

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

# CCS National Roadmap

[Czechia]

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# Chapter 1. The role of CCS in decarbonisation pathways

In 2019, the EU launched the European Green Deal to transform the EU into a modern, resource-efficient and competitive economy, cut greenhouse gas (GHG) emissions by at least 55% by 2030 and reach net-zero GHG 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 decarbonisation tools available. **Renewables and energy efficiency** are key components of that pathway, accounting for 80% of emissions reductions. But to reach net-zero emissions, renewables and energy efficiency **need to be supplemented by CO<sub>2</sub> capture and storage (CCS), utilisation (CCU) and carbon dioxide removal (CDR)** (particularly bioenergy with CCS/CCU also known as BECCS/BECCU) **technologies** (Figure 1), particularly in sectors such as cement, chemicals, iron and steel, waste incineration, and power and heat production. To address emissions from other sources as well as historic emissions, the role of direct air capture with storage (DACCS) or utilisation (DACCU) should be further explored. While these technologies are distinct in some ways, they use the same components of the value chain: CO<sub>2</sub> transport, storage and utilisation. Together they can mitigate **20% of global CO<sub>2</sub> emissions**, but to do so, **the scale of their deployment has to increase significantly** (Figure 2) from the current 0.04 gigatonnes (Gt) of CO<sub>2</sub> per year to approximately 8.5 Gt of CO<sub>2</sub> per year in 2050<sup>1</sup>.

The **benefit of CDR processes is that they remove CO<sub>2</sub> from the atmosphere**, 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 COP26 Glasgow Climate Pact. There are however preconditions to be assessed, such as biomass for BECCS needs to be sourced sustainably, while DACCS requires access to abundant and low cost renewable energy.

The pace of progress in validating and deploying these technologies across sectors has been slow to date and in many cases with significant cost overruns. Currently, CCS, CCU and CDR plants **globally capture 40 megatonnes (Mt) of CO<sub>2</sub> per year**<sup>2</sup>, with **many more being developed. An increasing number of pilot and demonstration projects** focus on safety issues, environmental impacts and costs, and generate lessons learned to be used to further improve these technologies and bring their costs down.

To remain on track to reach net-zero emissions by 2050, activities and changes to the current status quo have to be significantly accelerated already in the current decade. That requires **activities at the national and regional levels to enhance the collective understanding** of the issues surrounding CCS, CCU and CDR, **build confidence** and massively **scale up CCS deployment to reduce costs** of these technologies and related infrastructure.

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<sup>1</sup> [https://irena.org/-/media/Files/IRENA/Agency/Technical-Papers/IRENA\\_Capturing\\_Carbon\\_2021.pdf](https://irena.org/-/media/Files/IRENA/Agency/Technical-Papers/IRENA_Capturing_Carbon_2021.pdf)

<sup>2</sup> Ibid.

Figure 1: Carbon cycle with the use of CCS/CCU, BECCS/BECCU and DACCS/DACCU technologies<sup>3</sup>

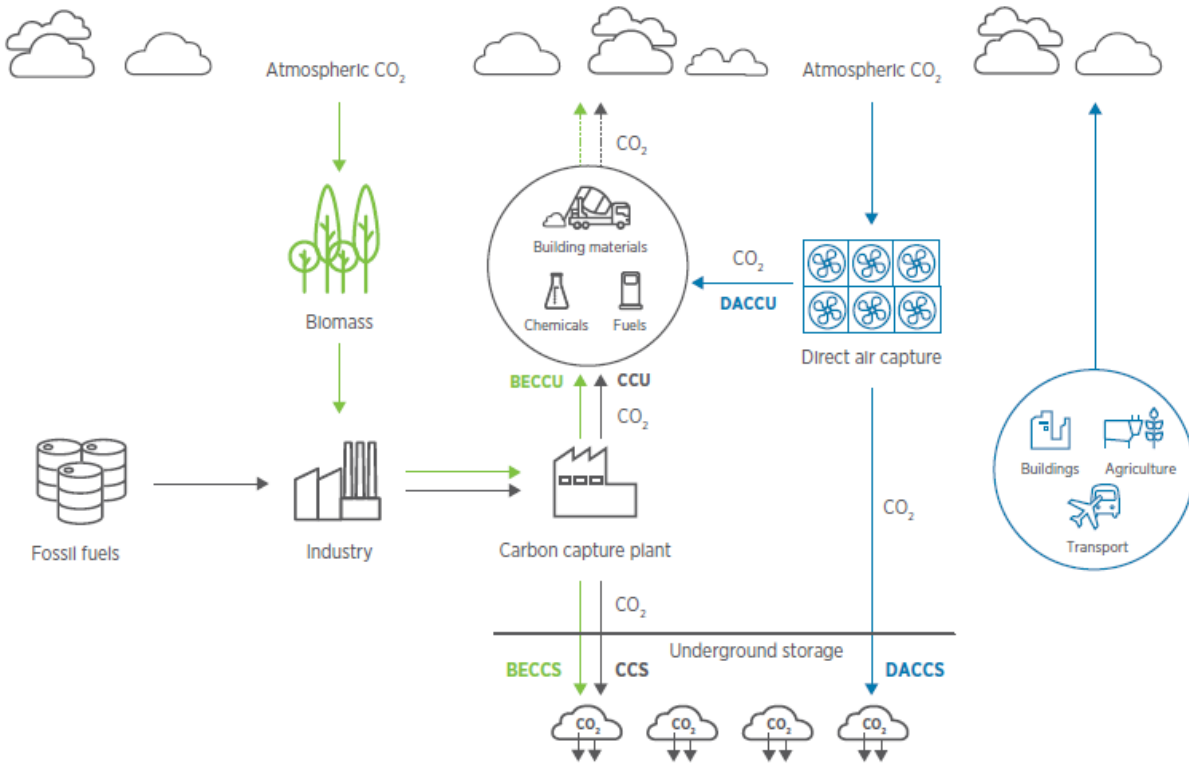
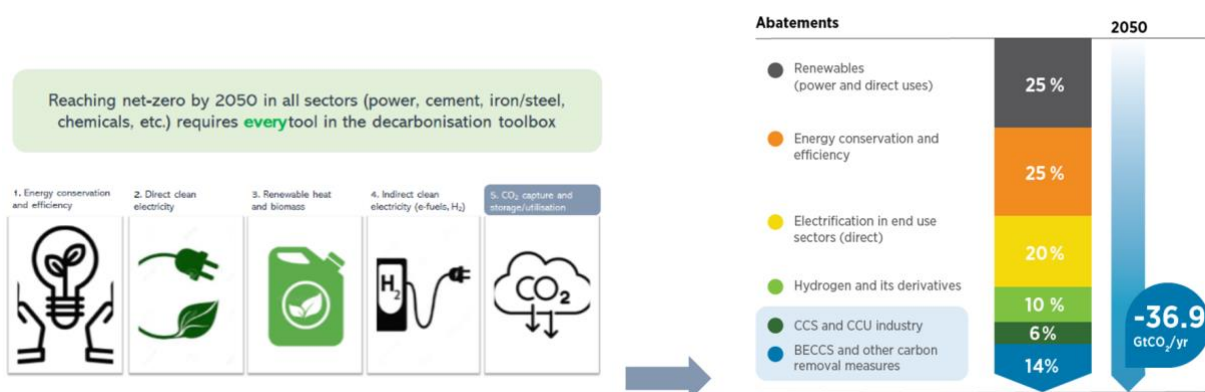


