The *Building momentum for the long-term CCS deployment in the CEE region* project is funded by Iceland, Liechtenstein and Norway through the EEA and Norway Grants Fund for Regional Cooperation.

BUILDING MOMENTUM
FOR THE LONG-TERM CCS DEPLOYMENT
IN THE CEE REGION

CCS National Roadmap

Lithuania

Ervinas Škikūnas, Povilas Jučinskas

Implemented by: WiseEuropa, BELLONA EUROPA, EPG ENERGY POLICY GROUP, CIVITTA, Institute for European Integration
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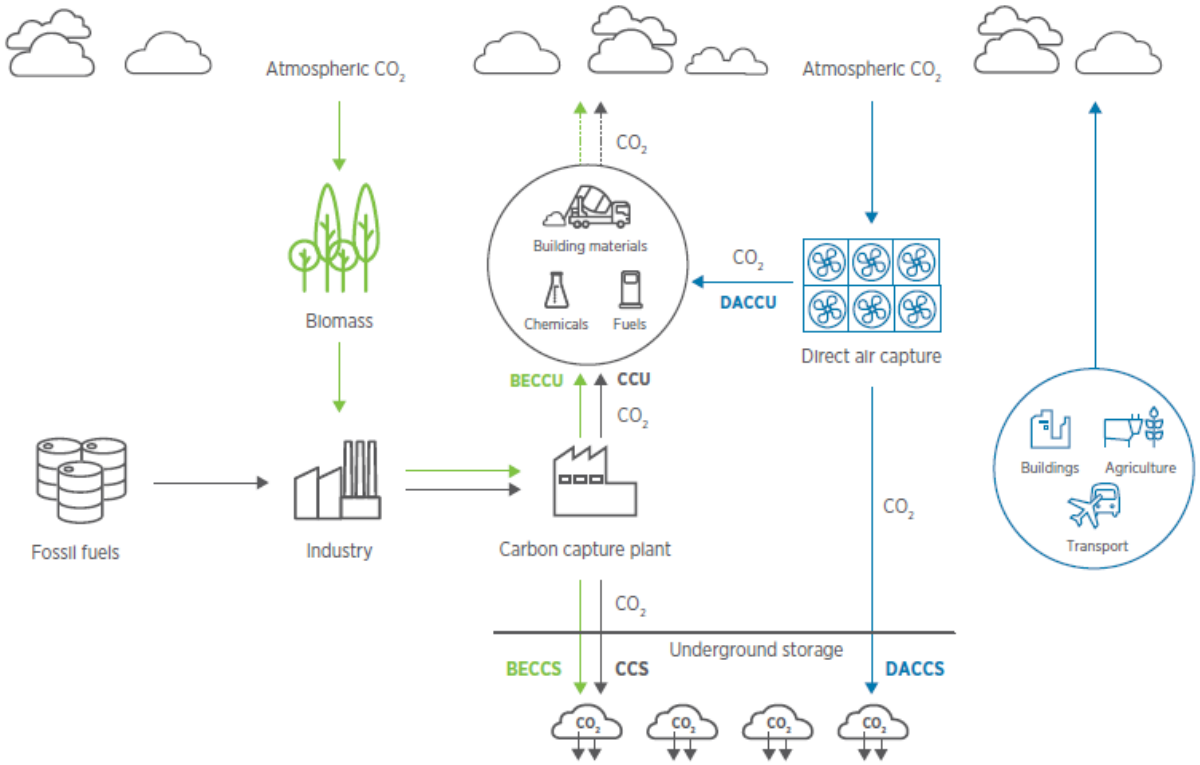
Chapter 1. Role of CCS in decarbonization pathways

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 CO_2 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 CO_2 emissions**, but to do so, **the scale has to increase significantly** (Figure 2), from the current 0.04 Gt of CO_2 per year to circa 8.5 Gt of CO_2 per year in 2050 (IRENA, 2021).

The benefit of CDR processes is that they remove CO_2 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: the CO_2 transport, storage and utilization.

