 emissions [15]. The majority of projects in the world associated with CO_2-EOR opportunities are operated by state-owned enterprises (for instance, the CO_2-EOR projects operated by Statoil, Norway's government-owned oil company, or PetroChina, a Chinese oil and gas company and the listed arm of state-owned China National Petroleum Corporation).

Many countries display a growing diversity in their CO_2 utilizing project portfolios, with pioneering new applications of CCS (in power generation, oil sands processing, bioethanol production, etc.) as well as developing dedicated CO_2 storage [10]. In this case, when CO_2 is used for any purpose (not only for storage), these projects are called CCUS (Carbon Capture, Utilization and Storage).

Thus, CO_2 utilizing technologies are circular business models connected with the usage of emissions for providing added benefits throughout the value chain. The introduction of circular business models in general leads to significant ecological, economic and social benefits [16]. CCS is principally an emissions mitigation technology, but it also has the ability to contribute to broader energy security, environmental, societal and economic goals [10,17,18].

Some experts claim that the circular economy is a coherent model that has value as part of a response to the end of the era of cheap mineral resources and materials, and can contribute to the transition to a low carbon economy. It has been proven that circular economy strategies may deliver emissions reductions that could basically bridge the gap of proclaimed emission mitigation [19]. A more circular economy can cut emissions from heavy industry by 56% by 2050 (circular scenario in comparison with baseline scenario) [20].

CCS projects directly support circular economy strategies and now are usually referred to as CCUS projects (not only the geological storage of CO_2, but also its utilization). In the latter, circular business models are being formed. The most widespread option of CO_2 utilization now is EOR-CO_2 technologies, as mentioned above. Besides, according to the last research of ICEF (Innovation for Cool Earth Forum) [21], it is possible to recycle CO_2 into useful products. This report identifies pathways to achieve this in cements, chemicals, and durable carbon materials.

However, the effective development of such projects depends not only on the technological and economic aspects, but also on the perception and support of such projects by the society and all of the stakeholders. In general, the transition to circular economy strategies can only be achieved when all stakeholders—individuals, the private sector, government and civil society—collaborate [22].

According to international experience, public perception can be crucial for implementation of CCS projects [23,24]. For example, a research conducted in Germany demonstrates that public perception of CCS technologies is the second barrier after economic aspects to its launch [25].

For instance, the Schwartze Pumpe project, planned to realization by the Vattenfall Company in Germany, and intended for the annual capture and storage of up to 100 thousand tons of CO_2 at the coal power plant, illustrates an example of how the public can exert influence on a project. Despite positive environmental impacts of the project, the public was concerned with the possible CO_2 leakage that would be dangerous for public health. For this reason and because of the active policy of non-governmental organizations (NGO), the project was rejected. Another example is the cancelled CCS project at the ethanol production plant in Greenville, U.S. The main cause for the project rejection was concerns by its municipality and society regarding the injection of CO_2 in geological formations, as this could provoke seismic activity. A third example is the Dutch Barendrecht project, which planned on storing 10 million tons of CO_2 from the Shell Pernis oil refinery. It was ultimately cancelled due to the delay with permissions for the project implementation as well as resistance from local officials and society. Experts argue that in Barendrecht, the National Government and Shell company mainly viewed the CCS project from a technological and economic point of view, whereas the city's municipality mainly adopted a social and local perspective. Under these circumstances, it is recommended that a stakeholder dialogue include all the different perspectives of the problem with participation in permitting procedures or policy-making [24].

As evidenced by the aforementioned cases as well as several other cases throughout the world, public perception and opinion can prove to be crucial factors for the realization of CCS projects. A critical problem is that awareness of CCS technology in the society is very low, especially in aspects pertaining to socio-economic, health, and safety consequences of such projects [24].

These projects are currently associated with a number of controversial issues from the public with regards to their influence on the health and safety of the local population and on the environment, about the risk level of such projects, and consequences of the projects which are not connected directly with CCS technologies (for instance, seismic activity). The greatest concerns arise with regard to CO_2 storage stage. For example, organizations such as Greenpeace and WWF consider that CCS technologies interfere with a more active usage of renewable power sources, which hence warrants a full investigation on the safety and potential hazards surrounding these projects. Thus, any largescale CCS project has to be initiated, developed and implemented within the constructive dialogue of all of the project's environment (stakeholders). Each stage of the project is faced with the problem of securing public confidence for this technology [26].