Figure 2: Carbon capture and storage as a part of the global decarbonisation toolbox<sup>4</sup>



<sup>3</sup> Ibid.

<sup>4</sup> Ibid.

## CCS deployment at the European level

The EU has put forward several mechanisms and instruments to enhance the understanding of various decarbonisation pathways consistent with the 1.5°C scenario. One of the mechanisms, the **European Strategic Energy Plan (EU SET-Plan)** aims to accelerate the development and deployment of low-carbon technologies. Its Implementation Working Group 9 on CCUS (IWG9, or **CCUS SET-Plan**) specifically focuses on **strengthening international cooperation** and **speeding up the deployment** of CCS and CCU technologies. Czechia is a member of the CCUS SET-Plan.

CCUS SET-Plan estimates that under the 1.5°C scenario, **230-430 MtCO<sub>2</sub> per year would have to be captured and stored by 2030. This will increase to 930-1200 MtCO<sub>2</sub> per year in 2050.** BECCS itself would need to be scaled up to **capture and store approximately 30 MtCO<sub>2</sub> per year in 2030, increasing to 400 MtCO<sub>2</sub> per year in 2050**<sup>5</sup>.

In November 2021, CCUS SET-Plan published the CCUS Roadmap to 2030<sup>6</sup>, in which it advocates for the launch of the **EU strategy for CCS and CCU** as a pivotal component of net-zero GHG emissions goals. The Roadmap proposes also amendments to existing plans and regulations including **strengthening the role of CCS in National Energy and Climate Plans (NECPs), Trans-European Networks for Energy (TEN-E) Regulation, CDR accounting scheme and the CCU guidance.**

## Focus on Czechia – Pathway modelling

In 2017 the Ministry of Environment prepared a Climate Long-Term Strategy<sup>7</sup> that included CCS in one of three scenarios to achieve 80% CO<sub>2</sub> emissions reduction by 2050. This 'CCS scenario' was limited to **CCS in the power generation by 2050** in gas and coal-fired power plants and did not include CCS in the industry. Czechia is the EU's 4<sup>th</sup> largest GHG emitter per capita and all available studies to decarbonise the Czech economy highlight a need to scale up deployment of CCS and/or BECCS, particularly in the industry sectors.

The 2020 McKinsey & Company study<sup>8</sup> estimates CCS's potential to **abate 8 MtCO<sub>2</sub> per year in 2050** from residual use of natural gas in **refining processes and steel production** and BECCS in the **cement and lime sector**. Industrial capture is recommended where **CO<sub>2</sub> can be effectively reused.**

A 2022 detailed study on the Czech decarbonisation pathways<sup>9</sup> by the Charles University Environment Centre estimates **CCS's potential to capture up to 20 MtCO<sub>2</sub> per year in 2050**<sup>10</sup>. The study foresees CCS for **power and heat production with biomass and natural gas, cement and lime and blue hydrogen production.** BECCS represents the potential for **negative emissions**<sup>11</sup>.

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<sup>5</sup> [https://www.ccus-setplan.eu/wp-content/uploads/2021/03/CCUS-SET-Plan\\_Review-of-CCU-and-CCS-in-future-EU-decarbonisation-scenarios\\_09.2020.pdf](https://www.ccus-setplan.eu/wp-content/uploads/2021/03/CCUS-SET-Plan_Review-of-CCU-and-CCS-in-future-EU-decarbonisation-scenarios_09.2020.pdf)

<sup>6</sup> [https://www.ccus-setplan.eu/wp-content/uploads/2021/11/CCUS-SET-Plan\\_CCUS-Roadmap-2030.pdf](https://www.ccus-setplan.eu/wp-content/uploads/2021/11/CCUS-SET-Plan_CCUS-Roadmap-2030.pdf)

<sup>7</sup> Officially Climate Protection Policy of the Czech Republic, our roadmap refers to it as *Climate Long-Term Strategy* in line with: [https://unfccc.int/files/na/application/pdf/cze\\_climate\\_protection\\_policy\\_summary.pdf](https://unfccc.int/files/na/application/pdf/cze_climate_protection_policy_summary.pdf).

<sup>8</sup> <https://www.mckinsey.com/cz/our-work/pathways-to-decarbonize-the-czech-republic>

<sup>9</sup> <https://www.mpo.cz/assets/cz/energetika/vyzkum-a-vyvoj-v-energetice/resene-dokoncene-projekty-a-jejich-vystupy/projekty-podporene-v-ramci-1-verejne-souteze-programu-theta/2022/4/Vyvoj-elektro-energetiky-a-teplarenstvi-v-CR- vystup-V1 .pdf>

<sup>10</sup> An example: a single stationary CO<sub>2</sub> source such as selected cement plant can emit around 0.5 MtCO<sub>2</sub> per year

<sup>11</sup> BECCS has to be assessed also from the perspective of soil carbon stock, agriculture and priorities for biomass use.

## Chapter 2. Opportunities and barriers for deployment of CCS and its related technologies in Czechia<sup>12</sup>

### The energy mix and CO<sub>2</sub> emissions in the power and energy-intensive sectors in Czechia

The energy mix is dominated by fossil fuels, followed by nuclear. Renewables play a minor role:

Table. 1: Czech energy mix<sup>13</sup>

Coal	Oil	Nuclear	Natural gas	Biofuels and waste	Wind and solar	Hydropower
30%	21%	19%	18%	12%	<1%	<0.5%

In the pre-pandemic year of 2019, total GHG emissions were **124 MtCO<sub>2</sub>eq**, or **102 Mt was CO<sub>2</sub> only (82% of total emissions)**<sup>14</sup>. The energy sector was responsible for **52 MtCO<sub>2</sub>eq**, or **49 MtCO<sub>2</sub>**. The industry was responsible for **26 MtCO<sub>2</sub>eq**, or **21 MtCO<sub>2</sub>**.

