

CCS National Roadmap

Estonia

Civitta Estonia

Implemented by:



Co-financed by:



Sfinansowano przez Narodowy Instytut
Wolności - Centrum Rozwoju
Społeczeństwa Obywatelskiego
ze środków Programu Rozwoju
Organizacji Obywatelskich
na lata 2018 – 2030



Table of contents

Table of contents	1
Chapter 1. Role of CCS in decarbonization pathways	2
Chapter 2. Opportunities and barriers for deployment of CCS and its related technologies in Estonia	5
Chapter 3. Policy roadmap for the scaled-up deployment of CCS and its related technologies in Estonia	8
A) Scaling-up RD&D activities and building national knowledge and experience	9
B) Policy, standards and regulations.....	12
C) Stakeholder engagement, cooperation & know-how dissemination.....	14
D) Social aspects and public support	16
Chapter 4. Next and immediate steps	18

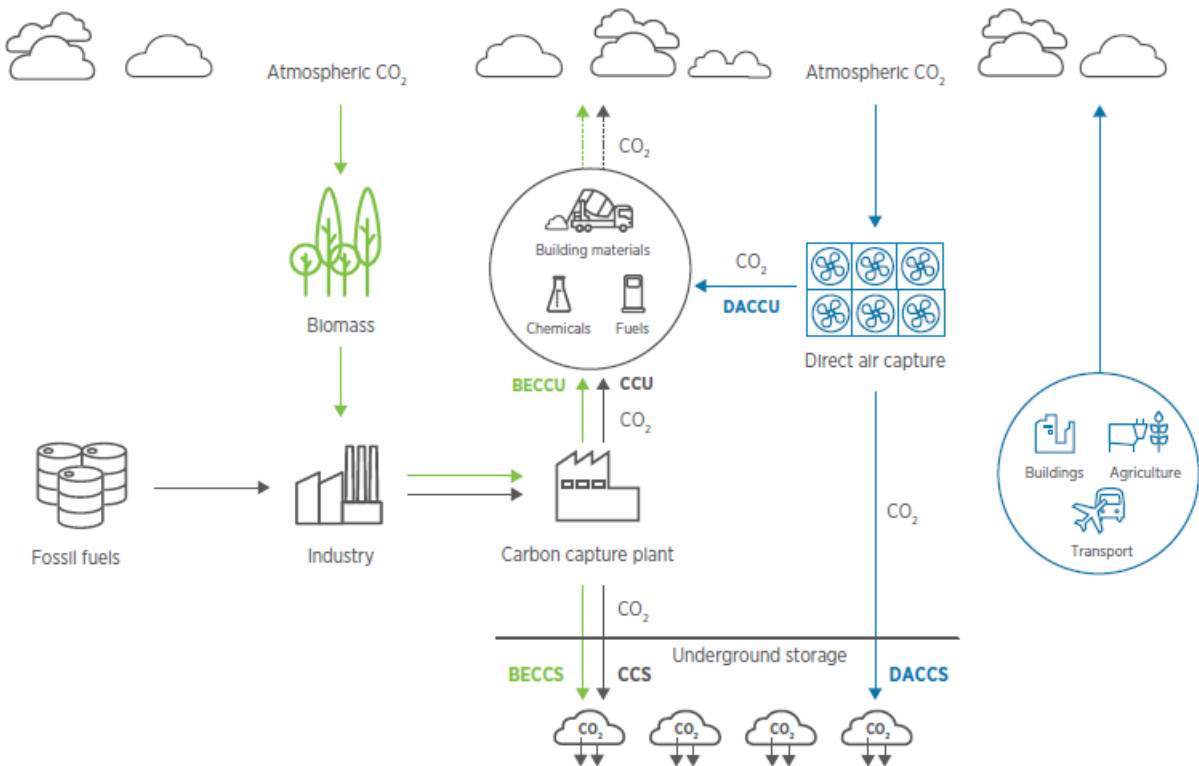
Chapter 1. Role of CCS in decarbonization pathways