Research conducted on this subject proved that the degree of awareness of CCS technologies remains low, emphasizing the need for CCS projects to interact with the external environment [27]. At the same time, it was demonstrated that the recognition of this technology by the society grows with an increase in information about it [28]. Based on the above, it is possible to conclude that the management system of stakeholders during the planning and implementation of CCS projects is a pivotal issue.

The concept of stakeholder management, originally developed for the strategic management field at the end of the last century, is a key knowledge field in project management today. At the same time, the influence of stakeholders on the success of a project is higher than that if the company's management, as economic activity in projects is more intensive [29], the projects' environment is new, and it is necessary to coordinate the project's interfaces in contrast to debugged interfaces in management of the company.

A stakeholder is defined as a person, group or organization that has an interest or concern in an organization [30]. In project management, stakeholders can affect or be affected by the projects' actions, decisions, or results [31]. The main idea behind stakeholder management is that the results of the project have to be estimated from the point of view of satisfaction of each stakeholder.

R. Edward Freeman originally developed the stakeholder theory for management. His book identifies the stakeholder groups of a corporation and describes a set of methods by which management can give due regard to the interests of those groups [32,33]. Freeman claimed that the optimization of management process requires a clear understanding and allocation of groups of people capable of influencing the business or a separate project [33].

Nowadays, a number of approaches exist for stakeholders' classification and management. A. Mendelow offers an analysis of stakeholders depending on their interests and power through the power-interest matrix [34]. Another approach is R. Mitchell's typology, which is based on three factors: legitimacy, importance and urgency. The first factor denotes the legal legitimacy to giving instructions, the second refers to the force of influence of stakeholder on the company (project), while the third designates minimum necessary speed of response to inquiries of the stakeholder [35].

According to modern expert opinion, the most popular classification models are the combination of the following defining stakeholder attributes: power, interest, influence, impact, urgency, and legitimacy [31–36].

Grant T. Savage not only classifies stakeholders by categories, but also offers strategies for interacting with them as well (collaborate, involve, defend, monitor). A similar approach is present in the PMBoK guide (Project Management Body of Knowledge), where standard strategies consist of the following: "keep satisfied", "manage closely", "monitor", "keep informed".

As for CCS projects, the problem of interaction of stakeholders is also under discussion among scientists. The importance of the social perception of CCS technology is discussed by Christopher R. Jones and others [37]. Their research is based on experts' interviews of stakeholders in Germany and Great Britain. The authors segment potential stakeholders into three groups, according to the "Triangle of Social Acceptance" offered by Wüstenhagen and others [38]. The "triangle" framework proposes that the social acceptance of policy and technology innovation is determined by the opinions and actions of stakeholders operating on three dimensions of acceptance: socio-political, market, and community. According to the authors [38], socio-political acceptance refers to the broad acceptance of technologies at the most general level by major social groups (industry decision-makers, national, and international policy-makers, public etc.); on the other hand, market acceptance is more specific and integrates considerations of the diffusion of technology among consumers and the investment decisions (investors, industry, etc.), while community acceptance consists of the acceptance of specific projects at a local level by stakeholders (municipality, local public, etc.). As a result of their research, the authors concluded that it is necessary to specify the main stakeholders and conduct a deep analysis of their expectations and fears.

The regional aspect of awareness of the public on CCS technologies' advantages and their acceptance was investigated by Manfred Fischedick and others, Rumika Chaudhry and others, and also by the experts of ASG (Alliance for Global Sustainability) [25,26,39]. As the basis of their research, they resorted to expert interviews; in particular, they interviewed stakeholders in Germany, U.S. and Sweden. The study conducted in Germany demonstrates the neutral or positive attitude towards CCS technology from the state and industry; however, ecological organizations reject this technology. A research undertaken in four states of the U.S. confirms the presence of considerable fears among the main stakeholders, as the level of awareness of CCS technology in that country remains low in general. A research in Sweden established that positive expectations from CCS technologies and public awareness are higher there than in the U.S. and Great Britain. Despite having interviewed representatives of different countries, they could not mark out the essential differences in public acceptance of the technology, as the interviews were carried out in different periods of time and on the basis of various selections. However, the research proved that the problem of increase in public awareness on CCS technology is reflected at an international scale. A similar research in the Netherlands [40] showed that the public is not aware of CCS technology in general. Other studies from the countries such as the U.S., the U.K., Sweden, Japan, Australia and Canada exhibited similar results [41–43].