Based on the European Pollutant Release and Transfer Register (E-PRTR), the table on the left includes the most emitting industrial activities in 2019<sup>15</sup> (in MtCO<sub>2</sub> release to air, including biomass). The table on the right lists selected EU ETS companies with verified emissions for 2019<sup>16</sup> (in MtCO<sub>2</sub>eq)<sup>17</sup>.

Table 2: Emission-intensive industries and installations

Selected NACE activities in E-PRTR	16.5	Selected EU ETS installations	10.3
• Iron and steel	5.2	• Třinecké železárny	2.7
• Chemicals	4.9	• Liberty Ostrava	2.5
• Cement	3.2	• Unipetrol Petrochemie	2.5
• Paper and pulp	1.3	• Unipetrol Agrochemie	0.8
• Lime	1.0	• Českomoravský cement (Mokrá)	0.8
• Refinery	0.6	• CEMEX	0.6
• Glass	0.3	• Vápenka Čertovy schody	0.4

<sup>12</sup> This chapter is a summary of the national CCS report published under previous Work Package 3 of CCS4CEE project, see: <https://ccs4cee.eu/wp-content/uploads/2021/11/CCS4CEE-Czechia.pdf>.

<sup>13</sup> <https://www.iea.org/countries/czech-republic>

<sup>14</sup> Total emissions reported to UNFCCC. See: <https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer>

<sup>15</sup> <https://portal.cenia.cz/irz/formularUnikyPrenosy.jsp>

<sup>16</sup> <https://ec.europa.eu/clima/ets/allocationComplianceMgt.do>

<sup>17</sup> The reportings under E-PRTR and EU ETS are different in their methodology, the numbers do not have to correspond.

## Lack of policy and regulations for CCS/CCU

- **The EU CCS Directive** has been **transposed** into the Czech law by **Act No. 85/2012 Coll.**<sup>18</sup> on the Storage of Carbon Dioxide into Natural Rock Structures and Amending Certain Acts. The Act introduces a **limit to commercially storing a maximum of 1 MtCO<sub>2</sub> annually per site**.
- To allow commercial storage of CO<sub>2</sub> above the limit **requires an 'implementing decree'** that would also set up financial security for CO<sub>2</sub> storage. The decree **is currently missing**.
- The **State Energy Policy** (2015) and the **Climate Long-Term Strategy** (2017) reference the prospect of applying CCS to power production from natural gas and coal. Both documents require revision and should be updated in 2023.
- The **NECP** (2019) references CCS/CCU deployment only in connection with natural gas and the production of synthetic gases (incl. hydrogen). **CCS/CCU technology is not considered readily available**.
- The **National Hydrogen Strategy** (2021) references the prospect of blue hydrogen production from natural gas with CCS/CCU. The Strategy concludes that CCS/CCU deployment is **not yet feasible from an economic and efficiency standpoint**, foresees **low demand for captured CO<sub>2</sub>** and outlines that Czechia **does not have suitable geological conditions to store CO<sub>2</sub>**.
- **The Recovery and Resilience Facility Plan** (2021) **does not include any reference to CCS/CCU**.

## Level of experience in CCS/CCU

### Research and development (R&D) projects

- Between 2004 and 2020, over 20 projects and studies were carried out.
- Mostly **theoretical studies and assessments of geological CO<sub>2</sub> storage capacity** and **transport infrastructure** have been conducted. **Capture technologies** have been **tested** in Universities' research centres. None of the **R&D projects have led to pilot projects yet**.
- There are **currently 6 ongoing projects**, 4 of them funded by the EEA/Norway grants, 3 of them with the support of the Technology Agency of the Czech Republic: [CO<sub>2</sub>-SPICER](#), [METAMORPH](#), [BIO-CCS](#), [RPB](#)<sup>19</sup>, [CCUS CZ-NO](#) and [CCS4CEE](#). **These projects could lead to a pilot storage project in 2024 and the industrial deployment of capture technologies in the future**.
- BECCS is being assessed as part of the [BIO-CCS](#) project focusing on the exploration of biomass and waste-to-energy processes with CO<sub>2</sub> capture.

### Pilot or demonstration projects

- **No pilot CCS/CCU projects**. Benefitting from the R&D outputs and outcomes from studies and research projects done in the past, several companies and institutions are planning a full-chain CCS project, which is subject to various enabling conditions. This information has not been disclosed.

### Commercial projects

- **No commercial CCS/CCU projects**.

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<sup>18</sup> Further called *Czech CCS Act* in this roadmap.

<sup>19</sup> RPB stands for Rotating Packed Bed. It is not an official acronym of the project, we use it for its simplicity.

## Status of CCS/CCU

### CO<sub>2</sub> capture

- Research centres have carried out several R&D projects on various capture technologies, including ongoing [METAMORPH](#), [BIO-CCS](#) and [RPB](#) projects. Due to missing transport, storage and utilisation infrastructure, no projects have been piloted yet.

### CO<sub>2</sub> transport

- **Czechia has a large infrastructure for natural gas which could be under several conditions retrofitted for CO<sub>2</sub>.** While experience with building the gas infrastructure is vast, legal obstacles remain and include the building of new linear constructions, conflict of interest, environmental considerations and would require inspections of technical aspects<sup>20</sup>.
- Stakeholders see the role of railways and roads for CO<sub>2</sub> transport but shipping has not yet been considered a feasible option.

### CO<sub>2</sub> storage

- The conservative estimate of **storage capacity** is over **850 MtCO<sub>2</sub>: saline aquifers (766 MtCO<sub>2</sub>), hydrocarbon fields (33 MtCO<sub>2</sub>) and coal fields (54 MtCO<sub>2</sub>)**. The storage would accommodate **more than 50 years of continuous storage of CO<sub>2</sub>** emissions from the energy-intensive sectors (~16 MtCO<sub>2</sub> per year). The capacity estimates, especially in saline aquifers, are burdened by considerable uncertainty due to a lack of site-specific geological data.

### CO<sub>2</sub> utilisation

- **CCU deployment is part of the research** currently under the BIO-CCS project. Several stakeholders highlighted the need to create a CO<sub>2</sub> market to incentivise CO<sub>2</sub> utilisation, which would in turn help scale up the deployment of capture technologies. CO<sub>2</sub> utilisation has also historically supported industries such as chemicals, pharmacy, building and construction.