In 2019, the EU launched the European Green Deal to transform the EU into a modern, resource-efficient and competitive economy, cut GHG emissions by at least 55% by 2030 and reach net-zero emissions by 2050. Many 1.5°C compatible scenarios have assessed these targets and shown that a credible but narrow pathway exists and will require the use of all decarbonization tools available. **Renewables and energy efficiency** are key components of that pathway and account for 80% of emissions reductions and provide solutions to many sectors including power, transport and energy-intensive industries. But to reach net-zero renewables and energy efficiency, they **need to be supplemented by CO₂ capture and storage (CCS) and utilization (CCU) and carbon dioxide removal (CDR)** (particularly bioenergy with CCS/CCU (BECCS/BECCU)) **technologies** (Figure 1), in sectors such as power and heat, cement, steel, chemicals production and waste incineration. In addition, to address emissions from other sources as well as historic emissions, direct air capture with storage (DACCS) or utilization (DACCU), can also be deployed. These technologies together can mitigate **20% of global CO₂ emissions**, but to do so, **the scale has to increase significantly** (Figure 2), from the current 0.04 Gt of CO₂ per year to circa 8.5 Gt of CO₂ per year in 2050 (IRENA, 2021).

The benefit of CDR processes is that they remove CO₂ from the atmosphere, they do not simply reduce what was added, and in combination with long-term storage can result in negative emissions. As such they are a critical component of net-zero pathways in the European Green Deal and most recently in line with the Glasgow Climate Pact. There are preconditions to be assessed: biomass for BECCS needs to be sourced sustainably, while DACCS requires access to cheap renewable energy.

All these technologies utilize the same components of the value chain: CO₂ transport, storage and utilization.

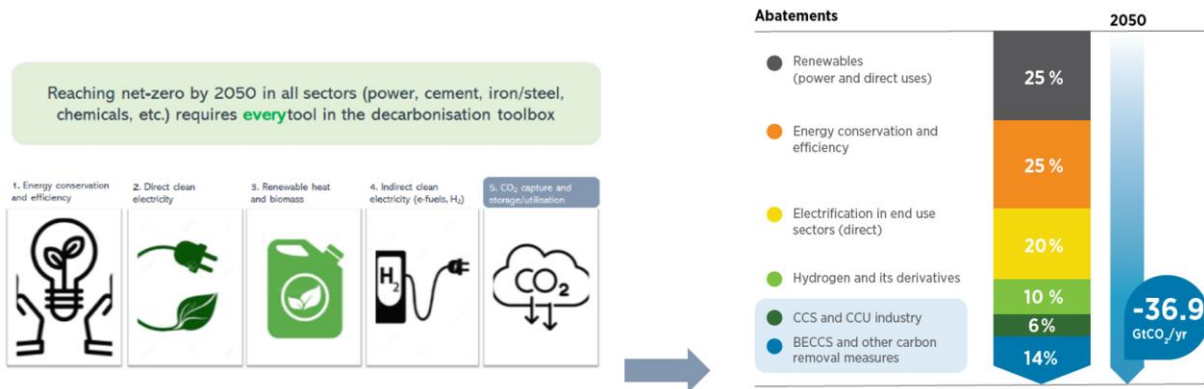
Figure 1: Carbon cycle with the use of CCS/CCU, BECCS/BECCU and DACCS/DACCU technologies¹



Source: (IRENA, 2021)

¹ https://irena.org/-/media/Files/IRENA/Agency/Technical-Papers/IRENA_Capturing_Carbon_2021.pdf

Figure 2: Carbon capture and storage as a part of the global decarbonization toolbox²



Source: Based on IRENA (2021)

The pace of progress in validating and deploying these technologies across sectors has been slow to date and in many cases with significant costs overruns. There are currently many commercial CCS, CCU and CDR plants globally capturing 40 Mt of CO₂ per year (IRENA, 2021), with many more being developed and an increasing number of pilot and demonstration projects that focus on safety issues, environmental impacts and economic costs, while generating lessons learned to be used to further improve these technologies and bring their costs down.

This current momentum to speed up energy and industrial transition considers these technologies as its necessary component of the transition and **activities at the national and regional levels** may help to **enhance the collective understanding** of the issues surrounding CCS, CCU and CDR, **build confidence** and **scale up their deployment** to **reduce costs** of these technologies and related infrastructure.

² Ibid.