Recommendations on the creation of interaction strategy with various stakeholders are presented in publications of the Bellona international ecological association, where they prove the need for integrating of technological and social procedures in CCS projects [44]. The features of communications with stakeholders and the main barriers have been analyzed by World Resources Institute (WRI), which developed a guideline on stakeholder management in CCS projects [45].

Considering the differences in approaches to stakeholder's identification, classification and management, the present study justifies the specified and expanded method of stakeholder classification and management in CCS projects with specification of stakeholder groups and creation of method for their quantitative assessment. The development of an interaction system between main stakeholders can be crucial for the implementation of these projects. One of the goals of the current study was to learn more about the stakeholders in these projects and to prescribe recommendations for their management.

2. Materials and Methods

The task was approached by first identifying the main stakeholders of CCS projects that can influence the prospects for their implementation, as well as their main critical topics and interests, and second by applying the checklist method based on drawing up a list of the questions to estimate the extent of the influence and importance of various groups of stakeholders in such projects. Key research methods include desk studies, elements of benchmarking, stakeholder management tools (such as stakeholder matrix and stakeholder analysis), and the aforementioned checklist method. We resort to the classic checklist method and create a list of questions to conduct a quantitative assessment of the stakeholders, then propose a matrix of stakeholders in CCS projects. Crucially, as these projects could be very specific, we provide general recommendations, which can enable increasing the efficiency of stakeholder's management in CCS projects.

A desk study was carried out as a preliminary study to provide an initial understanding of the subject and situation around CCS projects in the world, to highlight the main problems in their initiation and implementation, and to inform the detail, scope and methodology of subsequent research. As a result of this part of the investigation, a list of stakeholders in CCS projects and their crucial topics is presented, as well as identifying key stakeholders with their interests and expectations in CCS projects, and their potential contribution.

Our research employs the widely recognized PMBoK guide, which addresses the stakeholder management of the projects, as a methodological base. The processes of stakeholder management in CCS projects are created based on the PMBoK guide algorithm:

1. Identify Stakeholders
2. Plan Stakeholder Engagement
3. Manage Stakeholder Engagement
4. Monitor Stakeholder Engagement [31]

One of the main results of this paper consists of suggesting an approach to assess the groups of stakeholders through a created checklist, in order to identify their influence on and importance to these projects. The checklist was first produced according to the Challenge-And-Response method. Based on the conducted desk study, a list of the questions related to the importance or influence of the stakeholders was generated. Then, the main identified groups of stakeholders were assessed through this checklist, alongside justifications of our assessments.

In establishing the matrix of stakeholders in CCS projects to validate the obtained results, the adopted approach was also provided by the PMBoK guide. The stakeholder matrix is a simple, but highly effective tool for analyzing the stakeholders. A matrix is drawn and split into four quadrants. The stakeholders are analyzed through the created checklists and plotted on the graph. A common way to approach this task consists of plotting the stakeholder by importance on one axis and influence on the other axis with standard strategies consisting of: "keep satisfied", "manage closely", "monitor", "keep informed" [31].

3. Results and Discussion

In Figure 2, the processes of stakeholder management in CCS projects are specified and expanded, but they are isolated in the general cycle of "Identify-Plan-Manage-Monitor" as well. Since CCS projects possess a number of features (in particular, their high dependence of success on public acceptance), this prompts a proceeding dialogue with the external environment of the projects during all of its life cycle, and constant improvement of the stakeholder management system. At first sight, stakeholder management does not seem to be an important aspect in the implementation of such technical projects. However, we believe that these projects are especially difficult from organizational and managerial points of view.

The processes of stakeholder management should be based on a deep analysis of the environment of the project with identification of crucial external and internal stakeholders.

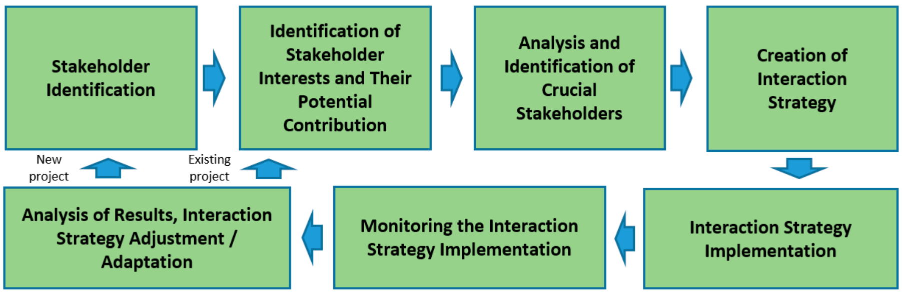

Figure 2. Processes of stakeholder management in CCS projects.