## Public perception

The only comprehensive survey on the awareness and acceptance of CCS/CCU in Czechia was done as part of the EU 2011 Special Barometer. It showed **very limited knowledge of CCS amongst the public** (6%), with around 33% believing CCS would benefit their region. Since then, no survey on public awareness and perception in Czechia has been conducted. The need for such a survey was emphasised as one of the conclusions of the [ENOS](#) project.

## Key stakeholders and their overall positions

### Research Institutions and Academia

- **Czech research institutions and academia** engage in a **high activity (pace-setter)**. Czech Geological Survey is the leader in the research of CO<sub>2</sub> geological storage and the assessment of potential geological storage structures, followed by the Czech Academy of Sciences. ÚJV Řež has been active in capture technologies.

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<sup>20</sup> Technical aspects of retrofitting existing pipeline infrastructure are being questioned by several stakeholders. For this reason, CO<sub>2</sub> liquefaction and freight or trail transport are being mentioned as preferred options.



- Universities, including CTU (Czech Technical University in Prague), UCT (University of Chemistry and Technology in Prague), BUT (Brno University of Technology) and VSB-TUO (Technical University of Ostrava) are leading the research in different aspects of CO<sub>2</sub> capture, storage and utilisation.

#### Governmental Institutions

- The **Ministry of Environment** and the **Ministry of Industry and Trade** engage in a **medium activity (fence-sitters)**. While they do not focus on CCS/CCU as a primary decarbonisation pathway, Ministries provide up-to-date information on the upcoming or foreseen legislative changes and may be a source of financial support for activities such as CCS-dedicated platform.
- A dialogue between governmental institutions, research institutions and the private sector is ongoing and focuses on the preparation of the currently missing implementing decree.

#### Private sector

- The companies with **high activity (pace-setters)** are MND oil & gas company, C-Energy power and heat provider, Českomoravský cement, InoCure nanomaterial producer and BeePartner consulting.
- The companies PREOL, a biofuel producer, Energetika Třinec, a power supplier, as well as the Steel Union and the Association for District Heating of the Czech Republic, engage in a **medium activity (fence-sitters)**.
- MND company and Českomoravský cement are **planning to deploy a full-chain CCS** as the result of the CCS strategy of Českomoravský cement (part of the HeidelbergCement) and as a follow-up of the currently ongoing CO<sub>2</sub>-SPICER research project led by the Czech Geological Survey.
- CO<sub>2</sub> Czech Solution Group and the Association of Chemical Industry engage in a **high activity** and aim to scale up CO<sub>2</sub> capture and transport activities.

#### Major news not yet covered by the WP3<sup>21</sup> national reports

- The project proposal on CCS was submitted to the Innovation Fund (large-scale projects call).
- MND publicly announced<sup>22</sup> plans to explore saline aquifers as a storage solution.
- The Ministry of Environment has started preparing the implementing decree (financial security regulation).
- BeePartners held a final conference of their CCUS CZ-NO project with Czech and Norwegian partners.
- BUT (Brno University of Technology) is currently developing an advanced Rotating Packed Bed system for CO<sub>2</sub> capture in cooperation with German and Polish universities and the private sector.
- A study by the Charles University Environment Centre was published<sup>23</sup>. It became the most detailed study on Czech decarbonisation pathways, with CCS foreseen to play a significant role in selected sectors.

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<sup>21</sup> Work package 3, see: <https://ccs4cee.eu/wp-content/uploads/2021/11/CCS4CEE-Czechia.pdf>.

<sup>22</sup> See, for example: <https://oze.tzb-info.cz/klimaticke-zmeny/23442-mnd-chce-ukladat-oxid-uhlicity-do-hlubinnych-usazenin-nasaklych-pravekou-morskou-vodou>

<sup>23</sup> <https://www.mpo.cz/assets/cz/energetika/vyzkum-a-vyvoj-v-energetice/resene-dokoncene-projekty-a-jejich-vystupy/projekty-podporene-v-ramci-1-verejne-souteze-programu-theta/2022/4/Vyvoj-elektro-energetiky-a-teplarenstvi-v-CR- vystup-V1 .pdf>

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

The roadmap provides an overview of various ambitious policy actions along the innovation cycle, from research and development to the commercialisation of CCS technologies to reach climate targets set by the EU and national strategies. While the roadmap aims to create an enabling environment to deploy CCS, it increasingly focuses on ways to develop transferable knowledge and skills by national stakeholders (government, research organisations, academia and the private sector) and set up channels to access knowledge and exchange experience from international stakeholders. It also underlines the importance of cross-border activities and joint regional demonstration projects to increase the stakeholders' prospects to access public and private funding.

## Technical note

Proposed actions are bundled under a common title with each action including a description, relevant stakeholders and a proposed time frame. There is no prescribed order of actions.

- Short-term – actions to be carried out between now and 2025.
- Mid-term – actions to be carried out between 2025 and 2030.
- Long-term – actions to be carried out after 2030.

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

Key action	Number	Approach	Stakeholders	Timeline
<b>Knowledge platforms</b>	A1.1	<ul style="list-style-type: none"> <li>A <b>national CCS-dedicated platform</b> should be created jointly by the private sector and the Czech Geological Survey in the lead. The platform would be a leading partner in discussions with the government. It could manage an interactive website in Czech and English focused on knowledge sharing, targeting national and international stakeholders. The website can be linked to the CCUS SET-Plan website.</li> </ul>	Private sector, NGOs <sup>24</sup> , civil society organisations, research institutions, Ministry of Environment, Ministry of Industry and Trade	Short-term
	A1.2	<ul style="list-style-type: none"> <li>Stakeholders could consider joining the recently launched <a href="#">CO<sub>2</sub> Czech Solution Group platform</a> focusing on CCU. Provided growing interest from stakeholders, the national CCS-dedicated platform could align its activities with the CO<sub>2</sub> Czech Solution Group which could lead to a <b>full CCUS value-chain platform</b>.</li> </ul>	Private sector, NGOs, civil society organisations, research institutions, Ministry of Environment, Ministry of Industry and Trade	Short-term
	A1.3	<ul style="list-style-type: none"> <li>The Ministry of Environment, Ministry of Industry and Trade, Czech Chamber of Commerce and/or CzechInvest should <b>support the CCS-dedicated platform</b> and share it via their official websites.</li> </ul>	Ministries, chambers, unions, investment platforms	Short-term
	A1.4	<ul style="list-style-type: none"> <li>The Czech Geological Survey, VSB Technical University of Ostrava and other institutions and universities together with the private sector could collaborate on developing new interdisciplinary <b>Bachelor/Master and PhD programmes and curricula</b> covering capture, transport and storage technologies.</li> </ul>	Universities (CTU, UCT, BUT and VSB-TUO), private sector	Short-term

<sup>24</sup> Non-governmental organizations.