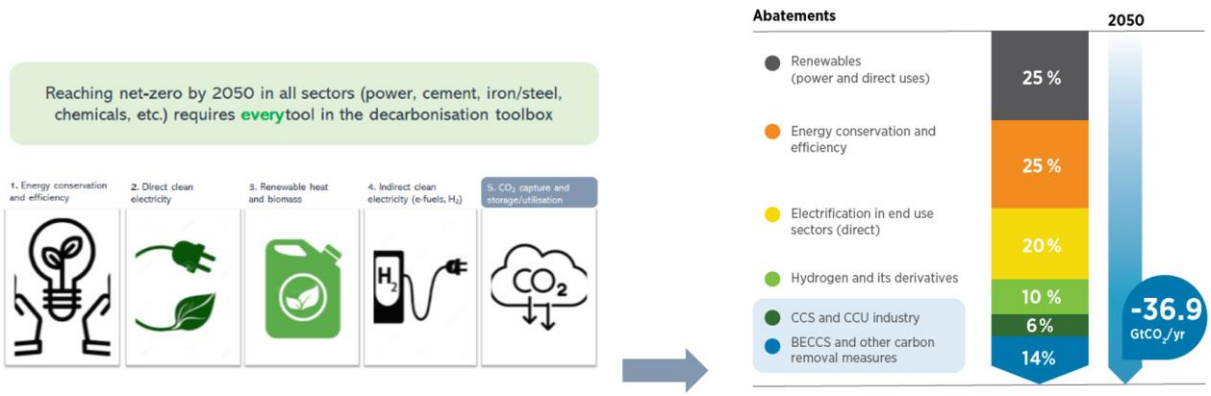
Figure 1: Carbon cycle with the use of CCS/CCU, BECCS/BECCU and DACCS/DACCU technologies[1]



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 toolbox[2]



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 CO_2 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, **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 Lithuania

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

- Based on the 2019 data, total CO_2 emissions in Lithuania (excluding biomass) were 14 700 kt.[3]
  - Transport sector: 6 300 kt. (43%)
  - Manufacturing: 5 650 kt. (38%)
  - Electricity, gas, steam and air conditioning supply: 975 kt. (7%)
  - Other: 1 775 kt. (12%)
- Lithuania is responsible for 0,55% of all EU-27 emissions (2019).
- Five companies are responsible for 67% of all CO_2 emissions in Lithuania's industry sector. The main carbon-intensive sectors of the Lithuanian economy are:
  - Fertilizer manufacturing and related chemical processes (one plant in the central part of Lithuania, 250 km from Klaipeda port);
  - Oil refinery and oil processing (north-west Lithuania, 130 km from the port of Klaipeda);
  - Cement manufacturing (north-west Lithuania, 160 km from the port of Klaipeda);
  - Heating and energy production (one emitter above 0,2 million tonnes per year in Klaipeda, 10 km from the port of Klaipeda).
- The geological and legal landscape seems fitting for CCS, but certain articles in the law on the Depths of the Earth have forbidden CO_2 storage underground. Experiments and tests in small amounts are permitted. However, they are not relevant or useful enough for stakeholders interested in CCS technologies to upgrade their processes and invest additional resources. Transportation is legal and is regulated by the law on CO_2 storage and other general transportation and safety requirements.
- Currently, CCS/CCU in Lithuania has few prospects due to the legal changes in recent years. This is countered by timid hope from various stakeholders that this might change. In any case, stakeholders from the industry have taken into account that carbon capture is unavoidable in the future. Some of them have preliminarily evaluated the possible costs of transporting CO_2 offshore (i.e., to the North Sea). CCU is another option that keeps stakeholders hopeful of reaching a financially viable way of capturing carbon, even though the effectiveness in emission reduction is not yet fully known, and the detriments of different CCU processes might even be worse for the climate but in separate ways. However, the most foreseeable option for decarbonization is green hydrogen. Lithuania is preparing its Hydrogen strategy, and this option is also mentioned in other policy planning documents. There is a goal of 400 MW electrolyzers capacity by 2030. Also, NECP defines hydrogen as a relevant technology to develop.
- Public awareness and the public image of CCS/CCU technology in Lithuania are not favourable. This is partly due to statements of public figures that were widely deliberated, and the opinions of researchers and geologists were often pushed aside. Among the stakeholders, the Lithuanian Geological

[3] Air emissions, 2019. Available: https://osp.stat.gov.lt/lt/statistiniu-rodikliu-analize?hash=2a6ebf85-3333-4f28-99f7-f7a046b4f88a

Survey does not suspect any significant risks regarding Lithuania's geological structure for CCS implementation, but they are willing to conduct more research (if allowed).

- The biggest emitters, Achema and Orlen Lietuva, are actively seeking solutions to lower their carbon footprint. Achema sees CCU as a better option, while Orlen Lietuva plans to install carbon capture technologies around 2027 and transport it offshore (most likely Norway). Klaipėdos nafta is considering transporting CO_2 of Lithuania's biggest emitters because they are sceptical about any legal changes regarding CCS in the short term. Lithuania's cement producer (Akmenės cementas) was acquired by the SCHWENK group, which is highly interested in CCS/CCU development and implementation. Other stakeholders, depending on the size of their emissions, are looking for decarbonization options but are not yet assigning additional funds due to the level of carbon prices. However, the increasing activity of industry leaders and the EU's agenda on transitioning to a carbon-neutral economy will surely increase the flow of information from multilateral sources. As a result, discussions and possible project implementations should have a more nuanced evaluation in terms of public acceptance. This can be best done together with academic and research personnel that have long-term experience in topics of CCS/CCU (Nature Research Centre, Lithuanian Geology service) and industry leaders who plan to be pace-setters of CCS development in the region.