A consolidated list of stakeholders in CCS projects does not exist, as it is specific for each project, and the number of stakeholders may vary during the project's lifespan. As a result of analysis of CCS projects' implementation worldwide, coupled with findings from literature review, a list of stakeholders in CCS projects and their crucial topics are presented in Figure 3.

Figure 3. Stakeholder groups in CCS projects and their crucial topics.

Crucial stakeholder topics in CCS projects are the basis for understanding the key expectations and interests of the stakeholder groups, as well as their possible contribution to the development of these projects.

We obtained project background information and attempted to identify key stakeholders as well as their interests and expectations in the CCS projects and their potential contribution to the projects (Table 1).

Table 1. Main stakeholders in CCS projects, their interests and potential contribution to the projects.

Stakeholder Groups	Key Expectations and Interests	Potential Contribution to the Project
Policymakers (state level)	Safety of CCS technologies, reducing the negative impact on the environment, fulfilling responsibility to reduce CO_2 emissions, modernizing equipment of industrial enterprises, technological and socio-economic development, improving the country's positions on the global area, budget revenues from the projects	Financial support of the projects, opportunities for lobbying, additional measures to stimulate emission reduction and development of CCS technologies based on cooperation with research centers, promoting projects implementation for socio-economic development of the regions and the country as a whole
Policymakers (municipality level)	Safety of CCS technologies, reducing the negative impact on the environment, increasing the investment attractiveness of the region, socio-economic development, budget revenues from the projects	Implementation of public–private partnership (PPP) mechanisms, opportunities for lobbying
Investors and financial institutions	Sustainable development and socially responsible investment, the creation and strengthening of partnerships with companies participating in the projects, diversification of the projects portfolio, the accumulation of experience in participating in CCS projects	Providing financial and other resources for project implementation
Industry (emitters and participants of the technological chain)	Achieving the goals of the projects, projects implementation in accordance with the terms and budgets, the technological development of the companies, increasing the investment attractiveness of the business	Full responsibility for the implementation of the projects, promoting the popularization of CCS technologies in industry

Table 1. *Cont.*

Stakeholder Groups	Key Expectations and Interests	Potential Contribution to the Project
Technology suppliers	Buoyant demand for CCS technology	Key impact on project costs (capital and operating)
Local public	Safety of CCS technologies, employment opportunities, socio-economic development of the region, preservation of the traditional lifestyle	Staffing, the ability to purchase local goods and services, "social license to operate"
Non-governmental environmental organizations (NGO)	Safety and evidence-based feasibility of CCS technologies, environmental compliance during the project implementation, minimizing the negative impact on ecosystems	Opportunities for lobbying due to the authority of a number of NGOs among the public
Media	Transparency and availability of information on projects, open dialogue with project participants	A communication tool, promoting a positive opinion about CCS technology in society, as well as a positive reputation of operating companies
Controlling organizations	Reliability and regularity of provided data on projects, implementation of projects in the framework of current legislation	Favorable institutional conditions for conducting work on the project
Project teams	Social responsibility of operating companies, high wages, decent working conditions, opportunities for professional development	The main influence on the achievement of project objectives and indicators of their effectiveness
Suppliers and contractors	Long-term contracts and stability of interaction	The main impact on the performance of projects in terms of cost, time and quality

The influence yielded by the stakeholders on the project can be classified as either positive or negative. It is possible to create more positive influence by understanding their interests and expectations better. The creation of mutually beneficial relations with stakeholders allows gaining considerable opportunities for project development, just as ignoring them can promote the emergence of additional risks.

For a quantitative assessment of the stakeholders, a checklist method is offered, which is based on drawing up a list of the questions to gauge the extent of the influence (the strength of the stakeholder in the project's management) and importance (the stakeholder's contribution to the project development) of various groups of stakeholders. This checklist is presented in Table 2.

Table 2. Checklist for quantitative analysis of CCS projects' stakeholders.