<b>Engagement with international fora</b>	A2.1	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade should increase its <b>engagement in the EU SET-Plan (IWG9)</b> that focuses on R&amp;I and establish a channel to regularly disseminate knowledge and plans of the EU SET-Plan to national stakeholders and actively seek their feedback.</li> </ul>	Ministry of Industry and Trade	Short-term
	A2.2	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade should play a more active role in the <b>global Carbon Sequestration Leadership Forum (CSLF)</b> and disseminate international knowledge and best practice to national stakeholders.</li> </ul>	Ministry of Industry and Trade	Short-term
	A2.3	<ul style="list-style-type: none"> <li>Czech stakeholders, including MND, Českomoravský cement, Czech Geological Survey and the CO<sub>2</sub> Czech Solution Group, should <b>join the EU Zero Emission Platform (ZEP)</b> and/or <b>CO<sub>2</sub> Value Europe</b> (focused only on CCU) to benefit from the shared knowledge and have access to networking activities across the EU. The same stakeholders should <b>join the IEAGHG<sup>25</sup></b> to benefit from global knowledge and networking.</li> </ul>	Private sector, research institutions	Short-term
<b>Identifying industrial hubs, clusters, CO<sub>2</sub> transport networks</b>	A3.1	<ul style="list-style-type: none"> <li><b>Municipalities</b> should access the available support from the <b>EU Just Transition Fund for 3 Czech regions</b> and include plans for CCS projects for selected waste incineration plants or high-emitting companies.</li> </ul>	Municipalities, private sector, Permanent Mission of the Czech Republic to the EU	Short-term
	A3.2	<ul style="list-style-type: none"> <li>Through the <b>national CCS-dedicated platform</b>, there should be a <b>university collaboration</b> including Czech Technical University, the University of Chemistry and Technology and the Technical University of Ostrava to deliver needed research tools, data and knowledge for industrial clusters.</li> </ul>	Universities, private sector	Short-term
	A3.3	<ul style="list-style-type: none"> <li><b>Municipalities</b> should develop <b>partnerships</b> with the waste-to-energy (WtE) and biomass-to-energy (BtE) plants to jointly explore possibilities of CO<sub>2</sub> capture and storage.</li> </ul>	Municipalities, private sector	Short-term
	A3.4	<ul style="list-style-type: none"> <li>A new <b>map</b> could reproduce existing knowledge from the EU-level projects (CASTOR, EU GeoCapacity and ENOS) and include further information such as available transport modes, existing infrastructure for gas transport and main road connections from large-scale CO<sub>2</sub> sources. The map can be incorporated into the website of the national CCS-dedicated platform.</li> </ul>	Czech Geological Survey	Mid-term

<sup>25</sup> International Energy Agency (IEA) Greenhouse Gas R&D Programme

<b>Funding and financial support for RD&amp;D projects</b>	A4.1	<ul style="list-style-type: none"> <li>Companies could share their knowledge and experience with the Innovation Fund and cooperate with the Permanent Mission of the Czech Republic to the EU and the Ministry of Environment which has already developed the guidance for the <b>Innovation Fund</b>.</li> <li>Technology Agency of the Czech Republic (TACR) could finance the preparation phase of grant proposals into the Innovation Fund or others.</li> </ul>	Private sector, Ministry of Environment, TACR, Permanent Mission of the Czech Republic to the EU	Short-term
	A4.2	<ul style="list-style-type: none"> <li>The Ministry of Environment with assistance from the Permanent Mission of the Czech Republic to the EU should develop guidance for interested stakeholders for <b>other grant opportunities, operational programmes, Just Transition Fund and Modernisation Fund</b>.</li> </ul>	Ministry of Environment, Ministry of Industry and Trade, Permanent Mission of the Czech Republic to the EU	Short-term
	A4.3	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade, the Ministry of Environment and the private sector should regularly invite the <b>European Investment Bank (EIB)</b> to share with national stakeholders the technical and funding process-related expertise, opportunities to access the project development assistance, including the loan guarantees and create guidelines based on these recommendations.</li> </ul>	Private sector, Ministry of Industry and Trade, Ministry of Environment, EIB	Short-term
	A4.4	<ul style="list-style-type: none"> <li>The private sector should be better informed about the role of EIB as a financial enabler for first demonstration and commercial CCS projects. The National Development Bank or CzechInvest on the other hand could initiate pilot small-scale capture projects, for example in WtE sector.</li> </ul>	Financial institutions, ministries, private sector	Mid-term
	A4.5	<ul style="list-style-type: none"> <li>A <b>consortium</b> of partners including <b>Central and Eastern European</b> companies, institutions and universities could be formed to apply for Horizon Europe or Innovation Fund (i.e. full-chain CCS development). Experience from unsuccessful proposals should be shared, too.</li> </ul>	Private sector, institutions, universities	Mid-term
	A4.6	<ul style="list-style-type: none"> <li>The Ministry of Finance and the Ministry of Environment should redistribute revenues from the <b>EU ETS allowances</b> to also support CCS projects.</li> </ul>	Ministry of Finance, Ministry of Environment	Short-term
	A4.7	<ul style="list-style-type: none"> <li>The government and respective ministries should allow for <b>direct financing</b> of pre-feasibility and feasibility studies and the exploration of the <b>saline aquifer</b> from the state budget to scale up CCS deployment.</li> </ul>	Government, Ministry of Finance, Ministry of Environment, Ministry of Industry and Trade	Short-term