Chapter 2. Opportunities and barriers for deployment of CCS and its related technologies in Estonia

This chapter outlines the main opportunities and barriers to the deployment of CCS in Estonia based on the findings from the national report:


- **CARBON EMITTERS** | Two major industrial **carbon-intensive sectors** can be distinguished in Estonia – energy production and production of chemicals. The three largest CO₂ emitters operate both in the energy and chemical production sectors (Enefit Group, Viru Keemia Group and Kiviõli Keemiatööstus). The three companies account for more than 90% of Estonia's total annual emissions. This is due to the power and chemicals produced from **high polluting oil shale and shale oil**.
- **GEOLOGICAL POTENTIAL** | Estonia is located on the eastern edge of the Baltic sedimentation basin, where the thickness reaches 800m. Aquifers that are suitable for CCS are, however, located deeper than the Estonian basin reaches. Therefore, due to the geological formation, **Estonia has no geological potential** for carbon storage.
- Currently, the main obstacle affecting CCS development in the **regulatory framework** is the prohibition on the storage of CO₂. Although Estonia has amended existing legislation to implement Directive 2009/31/EC on the geological storage of carbon dioxide, there is still a prohibition on the storage of carbon dioxide in onshore and offshore geological structures, except for research and development purposes.
- Stakeholders have brought up the potential for CO₂ storage in the neighbouring Baltic countries, where the potential is more evident. However, **the transport infrastructure** is non-existent, and significant investments are required for that. Therefore, the infrastructure and logistics plan should be developed. Further research is necessary to understand the detailed technical specifications.
- **PROJECT IMPLEMENTATION** | Practical large-scale CCS-related projects have not been implemented so far. There are small-scale plans and piloting sessions for potential CCU solutions, regarding the construction of an agropark, that would directly use the CO₂ of a local energy production unit for plant growth and the production of **net-zero precipitated calcium carbonate (PCC)**. However, as both projects are in anticipated entry into operation date, they can be considered carbon capture and usage (CCU), but not carbon capture and (permanent) storage (CCS) solutions.
- Due to the high use of oil shale in Estonia, in addition to capturing technology, major emitters engaging in CCS and CCU technologies would need to further develop and invest in **cleaning technologies**, as the oil shale industry's emitted CO₂ is polluted and for potential storage and usage purposes, it needs to be pure.
- **NATIONAL PLANNING DOCUMENTS** | **National planning documents** do not envisage CCS solutions, considering the high costs and the unassessed environmental impact. CCU solutions have somewhat more significant potential, however, at the current state, the level of CCU projects is minimal. The national planning and strategy documents do not cover CCS potential at all. The Environmental Development plan until 2030 that is currently being created and expected to be

approved in the second half of 2023 will cover CCU/CCS as one of the potential topics to mitigate carbon emissions but does not create a more specific action plan that would allow implementing such activities in Estonia.

- Estonian policymakers would like to see major emitters in the energy production sector working together regarding the capturing technologies, which would also allow to scale the capture technologies to be used in the industry.
- During several stakeholder interviews and a workshop, the **option of CCU** was emphasized more than CCS, which was identified as a more optimal option for the CO₂ emission volumes produced in Estonia and would more comply with the circular economy principles.
- **STAKEHOLDER SENTIMENT** | Generally, the stakeholders are relatively well **informed about CCS/CCU** and know the basic principles. However, most of the stakeholders for whom the introduction of such technologies could be relevant have a reserved position concerning the technologies and their potential in Estonia.
- Based on currently available information, no definite **public image** has been formed in connection with CCS/CCU technologies. However, stakeholders believe that as the technologies allow for a reduction or usage of CO₂, the majority will not oppose it. At the same time, they brought out that Estonians often have the NIMBY mentality, which for new technologies can become evident, as in the case of the development projects of new wind parks.
- The limited potential of carbon capture and storage solutions and the region's macroeconomic situation have stopped any planning and development of the CCS implementation. The topic is not covered in any major news outlets besides the publication of the research done during the ClimMit project that was referenced in the Estonian country report. In the article, the leading academics and scientists behind the research introduced the main findings of the CCS technology development and the fact that all the technology has now been piloted on a small scale and is ready for the scale-up to be used in the production processes of all the major oil shale companies in Estonia. Elaborating on the topic with the producers, none showed significant interest in going further with the technology introduction to their process, pointing mainly out the uncertainty in the economy and the energy sector together with the few plans and strategies that the Estonian government has developed. "At the current state of affairs, there is no reasonable explanation on why to go further with the high investments regarding carbon capture technologies."