Impact Assessment Questions (1)	Importance Assessment Questions (2)
(1) Can this stakeholder influence the financing of the project? (1.1)	(1) Do the knowledge and level of education of this stakeholder affect the resulting project performance? (2.1)
(2) Can this stakeholder influence the project timeline? (1.2)	(2) Can this stakeholder contribute to the technological development of the project? (2.2)
(3) Can this stakeholder influence the choice of location? (1.3)	(3) Can this stakeholder contribute to the formation of an opinion about the project in the external environment? (2.3)
(4) Can this stakeholder influence the creation of a favorable institutional environment? (1.4)	(4) Can this stakeholder contribute to the staffing, product and service supply of the project? (excluding financial and technological resources) (2.4)
(5) Can this stakeholder completely stop the project? (1.5)	(5) Are representatives of this category of stakeholders replaceable? (assessment of category flexibility) (2.5)

One of the most widespread tools for stakeholder assessment is expert assessment. Within this research, no specific CCS project is investigated; instead, there exists a complexity with the choice of the group of experts and receiving relevant assessments. In this regard, the checklist method is applied to carry out the assessments. In further research, we intend on expanding and developing an evaluating technique with the use of new methods and approaches.

Based on the proposed checklist, each group of stakeholders is assessed, with the answer "yes" corresponding to 1 and "no" to 0. The results of the analysis are presented in Appendix A.

On the basis of the analysis, the matrix of the influence and importance of stakeholders in CCS projects is presented in Figure 4.

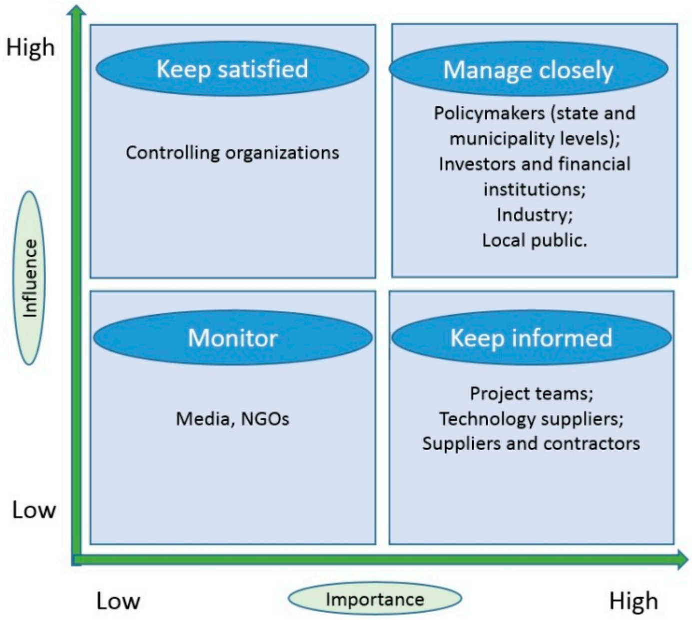

Figure 4. Stakeholder matrix in CCS projects.

The main objective of stakeholder management is acquiring maximum benefits from interacting with the external environment of the project at simultaneous decreasing of the risks. The results of the quantitative analysis of stakeholders proved that the greatest attention during the planning and implementation of CCS projects ought to be concentrated on businesses (the industrial companies and investors), the government, and society.

We assume that the conducted research allowed us to look at implementing more technical CCS projects from a managerial point of view. However, we recognize that the offered approach for the management of stakeholders in CCS projects is more general than specific, and has to be adapted for particular projects and circumstances. We tried to delineate the specifics of implementing the CCS projects, their features, and realization problems and also to prove the importance of stakeholder management in the CCS system. However, the results pertaining to this research are not universal and may vary in connection with different factors, such as the type of the project (CCS or CCUS), the country and region in which the project is implemented, government policies (in some cases such projects can be forced), clearly stated conditions of project implementation, etc.

The success of CCS projects in many respects depends on effective stakeholder management and the possibilities to balance their interests and expectations. Various stakeholders could have rival expectations, which can create conflicts in the project. The CCS projects usually act as local projects; however, they are implemented in the context of national and even international interests. This implies that the circle of stakeholders is rather wide, and establishing a constructive dialogue with all of them proves to be a rather difficult task. The list of general recommendations is displayed in Figure 5.