<b>Storage site exploration</b>	A5.1	<ul style="list-style-type: none"> <li>The Ministry of Finance and the Ministry of Environment should allocate appropriate <b>funding to Czech Geological Survey</b> to explore the most promising saline aquifer sites and confirm their potential.</li> </ul>	Ministry of Finance, Ministry of Environment, Czech Geological Survey	Short-term
	A5.2	<ul style="list-style-type: none"> <li>The CO<sub>2</sub> <b>storage permitting process</b> should be incentivised for <b>depleted oil &amp; gas fields</b>. Coal seams could be inspected for CO<sub>2</sub> storage in more detail.</li> </ul>	Czech Mining Authority, Ministry of Environment	Mid-term
	A5.3	<ul style="list-style-type: none"> <li>The Ministry of Environment and the Ministry of Industry and Trade should jointly communicate to the <b>European Commission</b> the need for <b>budget</b> allocation (e.g., through CEF) for <b>new EU-wide CO<sub>2</sub> storage projects</b> that would finance the exploration of saline aquifers.</li> </ul>	Ministry of Industry and Trade, Ministry of Environment	Short-term
<b>Bridging the valleys of death</b>	A6.1	<ul style="list-style-type: none"> <li>Interested stakeholders should consult respective ministries and consulting companies on the availability of <b>funding opportunities and the application process</b>.</li> </ul>	Private sector, ministries, consulting companies	Short-term
	A6.2	<ul style="list-style-type: none"> <li>There must be a concerted action at the EU level to pursue <b>PCI<sup>26</sup></b> that would finance the <b>pipeline infrastructure for CO<sub>2</sub> transport</b>.</li> <li>Net4gas (Czech natural gas TSO<sup>27</sup>) could join the newly formed <b>consortium of TSOs</b> of Poland, Slovakia, Hungary and Romania to develop hydrogen and CO<sub>2</sub> transport infrastructure.</li> </ul>	European Commission, Ministry of Industry and Trade, TSO Net4Gas, Permanent Representation of the Czech Republic to the EU	Long-term
	A6.3	<ul style="list-style-type: none"> <li>PCI could be developed for the CO<sub>2</sub> transport by local oil &amp; gas companies, either to transfer CO<sub>2</sub> to interim storage hubs (as planned in the EU CCS Interconnector, Gdansk) or to connect the onshore storage locations with industrial hubs. These could seek financial support through the <b>CEF<sup>28</sup> fund</b>.</li> </ul>	European Commission, private sector, Permanent Representation of the Czech Republic to the EU	Mid-term
	A6.4	<ul style="list-style-type: none"> <li>Stakeholders should follow the nearby Gorazdze (PL) cement plant, where a pilot capture project with the transport of CO<sub>2</sub> to the North Sea is being developed.</li> </ul>	Private sector, government	Short-term

<sup>26</sup> Project of Common Interest

<sup>27</sup> Transmission system operator

<sup>28</sup> Connecting Europe Facility

## B) Policy, standards and regulations

Key action	Number	Approach	Stakeholders	Timeline
<b>Policies</b>	B1.1	<ul style="list-style-type: none"> <li>The Czech government should consult <b>examples of climate and CCS strategies and policies</b> with countries such as the UK, Denmark, Norway and Sweden.</li> </ul>	Government, NGOs, civil society organisations	Short-term
	B1.2	<ul style="list-style-type: none"> <li>The Czech government should <b>follow the available evidence of CCS importance</b> (IPCC, IEA, IRENA and others) as one of the decarbonisation pathways in tackling climate change and benefiting also country's economy through new foreign direct investments and jobs creation.</li> </ul>	Government, NGOs, civil society organisations	Short-term
<b>Guidelines and standards</b>	B2.1	<ul style="list-style-type: none"> <li>The Ministry of Environment should request the <b>European Commission to publish CCS guidelines</b> on best practices on financial security mechanisms and permitting processes.</li> </ul>	European Commission, Ministry of Environment	Short-term
	B2.2	<ul style="list-style-type: none"> <li>Czechia should explore the possibility to increase engagement in the <b>ISO<sup>29</sup> CCS technical committees</b> to access global knowledge, communicate such knowledge to national stakeholders and seek their feedback as well as shape standards development within the technical committee. The latter would require Czechia to become a 'participating member' (instead of an 'observing member'). A person/team should have this task allocated on CAS/UNMZ<sup>30</sup> by the Ministry of Industry and Trade.</li> </ul>	Ministry of Industry and Trade, CAS/UNMZ, private sector	Short-term
<b>Regulatory framework</b>	B3.1	<ul style="list-style-type: none"> <li>The <b>Czech CCS Act</b> (the transposed EU CCS Directive) should reflect the current CCS development and remove any storage capacity limitation (currently set at 1 MtCO<sub>2</sub> per year).</li> </ul>	Ministry of Industry and Trade, Ministry of Environment	Short-term
	B3.2	<ul style="list-style-type: none"> <li>The Ministry of Environment should finalise the proposal for financial guarantees ('<b>implementing decree</b>' of the Czech CCS Act) to enable the commercial scale of CO<sub>2</sub> storage.</li> </ul>	Ministry of Environment, Czech Mining Authority	Short-term

<sup>29</sup> International Organisation for Standardisation

<sup>30</sup> Czech Standardization Agency/Office for Technical Standardization, Metrology and State Testing – Česká agentura pro standardizaci/Úřad pro technickou normalizaci, metrologii a státní zkušebnictví.

		<ul style="list-style-type: none"> <li>The financial security regulation should support <b>first-movers</b> in CO<sub>2</sub> storage and set the guarantee on a case-by-case basis.</li> </ul>		
	B3.3	<ul style="list-style-type: none"> <li>The transport of CO<sub>2</sub> by rail, truck and barge should be properly addressed by TEN-T<sup>31</sup> regulation which would enable the CCS first-movers to operate CO<sub>2</sub> capture and transport projects connected to the CO<sub>2</sub> storage facilities.</li> <li>The Czech government and the Ministry of Transport should negotiate such a proposal and shape the discussion during the <b>Czech EU presidency</b>.</li> </ul>	Government, Ministry of Transport, Permanent Representation of the Czech Republic to the EU	Short-term
	B3.4	<ul style="list-style-type: none"> <li>Provided the CO<sub>2</sub> pipeline creation, the rights and obligations for CO<sub>2</sub> transport could be transferred through a license to a Czech natural gas TSO Net4gas that owns this license for natural gas transport.</li> </ul>	Ministry of Industry and Trade	Long-term
<b>Strategies for CCS application for industrial decarbonisation and climate neutrality of the economy</b>	B4.1	<ul style="list-style-type: none"> <li>The upcoming updated version of the <b>Climate Long-Term Strategy (LTS)</b> and NECP should reflect the current CCS development. It should avoid the language such as “CO<sub>2</sub> storage is not available” or “CCS is not economically and technologically feasible” and remain technology-neutral.</li> </ul>	Ministry of Environment, Ministry of Industry and Trade	Mid-term
	B4.2	<ul style="list-style-type: none"> <li>New LTS should prioritise CCS for the industry only and discourage the deployment of CCS in the power sector (e.g., coal or natural gas).</li> </ul>	Ministry of Environment	Mid-term
	B4.3	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade, the Ministry of Environment and the Ministry for Regional Development should jointly develop the <b>CCS national strategy</b> in close collaboration with the CCS-dedicated platform.</li> </ul>	Ministerial collaboration, CCS-dedicated platform	Short-term
	B4.4	<ul style="list-style-type: none"> <li>Relevant stakeholders should jointly develop a <b>sectoral decarbonisation strategy</b>: <ul style="list-style-type: none"> <li>The Association of the Chemical Industry, High-level Group on Chemistry, and the CO<sub>2</sub> Czech Solution Group on a <b>chemical</b> sector-specific strategy.</li> <li>The Association of Cement Manufacturers and respective companies should cooperate on a <b>cement</b> sector-specific strategy.</li> <li>Steel Working Group and the Czech Steel Union should cooperate on an <b>iron and steel</b> sector-specific strategy.</li> </ul> </li> </ul>	Association of Chemical Industry, High-level Group on Chemistry, CO <sub>2</sub> Czech Solution Group, Association of Cement Manufacturers, Steel Working Group, Czech Steel Union, private sector, ministries	Short-term

<sup>31</sup> Trans-European Networks for Transport.