The position of stakeholders can be grouped into two categories:

- **Pace-setters** – some stakeholders see the potential of CCS/CCU in the near future and are working towards it. Enefit Group has been the most promising, together with the scientists from Tallinn Technical University and the University of Tartu. They have selected and piloted 1-2 technological solutions that are easily scalable for use in the oil shale industry. Still, the storage possibility in Estonia is negligent. Therefore, the primary question comes from down the value chain on what to do with the captured CO₂. Thus, the stakeholders can be described as pace-setters within the industry, but compared to other countries, Estonia has taken few actions to move forward with the CCS technologies.
- **Fence-sitters** – the majority of other stakeholders in Estonia. The principal reasons for this position are lack of economic justification, lack of geological potential and uncertainty about the future macroeconomic outlook. Stakeholders having the fence-sitter approach often move the focus of the questions from themselves to the public institutions/government. The primary reason for a standstill with the topic is indecisiveness regarding the addition of a solid decarbonization plan and CCS initiatives to the national energy and climate plans. Also, for some stakeholders, a specific position for or against the CCS and CCU has not yet been taken, and they believe the question lies deeper in the



oil shale industry and its future in Estonia. If the political view is that CCS technologies should be used for biomass related capture, then the oil shale sector has no incentives to implement the solutions.

Chapter 3. Policy roadmap for the scaled-up deployment of CCS and its related technologies in Estonia

As brought out in the country report and the previous summary, Estonia is slowly following the developments of CCS technologies, but no concrete actions are taken nor planned in the future to deal with the topic. Nevertheless, the following overview will outline the main actions and key stakeholders that would be responsible for the process of developing the CCS topic further in Estonia.

The roadmap provides an overview of various policy actions along the innovation cycle, from research and development to the potential commercialization of these technologies to reach climate targets set by the EU and national strategies. While the roadmap aims to create an enabling environment to deploy CCS projects, it increasingly focuses on ways to develop transferable knowledge and skills by national stakeholders (governments, research organizations, academia, and private sector) in one or more stages along the carbon capture, transport, storage and utilization chain, and create linkages to gain knowledge and experience from more experienced stakeholders across the globe. It also underlines the importance of cross-border activities and joint regional demonstration projects to increase stakeholder access to funding considering their different geographies.

Each group of actions has a specific name and is divided into single actions that could be done by specific stakeholders within a proposed time frame:

- Short-term – actions to be done from now to 2025;
- Short-term with continuous efforts – done until 2025 but need continuous efforts from the moment of implementation;
- Mid-term – actions to be done between 2025 and 2030;
- Mid-term with continuous efforts – done until 2030 but need continuous efforts from the moment of implementation;
- Long-term – actions to be done after 2030;
- Long-term with continuous efforts – done after 2030 and need continuous efforts from the moment of implementation.

A) Scaling-up RD&D activities and building national knowledge and experience

Key action	No.	Approach	Stakeholders	Timeline
Knowledge platforms	A 1.1	Emphasize the importance of CCS deployment on the governmental level and nominate an officer potentially from the Ministry of Environment who actively participates in and coordinates the activities, cross-border communication and the development of CCS.	Ministry of Environment	Short-term initiative
Knowledge platforms	A 1.2	Gather information from key stakeholders on CCS-related activities, contact persons to coordinate the communication and potential plans regarding the implementation of CCS and update it regularly.	Ministry of Environment,	Short-term initiative with continuous efforts
Knowledge platforms	A 1.3	A platform/working group should be set up under decarbonization or other relevant working groups to represent key stakeholders involved in CCS development: mainly representatives from the industry and public sector, but also other stakeholders (possibly at the Baltic level). It would be possible to discuss current issues, accumulate knowledge, share experiences and best practices and advance the questions necessary for this topic.	All relevant and interested stakeholders who are in the value chain, chaired potentially by the Ministry of Environment	Short-term initiative
Knowledge platforms	A 1.4	Create a separate website/section to the Ministry's homepage where information regarding CCS-related projects, working groups and decisions is made publicly available.	Ministry of Environment	Short-term initiative
Engagement with international fora	A 2.1	According to the needs/identified future development directions, identify the need for participation in international platforms or broader representation in existing forums. Accordingly – joining or ensuring greater involvement in those forums (e.g., Zero Emissions Platform (ZEP), Carbon Sequestration Leadership Forum (CSLF), IEAGHG, Baltic Carbon Forum (BASRECCS)).	All relevant and interested stakeholders who are in the value chain	Short-term initiative with continuous efforts