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

The roadmap provides an overview of various ambitious policy actions along the innovation cycle, from research and development to potential commercialization of these technologies in order 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, 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	Action	Approach	Stakeholders	Timeline
Knowledge platforms	A.1.1	Institute a working group with a defined coordinator to track decarbonization, including CCS issues and projects to represent key stakeholders involved in CCS development. This could be an analogue to the Lithuanian hydrogen platform.	Industry stakeholders	Short-term
	A.1.2	Institute a knowledge-sharing group for the Baltic states to facilitate research efforts and information dissemination for topical issues for all three Baltic countries.	Industry stakeholders	Short-term
Identifying industrial hubs/clusters/ transport networks	A.2.1	Develop a feasibility study for establishing a formal/informal collaboration cluster or another form of an organization representing industry stakeholders and coordinating CO_2 transportation actions (potentially joint study with other Baltic states and Poland).	Industry stakeholders	Short-term
	A.2.2	Based on the results of action A.2.1, establish a CCS cluster or other form of an organization nationally or internationally (Baltic states, Poland).	Industry stakeholders	Mid-term
Funding and financial support for R&D projects	A.3.1	Monitor funding opportunities at local, EU and international scale (e.g., Innovation Fund, Horizon Europe, Connecting Europe Facility (including Projects of Common Interest), EEA and Norway Grants) and disseminate them among interested stakeholders through various channels (seminars, websites etc.).	Ministry of Environment; Ministry of Economy and innovation; Ministry of Energy; industry stakeholders	Short-term with continuous efforts
Storage site exploration	A.4.1	With the government's funding, Lithuania's Geology Survey could inspect feasible carbon storage locations (e.g., depleted oil fields).	Ministry of Environment; Lithuanian Geological Survey	Short-term
Bridging the valley of death	A.5.1	Analyze existing CO_2 transport and storage experiences at an industrial scale among various countries (e.g., Norway, other EU countries, and the US).	Industry stakeholders	Short-term with continuous efforts

	A.5.2	Implement gained insights based on A.4.1 results among the Baltic States, Poland or nationally.	Industry stakeholders	Mid-term
	A.5.3	Collaborate with companies that are starting to use carbon capture technologies. For example, academic researchers or representatives from the Lithuanian Geological Survey could plan out and begin testing possibilities of utilizing captured carbon (e.g., fusing it with the serpentinite found underground (research on CCU technologies)).	Industry stakeholders; Lithuanian Geological Survey; research centres	Mid-term
	A.5.4	Permits to conduct experiments would allow interested stakeholders to collaborate and look for solutions in Lithuania. Although, a long-term plan of bioenergy sources and different scenarios, together with a cost-benefit analysis, must be done considering Lithuanian usage of biomass as a major energy source in heating (BECCS research).	Ministry of Environment; district heating providers; research centres	Long-term
	A.5.5	Implement joint pilot projects and ensure continuous cooperation between industry and research centres regarding CCS technologies, prioritizing storage/transportation, and its implementation. Such collaboration could eliminate bottlenecks by combining knowledge of academia and capital from interested private stakeholders.	Industry stakeholders; universities	Short-term with continuous efforts

B) Policy, standards and regulations

Key action	Action	Approach	Stakeholders	Timeline
Policies	B.1.1	Incorporate the CCS aspects into the new versions/amendments of the main policy-planning documents (such as updated "National energy and climate plan", "National energy independence strategy", etc.), including the main steps, stakeholders, specific financing possibilities, etc. All policies must be supported by research done in Lithuania and neighbouring countries and good practices internationally. Recommendations from international institutions must be taken into consideration.	Ministry of Environment	Short-term with continuous efforts
Regulatory framework	B.2.1	Amend the carbon storage prohibition law[4] in several steps. Firstly, starting with permission for underground storage for research purposes.	Ministry of Environment	Short-term
	B.2.2	If underground carbon storage is to be found safe in Lithuania, it could be allowed on the industrial scale[5].	Ministry of Environment	Mid-term
	B.2.3	In case of successful B.2.2 implementation, the EU CCS directive[6] should be adopted to ensure safe and environmentally friendly CCS practices.	Ministry of Environment	Mid-term
	B.2.4	Lithuania should join the London Protocol and ratify its 2009 amendment to article 6, enabling the export of CO_2 streams for the purpose of sequestration in transboundary sub-seabed geological formations. After joining the London Protocol and until the amendment is ratified by the required majority, sign bilateral agreements with the country of potential offshore storage to facilitate provisional export of CO_2 (if evaluated necessary at this stage).	Ministry of Environment	Mid-term initiative

[4] Carbon storage underground in Lithuania is forbidden since 2019. Lithuania's underground law no. I-1034. https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/a4393212f56311e9b1edb3c76ab78f41

[5] Projects would begin only after the full implementation of EU Fit for 55 legislation packages to ensure defined criteria, carbon footprint calculations wouldn't change as it is now with every RED update.