	B4.5	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade should establish a <b>Working Group</b> specifically focused on the CCS covering all industries.</li> </ul>	Ministry of Industry and Trade, private sector	Short-term
	B4.6	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade and the Ministry of Environment should work on a <b>strategy</b> that would take account of <b>WtE coupled with CCS</b> (also as part B4.3). The existing examples to consult include the Swiss strategy for WtE or the Norwegian WtE project in Oslo.</li> </ul>	Ministry of Industry and Trade, Ministry of Environment, private sector, municipalities	Short-term
	B4.7	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade should amend the <b>Czech Hydrogen Strategy</b> to reflect the current CCS development and the production of <b>blue hydrogen</b>, despite the current natural gas market's turmoil.</li> </ul>	Ministry of Industry and Trade	Mid-term
	B4.8	<ul style="list-style-type: none"> <li>The Ministry of Environment could promote <b>CCU mineralisation or carbonation activities</b><sup>32</sup> through the operational programmes, Modernization Fund and Just Transition Fund.</li> </ul>	Ministry of Environment	Mid-term
<b>Enabling environment for CO<sub>2</sub> market</b>	B5.1	<ul style="list-style-type: none"> <li>Oil &amp; gas companies with support from the Ministry of Industry and Trade could develop an <b>intermediate CO<sub>2</sub> storage hub for small-scale emitting facilities</b>. The hub would either enable CO<sub>2</sub> to be permanently stored either nationally or transported to another storage facility abroad.</li> </ul>	Private sector, Ministry of Industry and Trade, Ministry of Environment	Mid-term
	B5.2	<ul style="list-style-type: none"> <li>The Ministry of Environment could negotiate a faster development of <b>the EU CCU guidelines</b> and inclusion of CCU storage such as mineralisation or carbonation in the revisions of the Renewable Energy Directive and the EU ETS.</li> </ul>	Ministry of Environment	Short-term
<b>Resilience of CCS strategies</b>	B6.1	<ul style="list-style-type: none"> <li>Any <b>amendments to the existing Czech decarbonisation strategies</b> should reflect the international findings (IPCC, IEA and IRENA) which include CCS in all decarbonisation net-zero scenarios.</li> </ul>	Ministerial cooperation	Short-term
	B6.2	<ul style="list-style-type: none"> <li>Climate Long-Term Strategy should prioritise the inclusion of industrial CCS.</li> </ul>	Ministry of Environment	Short-term

<sup>32</sup> Although they can store only a fraction of the potential of geological storage.

## C) Stakeholder engagement, cooperation & know-how dissemination

Key action	Number	Approach	Stakeholders	Timeline
Engagement with stakeholders	C1.1	<ul style="list-style-type: none"> <li>The national CCS-dedicated platform should benefit from the financial support from the Ministry of Industry and Trade and/or the Ministry of Environment. The financial support should be directed to developing a model by (for example) the Environment Centre of Charles University, exploring macroeconomic and environmental consequences of deploying CCS in Czechia and disseminating findings from such studies to all stakeholder groups.</li> </ul>	Universities, Ministry of Industry and Trade, Ministry of Environment, Ministry of Finance, private sector	Short-term
	C1.2	<ul style="list-style-type: none"> <li>Existing global studies from the IPCC, IEA, IRENA and others should be disseminated and external experts invited to Czechia to speak at forums, conferences and other events. This could be particularly beneficial during the <b>Czech EU Presidency</b>.</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations, Permanent Representation of the Czech Republic to the EU, Permanent Mission of the Czech Republic to the OECD and the United Nations	Short-term
International and regional cooperation	C2.1	<ul style="list-style-type: none"> <li>Municipalities and the private sector in <b>regions bordering other countries</b> could explore funding opportunities to estimate the CO<sub>2</sub> transport and storage potential (see Upper Silesia as an example).</li> </ul>	Municipalities, private sector, Czech Geological Survey	Mid-term
	C2.2	<ul style="list-style-type: none"> <li>The Czech government should initiate discussions with the <b>V4 countries</b> to cooperate and explore state aid to finance joint CO<sub>2</sub> transport and/or storage projects via TEN-T, TEN-E and IPCEI<sup>33</sup>. For example, Poland recently approved a CO<sub>2</sub> storage hub in Gdansk (PCI) and a cement plant</li> </ul>	Private sector, ministerial cooperation	Mid-term

<sup>33</sup> Important Projects of Common European Interest.

		in Gorazdze (bordering Czechia) aims to develop a CO <sub>2</sub> transport route to Gdansk.		
<b>Stakeholders cooperation to create the CO<sub>2</sub> market</b>	C3.1	<ul style="list-style-type: none"> <li>The Northern Moravia region could create a <b>local heavy-industry hub and a CO<sub>2</sub> market</b>.</li> </ul>	Private sector, Czech Geological Survey, ministerial cooperation	Mid-term
	C3.2	<ul style="list-style-type: none"> <li>Steel and cement companies, WtE and BtE plants considering <b>CCU</b> could explore <b>cooperation with the chemical sector</b> that can utilise captured CO<sub>2</sub>. Such examples already exist in other EU countries. In Czechia, CO<sub>2</sub> Czech Solution Group could be the leading initiative for CO<sub>2</sub> utilisation.</li> </ul>	Private sector, Czech Geological Survey, ministerial cooperation	Mid-term
	C3.3	<ul style="list-style-type: none"> <li>Scaling-up capture technologies could happen fast in the <b>chemical</b> sector that can also use the captured CO<sub>2</sub> as an input in their own operations.</li> </ul>	Chemical and other private sector, Ministry of Industry and Trade, Ministry of Environment	Short-term
	C3.4	<ul style="list-style-type: none"> <li><b>MND or other gas storage</b> companies could build gas storage facilities that would enable CO<sub>2</sub> storage from small-scale sources. Larger volumes of CO<sub>2</sub> could be delivered to the permanent storage facilities at a later stage.</li> </ul>	Private sector	Mid-term