Identifying industrial hubs/clusters/CO₂ transport networks	A 3.1	For Carbon Storage potential, Baltic States should collaborate on finding suitable potential for cross-border activities in the form of storing or transportation through a single location.	Cross-border collaboration stakeholders, producers, scientists, Ministry of Economic Affairs and Communication to lead	Mid-term initiative with continuous efforts
	A 3.2	Identify industrial CCS clusters for shared CO ₂ transport and storage infrastructure, including potential cross-border connections with the Baltic states regarding overland transportation and with Nordic countries regarding marine transportation of CO ₂ .	Ministry and national emissions authority (in charge of ETS compliance)	Mid-term initiative
	A 3.3	Start with pre-feasibility studies on CCS technologies usable in the Estonian oil shale sector and research on both the national and Pan-Baltic levels. The primary purpose would be to get a deep understanding of the role of CCS technologies in Estonia's decarbonization and climate goals. This depends on the future of the oil shale energy sector and to what extent CCS helps to achieve the goals.	Collaborative activities from all relevant stakeholders in the Ministries, public institutions, and producers both locally in Estonia but also at the Baltic level	Short-term initiative with continuous efforts
Funding and financial support for RD&D projects	A 4.1	Provide support to any projects interested in funding opportunities from the European Commission Innovation Fund. The Estonian Ministry of Environment and the Environmental Investment Centre are working together to support sustainability-related project funding under the EC Innovation Fund. The knowledge of CCS topic consulting is there, but there have not been any projects seeking the funding of CCS-related investments.	Ministry of Environment and the Environmental Investment Centre	Mid-term initiative with continuous efforts
	A 4.2	The nominated Government person responsible for network and communication activities should be well aligned with funding opportunities – alignment and connecting different businesses and consultancies who can help with funding applications. Without financial support, companies do not find the investments attractive without having the help to cover the risks.	Ministry of Environment	Mid-term initiative with continuous efforts
	A 4.3	Monitor funding opportunities at the local, EU and international levels that could help the development of CCS activities (e.g., Innovation Fund, Horizon Europe, Connecting Europe Facility (including Projects of Common Interest), EEA and Norway Grants).	CCS working group and independent consultancies, offering funding support services supported by the	Short-term initiative with

		This involves distributing information between the stakeholder network created in Action A 1.3 and external consultancies and public institutions. This makes the public funding process easier and more accessible.	Ministry and Environmental Investment Centre	continuous efforts
	A 4.4	Continuous implementation of research projects, potential piloting/ validation of the technology, and promotion of this step (e.g., ensuring financial support). Due to the limited CCS potential in Estonia, both the research projects and their implementation should happen via cross-border collaboration. Estonian research could benefit from shared knowledge and experience from colleagues in other countries in the Baltics or the Nordics to enhance the knowledge on the topic.	Scientists from major Universities, Parties involved in the cross-border collaboration on the topic Ministry of Economic Affairs and Communication, together with the Ministry of Environment	Mid to long-term initiative
Storage site exploration	A 5.1	Upscale exploring/research regarding the potential of unused oil shale mines in the North-Eastern part of Estonia regarding carbon storage/mineralisation. Continuation of explorations and legislative processes that allow offshore storage in the Baltic Sea.	Tallinn Technological University and University of Tartu, together with the Estonian Geological Survey and Energy producers who own the old mining sites	Mid-term initiative with continuous efforts
Bridging the valley of death	A 6.1	Close cooperation between the oil shale energy producers and researchers from the Universities who have successfully developed a pilot technology for potential immediate scale-up and implementation for Estonian oil shale production that allows for carbon capture. Collaboration eliminates any bottlenecks or issues and mitigates risks that the producers might encounter during the technology implementation and project start-up phase.	Scientists from Tallinn Technical University and University of Tartu and also from cross-border collaboration, the main producers in the value chain	Mid-term initiative with continuous efforts