[6] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006

Strategies for CCS application for industrial decarbonization and climate neutrality of the economy	B.3.1	The government could support and promote CCS technologies adoption in the industry by providing additional funding and/or knowledge gained from other countries' examples regarding CCS technologies implementation.	Ministries	Mid-term
Resilience of CCS strategies	B.4.1	To ensure the resilience of CCS strategies, the constant dissemination of new research results (both local and international) as well as activities of other countries in this sphere must be discussed constantly through various channels.	Ministries; knowledge platform	Short-term with continuous efforts
Guidelines and standards	B.5.1	Cooperate with foreign stakeholders to implement the best guidelines (based on ISO/TC 265 committee proposed standards) for CO_2 capture, transportation and other related processes. It would ensure that the CCS technology application is deployed safely and successfully.	Ministry of Environment	Short-term with continuous efforts

C) Stakeholder engagement, cooperation & know-how dissemination

Key action	Action	Approach	Stakeholders	Timeline
Engagement with stakeholders	C.1.1	The knowledge platform and clusters created could disseminate gained insights through various events (conferences, seminars, etc.) related to CCS implementation. Such events would benefit significantly from outside opinions from economists, researchers and foreign specialists.	Interested stakeholders; Ministries; academia	Mid-term with continuous efforts
International/ regional cooperation	C.2.1	Organize and attend international forums or projects regarding CCS and other low-carbon solutions. Examples include the Global hydrogen & CCS forum, EU-organized forums, BASRECCS (Baltic Sea Region CCS expertise), ZEP and Global CCS Institute.	Industry stakeholders; Ministries	Short-term with continuous efforts
	C.2.2	Cooperating between neighbouring countries' stakeholders could help with the costs related to pilot projects and help with insights dissemination.	Interested stakeholders among neighbouring countries	Short-term with continuous efforts
Stakeholder cooperation towards CO_2 market	C.3.1	All industry stakeholders could potentially sell their captured CO_2 to other companies, thus enabling CCU application (without interfering with CO_2 infrastructure deployment in the country). The best option would be to cooperate within close distance from carbon capturing locations.	Industry stakeholders; interested consumers of CO_2	Mid-term with continuous efforts

D) Social aspects and public support

Key action	Action	Approach	Stakeholders	Timeline
Building awareness	D.1.1	Public awareness and support could be built by factual research of CCS and its impact on the people and the environment. Transparent research should be conducted by an independent institution and made publicly available for questioning.	Ministry of Environment; knowledge platform	Short-term with continuous effort
Building public support	D.2.1	Carry out proactive communication activities from industry representatives highlighting the importance of this issue and the wider context of this topic in connection to climate change.	All the relevant industry stakeholders	Short-term with continuous effort
Building trust in decision-makers and other relevant stakeholders	D.3.1	If pilot CCS projects would be allowed in Lithuania, all results must be made public regarding any problems, risks and benefits.	All the relevant industry stakeholders	Mid-term with continuous effort

Chapter 4. Next and immediate steps

For Lithuania, the main goal is to alter legislation prohibiting carbon storage underground, even for research purposes. It is a big obstacle for industry stakeholders since they must look for transportation options which could increase costs and their carbon impact wouldn't change much depending on preferred logistics. Implementing a national/international cluster could offset some individual funding and allow easier cooperation. Together, ministries and industry should monitor funding opportunities or collaborate with research centres for small-scale projects that could help with future decisions.

For a change to happen on the regulatory side, a knowledge platform with explicit objectives should be instituted to gather and disseminate all available information regarding CCS technologies while simultaneously providing the public with reliable insights that could help gain support.

The main steps in this regard for the development of CCS (as well as for the next stage of this project):

1. Launch a knowledge platform consisting of interested stakeholders:
    a. Define clear objectives that the platform would work on;
    b. Appoint a person or entity to coordinate the group's work;
    c. Create or apply a tool that could help with the dissemination of gathered insights to increase public support (e.g., website).
2. Conduct a feasibility study to validate the need for a cooperation cluster nationally and internationally regarding CO_2 capturing, transportation and storage opportunities abroad.
3. Suggest the government to alter the legislation on underground storage, which prohibits any research.
    a. Define a safety benchmark for significant scale research projects;
    b. If proved safe, propose that industrial CO_2 storage could be permitted by law.
4. Lithuania's Geology Survey research on depleted oil fields as a carbon storage option:
    a. Arrange funding from the government to conduct these experiments.
5. Explore funding opportunities on a national and international level:
    a. Conduct research on available funding for CCS technologies implementation.

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