The implementation of CCS projects demands considerable investments; nonetheless, these projects are not commercially effective alone. They are focused majorly on its external impact, such as the decrease in greenhouse gas emission, increase in energy efficiency and the indirect social and economic benefits generated, such as new jobs, tax revenue, etc. For this reason, financial and any other support from the state and external investors is mandatory for such projects, which should thus be attractive in addition to creating trust in its technology.

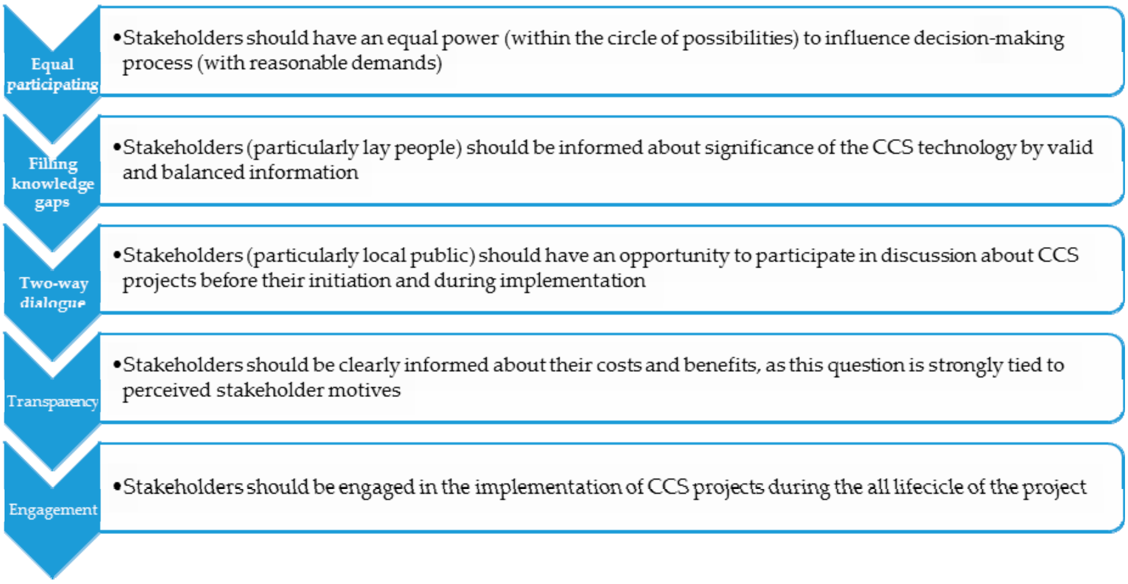

Figure 5. General recommendations for stakeholder management in CCS projects.

In this paper, we tried to model the processes of stakeholder management in CCS projects based on the PMBoK methodology and to suggest an approach to assess the groups of stakeholders through a created checklist, in order to identify their influence and importance to CCS projects. We assume that our approach to stakeholder management and assessment in CCS projects is quite general and demands adaptation and approbation on specific CCS projects and situations. We offer a comprehensive list of the stakeholders who can participate in CCS projects, but this does not necessarily imply that they will always be present in the projects. Many projects around the world are implemented by governments and are not commercial; thus, the key stakeholders in this case are the government, the scientific organization (or university), the plant that produces CO_2, and the local community. We suppose that in our further research, we will narrow down the list of stakeholders for more specific projects and will investigate their assessment more carefully for various situations.

4. Conclusions

Considering the differences in approaches to stakeholder management, we presented an approach to stakeholder classification and management in CCS projects with the specification of stakeholder groups and creation of methods for their quantitative assessment. As directions for further research, we plan to specify the main stakeholder groups in CCS and CCUS projects (depending on the specifics and goals of the projects), their interests and contributions to the projects, as well as develop an approach to stakeholder assessment to get more reasonable results. At the same time, we plan to reveal the features of implementation of these projects in Russia, and, as a result, the peculiarities of stakeholder management in CCS projects in Russia.

In Russia, there are strongly pronounced specifics in possible implementation of CCS projects. The vast territories of the country permit the storage of CO_2 at a considerable distance from industrial centers and residential areas that can potentially weaken stakeholder counteraction to the projects. A considerable impact on the CCS projects implementation in Russia is the extent of industrial development of the region and population density; for example, the Republic of Tatarstan and certain regions of Western Siberia that have depleted oil fields. The level of stakeholder influence and the number of stakeholder groups in such developed industrial regions will obviously be more than in the remote areas of Western Siberia. In this regard, the system of stakeholder management varies and this will be one of the directions for further relevant research.