## D) Social aspects and public support

Key action	Number	Approach	Stakeholders	Timeline
<b>Building public support</b>	D1.1	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade (or Environment) and the foreseen Czech CCS-dedicated platform should create a <b>communication strategy</b> to educate the public about the needs, pros and cons of the CCS deployment.</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations	Short-term
	D1.2	<ul style="list-style-type: none"> <li><b>High-emitting industries</b> are at the centre of current decarbonisation efforts. The <b>media</b> would welcome more proactive communication and dissemination of their efforts towards decarbonisation.</li> </ul>	Private sector, NGOs, civil society organisations, media	Short-term
	D1.3	<ul style="list-style-type: none"> <li>The Czech Geological Survey should continue its website dedicated to CCS and assist in spreading <b>well-balanced news on the CCS development</b>. It could later collaborate with the national CCS-dedicated platform with support from the Ministry of Environment and the Ministry of Industry and Trade.</li> </ul>	Czech Geological Survey, ministerial cooperation, private sector	Short-term
<b>Building awareness</b>	D2.1	<ul style="list-style-type: none"> <li>Podcasts, blogs and other <b>modern ways of communication</b> should be deployed. National CCS stakeholders should individually and/or collectively explore opportunities in the online world to share findings from their work with international experts.</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations	Short-term
	D2.2	<ul style="list-style-type: none"> <li><b>International experts</b> should be invited to Czechia by the government and universities to share insights and findings from their work.</li> <li>The ministries should give CCS a space in media and ministerial events during the <b>Czech EU presidency</b>.</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations	Short-term
	D3.3	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade and the Ministry of Environment should also rely on the <b>research done by civil societies and NGOs, including international work</b> (Bellona, E3G, Bruegel, EPG, WiseEuropa).</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations	Short-term
<b>Improving fairness of the</b>	D3.1	<ul style="list-style-type: none"> <li><b>Regional governments</b> should use existing schemes of <b>support for local communities</b> living in close vicinity to storage facilities of oil &amp; gas fields, where drilling and exploration takes place.</li> </ul>	Municipalities, private sector, NGOs	Mid-term

<b>decision-making process</b>	D3.2	<ul style="list-style-type: none"> <li>The oil &amp; gas companies with the support of the Czech Geological Survey should <b>communicate to the general public</b> the international scientific conclusions on <b>negligible risks from the CO<sub>2</sub> storage leakage</b>.</li> </ul>	Private sector, civil society organisations, NGOs	Short-term
<b>Communication of costs, risks and benefits of CCS/CCU projects</b>	D4.1	<ul style="list-style-type: none"> <li><b>Public consultations</b> on the project overview must be held and <b>environmental impact assessments</b> must be made publicly available.</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations	Mid-term
	D4.2	<ul style="list-style-type: none"> <li>The common interest in CO<sub>2</sub> storage facilities must be stressed publicly.</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations	Short-term
<b>Making sure the CCS project fits the local context</b>	D5.1	<ul style="list-style-type: none"> <li>CCS stakeholders can use existing infrastructure for coal and oil &amp; gas (routes for transport, for example), which is already inherently coupled with regions. The alignment with the local needs must be ensured.</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations	Mid-term
<b>Building trust in decision-makers and other relevant stakeholders</b>	D6.1	<ul style="list-style-type: none"> <li>The Ministry of Industry and Trade and the Ministry of Environment should stress the importance of CCS in the national decarbonisation strategy vis-à-vis the general public including its positive impact on the economy.</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations	Mid-term
	D6.2	<ul style="list-style-type: none"> <li>All stakeholders should regularly share success stories from international CCS pilot projects, emphasising the maturity of the technology and existing experience to learn from.</li> </ul>	Ministerial cooperation, private sector, universities, NGOs, civil society organisations	Short-term

## Chapter 4. Next and immediate steps

We see a shift in the private sector towards CCS technologies, which is exploring opportunities to collaborate with universities to use their laboratory results to pilot projects in commercial plants. This is particularly true for capture technologies. In terms of CO<sub>2</sub> transport, no ongoing research has covered it yet, but it is becoming a focus of all key stakeholders. Geological storage of CO<sub>2</sub> is led by the Czech Geological Survey and MND. Their joint activities aim to prepare depleted oil & gas fields for future pilot storage projects. Recurring comments from all types of stakeholders were about a lack of governmental support beyond R&D, due to which stakeholders are unable to move to pre-feasibility and feasibility studies. Stakeholders demand the government reconsider its position.

### Key immediate actions from Chapter 3 to be implemented:

- The Ministry of Environment and the Ministry of Industry and Trade should publicly demonstrate the importance of CCS and include it in the broader decarbonisation strategies of Czechia, especially in the upcoming revision of the State Energy Policy and Climate Long-Term Strategy<sup>34</sup>.
- The private sector and all key stakeholders should launch the CCS-dedicated platform which would become a strong and stable partner to the government and respective ministries in the debate on CCS development and deployment. The platform would be the main advisor for CCS inclusion in the revision of the state energy and climate strategies.
- Direct financing from the state budget would enable faster exploration of saline aquifers and pre-feasibility and feasibility studies for full-chain CCS projects to be carried out. A lack of finance through other channels is a major hurdle. Overcoming it can significantly accelerate CCS deployment as can be evidenced in other EU Member States (MS) that deploy CCS at a much faster pace.
- The Ministry of Environment should adopt the implementing decree to Czech CCS Act<sup>35</sup> as soon as possible. The financial security regulation for CO<sub>2</sub> storage is currently a missing element for successful commercial storage projects in the future.
- The Czech government with respective ministries should include CCS in discussions on the EU Green Deal and decarbonisation efforts during its Czech EU Presidency. Showing the interest of CEE countries in the CCS deployment is a crucial point for the successful transfer of knowledge and could enable the inclusion of CEE countries in future international projects, especially to build CO<sub>2</sub> transport and storage infrastructure.
- The Czech government should consult other EU governments and international platforms and fora to increase collaboration and more frequently disseminate knowledge and practical experience with national stakeholders at all levels.

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<sup>34</sup> In English the official name is *Climate Protection Policy of the Czech Republic*.

<sup>35</sup> Act No. 85/2012 Coll.