B) Policy, standards and regulations

Key action	No.	Approach	Stakeholders	Timeline
Policies	B 1.1	<p>Incorporate the CCS aspects more widely into the planned amendments of Estonia's strategy to achieve climate neutrality, the National Climate and Energy Plan and other relevant existing or new policy-planning documents (including the main development steps, relevant stakeholders, specific financing possibilities etc.). In addition, amendments must reflect on the international and global research findings (IPCC, IEA, IRENA, etc.), where CCS is included in almost each successful decarbonization scenario.</p> <p>Include CCS definition and strategy in the Estonian Energy Economy Development Plan until 2030 (amendments will be made in 2023 and 2024) and the Environmental Development plan (in creation).</p> <p>Inclusion of CCS technologies and development as real action plans, beyond the current status of being a solution to achieve climate goals.</p> <p>The policy changes should address the potential and possibilities of CCS technologies.</p>	<p>Ministry of Economic Affairs and Communication and the Ministry of Environment are responsible for creating National Energy Plans and Strategy.</p> <p>Producers and stakeholders need to give input for the inclusion of such technologies in the strategies</p>	<p>Mid and long-term initiative</p> <p>Development plan inclusion – a short-term initiative in 2023 and 2024</p>
Regulatory framework	B 2.1	<p>Change the existing law that prohibits the storage of CO₂ in geological formations, including marine areas, in the territory of Estonia by changing the current laws (Atmospheric Air Protection Act, Water Act, Earth's Crust Act). Determine the basic principles, define CCS in its nature for this field, and delegate further development of the regulatory framework (regarding transportation, storage, usage of CO₂ and other aspects).</p>	<p>Ministry of Environment, Ministry of Economic Affairs and Communication (involving other relevant stakeholders)</p>	<p>Short-term initiative</p>
Strategies for CCS application for industrial decarbonization and climate	B 3.1	<p>Feasibility study/research at the national (potentially Baltic) level, which is incorporated into national strategies, with the primary purpose to determine and define whether and what role CCS technologies could play in achieving decarbonization goals (whether and under what circumstances these technologies can be used to achieve these goals). As a result, the direction/scenario would be defined. According to that, it would be clear whether and towards which way there</p>	<p>Ministry of Economic Affairs and Communication, together with the Ministry of Environment</p>	<p>Short to mid-term incentive</p>

neutrality of the economy		will be progress in this area in the future, the main steps will be outlined, as well as the main problems and possibilities for solving them.		
Guidelines and standardized processes	B 4.1	Participate in the ISO Carbon dioxide capture, transportation, and geological storage technical committee (ISO/TC 265) to validate the assumptions about standardizations of technological processes. Estonia can potentially participate there as an observing member.	National Regulator (involving other interested stakeholders)	Short-term initiative

C) Stakeholder engagement, cooperation & know-how dissemination

Key action	No.	Approach	Stakeholders	Timeline
International/ regional cooperation	C 1.1	Identify up-to-date information on CCS projects in the surrounding region – any projects or piloting initiatives in the neighbouring countries, including the Baltics and the Nordics, as well as any potential transportation solutions from the Baltic region to other storage sites. Regularly update this information, which can provide insight into cooperation opportunities.	Ministry of Environment Representative of Estonia in the Three Seas Initiative and the Nordic Council of Ministers	Mid-term initiative with continuous efforts
	C 1.2	Promotion of cooperation and further communication between the largest emitters and other stakeholders in Estonia within the created network of relevant stakeholders in Action A 1.3, as well as promotion of cooperation platforms with stakeholders in the other Baltic States.	Parties involved in the above-mentioned platform/working group Ministry of Economic Affairs and Communication	Short-term initiative with continuous efforts
	C 1.3	Regional cooperation through regional coordination forums, such as the Three Seas Initiative and the Baltic Sea Region Energy Cooperation. Utilize the communication and initiatives in the Nordic Council of Ministers and its CCS working group.	Local representatives in coordination forums and consortiums	Short-term initiative with continuous efforts
Engagement with stakeholders	C 2.1	Communication on CCS, based on the needs and capabilities of stakeholders, should occur from the start (i.e., before applying for an exploration permit) to raise awareness of CCS technologies	Efforts of the Ministry of Environment and the Ministry of Economic Affairs and communication with the help of NGOs	Short-term initiative with continuous efforts