CCS projects, when taken into isolation, are not generally commercially effective, as their successful implementation requires suitable partnerships, government support, and relevant legal framework. However, CCS technology is not only directed at obtaining ecological effects, but also at increasing energy efficiency and promoting social and economic development for the regions where the project is being implemented. It is possible to emphasize the five key advantages of CCS industrial projects:

(1) Decrease in negative impact on the environment
(2) Contribution to the socio-economic development of the regions and territories
(3) Attractive direction for socially responsible investments
(4) Assistance to sustainable development of the companies participating in the CCS projects
(5) Usage of CO_2 for purposes such as enhancing oil recovery by oil and gas enterprises, increase in energy efficiency of industrial enterprises, etc.

The last advantage represents an example of the circular business models that are of special interest in modern conditions. Switching from the current linear model of economy to a circular one has recently attracted increasing attention from many industries around the world, due to the huge financial, social, and environmental benefits associated with the latter [46].

One of the key issues in CCS project implementation lies in their perception by the public, as stakeholder groups can exert a strong influence on the project. Low levels of public awareness of CCS technology can cause a number of risks toward new projects.

The creation of a stakeholder management system is a crucial part of the initiation, planning, and implementation of CCS projects.

Prior to initiating these projects, a reasonable strategy for stakeholder management must be formulated, requiring the identification and careful analysis of key stakeholders at the earliest stages of the project. In this paper, it was proven that the circle of stakeholders in CCS projects is rather wide, and their interests can clash.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Quantitative Assessment of the Stakeholders in CCS Projects.

Number of Question *	Policymakers (State Level)	Policymakers (Municipality Level)	Investors and Financial Institutions	Industry	Technology Suppliers	Local Public	Non-governmental Environmental Organizations	Media	Controlling Organizations	Project Teams	Suppliers and Contractors	Justification
Influence assessment (1)												
1.1	1	1	1	1	0	0	0	0	0	0	0	Sources of project financing are government funds, companies' funds, as well as attracted funds, etc.
1.2	1	1	1	1	1	1	0	0	1	1	1	The duration of the project is determined by the time spent not only on the implementation of internal (project) work, but also on the solution of external issues (institutional factors, project acceptance by the society, etc.)
1.3	1	1	1	1	0	1	0	0	1	0	0	The choice of project location is determined by the operator company depending on the type of the project, industry participation, transport infrastructure, requirements of the government and investors, institutional conditions, "social license to operate", etc.
1.4	1	1	0	0	0	0	0	0	1	0	0	Institutional conditions are created by the government and controlling organizations
1.5	1	1	1	1	0	1	1	1	1	0	0	Inadequate financing, internal problems of the company, institutional problems and the failure of the project in society can stop the project
Total	5	5	4	4	1	3	1	1	4	1	1	
Importance assessment (2)												
2.1	0	0	1	1	1	1	0	0	0	1	1	The resulting project performance directly depends on the qualifications of its performers and participants, and the educational factor influences the level of project acceptance in society

Table A1. *Cont.*

Number of Question *	Policymakers (State Level)	Policymakers (Municipality Level)	Investors and Financial Institutions	Industry	Technology Suppliers	Local Public	Non-governmental Environmental Organizations	Media	Controlling Organizations	Project Teams	Suppliers and Contractors	Justification
2.2	1	1	1	1	1	0	0	0	0	1	0	Technological development is achieved through the development and implementation of innovations. Innovations can occur both in the internal (companies-participants of the technological chain, team), and in the external (companies-suppliers of technology, promotion of research and development by the state) environment. The development of innovations requires additional funding
2.3	1	1	1	1	0	1	1	1	0	0	0	The initiators of the project (industrial companies, investors), channels of information dissemination (media, NGOs, communication in society) participate in the process of forming opinions. Government may also influence project progress
2.4	1	1	0	0	0	1	0	0	0	0	1	The authorities can oblige the operating company to use local resources in the project, therefore, human and other needs can be satisfied with the resources of the region
2.5	0	0	1	1	1	0	0	0	0	1	1	Only investors (or financial institutions), suppliers, participants in the technological chain and team members can be changed in the project
Total	3	3	4	4	3	3	1	1	0	3	3	

* See for the numbers Table 2.

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