	C 2.2	A financial framework should be put in place to provide certainty to stakeholders and enable them to engage, separating the public and private financing components (i.e., the state should finance large infrastructure projects such as transport and storage components, while capture installations may be funded privately)	Efforts of the Ministry of Environment and the Ministry of Economic Affairs and communication with the help of NGOs	Short-term initiative with continuous efforts
--	-------	--	---	---

D) Social aspects and public support

Key action	No.	Approach.	Stakeholders	Timeline
Build public support	D 1.1	<p>With the topic of CCS becoming increasingly important with the decarbonization plans, there needs to be an increasing focus on the communication of the wider audience and public to avoid unnecessary risks that might arise due to CCS being tied with the continuation of using oil shale for energy production. CCS technologies cannot portray as an excuse to continue with oil shale.</p> <p>The wider public in Estonia is quite often against such energy and environment-related initiatives, especially if they are based on new technologies and can leave the impression that this increases oil shale usage in Estonia. This could be solved by early communication activities by all the relevant stakeholders and the Estonian Green movement, which actively monitors and supports the topic to an extent.</p>	Public movements like the Green Movement of Estonia, together with other relevant non-governmental organizations	Short-term initiative
	D 1.2	According to the needs/identified future development directions, develop the communication plan to build public support and introduce and educate the public about CCS and its broader context of climate change and energy policy. The communication plan should also define and include the key messages, benefits, risks and potential costs of such a solution.	Parties involved in the above-mentioned platform/working group, all relevant stakeholders	Mid-term initiative
Building awareness and communication of costs, risks and benefits	D 2.1	<p>The main outputs/information from the cooperation platform should be made available to the public and other institutions. Make information on this topic more widely available (linkage with the website/section described under Action A 1.4), highlighting the potential and security of the technology, as well as the importance of mitigating climate change.</p> <p>Disseminate information about this and similar projects.</p>	Parties involved in the above-mentioned platform/working group, all relevant stakeholders	Short-term initiative with continuous efforts
	D 2.2	Repeating the success of CCS pilot projects from abroad must be highlighted by all the stakeholders. The fact that it is new in Estonia does not mean it is unknown in other countries.	Research institutions, private sector, Ministry of Environment, Ministry of	Mid-term initiative



			Economic Affairs and Communication	
--	--	--	---------------------------------------	--

Chapter 4. Next and immediate steps

One of the main emphases for the advancement of this sector should be changes and further development of the regulatory framework. The first steps in this regard for the development of CCS (as well as for the next stage of this project) would be the nomination of a responsible person from the Ministry and the creation of the stakeholder working group or platform on this issue (which also contributes to the promotion of cooperation and knowledge/experience dissemination in general), as well as the adoption of the prohibiting laws in a version which abolishes the current prohibition on CO₂ storage. However, the accomplishment and time frame of those activities depends on the interaction of several factors.

Stakeholders can also implement several continuous activities under WP5, such as monitoring available funding for further activities, implementing different studies and pilot projects, analyzing the existing experience of implemented and functioning projects / operating models, promoting cooperation and further communication between the largest stakeholders, supporting regional cooperation, etc.

The main steps for WP5 would be:

1. Launch a knowledge platform consisting of interested stakeholders. (Ministry of Environment)
 - a. Define clear objectives that the platform would work on;
 - b. Appoint a person or entity to coordinate the group's work; the leader should be the Ministry;
 - c. Create or apply a tool that could help with information dissemination to increase public support (e.g., a website).
2. Conduct a feasibility study to validate the need for a cooperation cluster nationally and internationally regarding carbon capture and storage. (Ministry of Environment)
3. Define the CCS process and technologies.
4. Propose that industrial CO₂ storage could be permitted by law and start the process of changing the necessary laws. (Universities and Industry stakeholders)
5. Update the research of depleted oil shale mines as a carbon storage option. (Universities)
6. Arrange funding from the government to conduct these experiments. (Ministry of Environment; Ministry of Economic Affairs and Communication)
7. Explore funding opportunities on a national and international level. (Responsible person nominated from the Ministry of Environment)
8. Explore cross-border collaboration opportunities between the Baltic States or the Nordic countries. With the created network, best practices, experiences and knowledge should be shared between the stakeholders, allowing the roadmap and action plan to be adjusted. This helps to incentivize and steer away from the fence-sitter mentality. (Created network stakeholders)

