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Policy Paper

Potential for CCS in V4 – will we seize the momentum?

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Contents

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Instroduction

Twelve years have passed since the introduction of the EU carbon capture and storage (CCS) Directive[1] and a plan for 12 EU demonstration CCS projects by 2015 has never been realized.[2] Still, the last years saw a greater interest with an increase[3] in CCS plants[4] deployment globally and present a new opportunity for CCS projects to materialize. Although the original purpose for CCS was mainly to "catch" the emissions in the energy sector, coal-fired and natural-gas fired power plants, most of the promising projects prepared under the EEPR[5] and NER300, such as Janschwalde (Germany), Bełchatów (Poland) or Getica (Romania) failed.[6] Then, CCS has started to be thought of as a net-zero tool and a valuable asset for decarbonization in other sectors, too. Today, the most promising goal of CCS might be to allow for bioenergy CCS (BECCS), direct air CCS (DACCS), to abate carbon dioxide from operations in energy sector, yet with the focus on waste-to-energy concept, and mainly to decarbonize the hard-to-abate sector with its process emissions – e.g. cement, steel, refinery or chemical production.

It is certainly not the most important decarbonization tool, yet its necessity is confirmed by many global stakeholders, including IPCC, IRENA or IEA. Large and ambitious projects are under construction in the Western Europe, but the Central and Eastern Europe (CEE) and, specifically, the Visegrad Group (V4) might be lacking such ambitions. This paper aims to 1) introduce the CCS technology 2) show the progress made in V4 and 3) stress new challenges and opportunities to decarbonise the V4's vital industries and reach net-zero by 2050. It should appeal and encourage policy makers to take ambitious steps by highlighting all the research and projects already done in the V4 countries.

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0031
[2] https://ec.europa.eu/commission/commissioners/2019-2024/simson/announcements/speech-commissioner-simson-carbon-capture-utilisation-and-storage-forum_en
[3] https://www.globalccsinstitute.com/resources/global-status-report/
[4] Along with CCU (carbon capture and utilization) and CDR (carbon dioxide removal).
[5] The European Energy Programme for Recovery.
[6] All onshore CCS project failed to get on the commercial scale. Offshore CCS projects were more successfull. See https://www.sciencedirect.com/science/article/pii/S187661021731929X

Brief technology description

CCS-based technology is known for almost 50 years.[7] Although there are large-scale projects around the globe, it is still considered the least economically feasible decarbonization solution in some countries and, specifically, in some industries. However, it may not be possible to achieve net-zero economy globally by mid-century without the use of CCS. While the original purpose of CCS was to inject CO_2 underground to enhance oil recovery (EOR)[8], decarbonization goal has been stressed only in the last two decades. So, what does the "CCS" stand for?

Carbon – Carbon dioxide, as one of the greenhouse gases (GHGs), can be, under specific conditions, separated, processed, transported, further utilized and stored. Out ofall GHGs, CO_2 may be literally called "The Most Wanted" and all the latest reports from IPCC[9], IRENA[10] or IEA[11] only confirm the role of anthropocene in increasing the amount of atmospheric CO_2 and its influence on the climate change.

Capture – This is the first stage of the CCS process. Once the gases are released from the industrial processes, be it energy or manufacturing process CO_2, CO_2 may be separated from other gases and particles. Capture technologies may be fitted well to both coal and gas-fired power plants, cement plants, refineries, or steel mills, which are responsible for most of the industrial CO_2 emissions worldwide.[12]

Storage – CO_2 ends up being injected and stored in geological underground structures and rock formation, as well as dissolved in saline aquifers, usually at depths of one kilometer or more.[13] Without the possibility to store CO_2, capture technologies do not offer the possibility to effectively reduce or remove atmospheric CO_2. In such case, captured CO_2 may serve for **utilization** – for example production or synthesis of new products (e.g., methanol, building

[7] https://www.sciencedirect.com/science/article/abs/pii/S1040619021000890
[8] https://www.globalccsinstitute.com/about/what-is-ccs/
[9] https://www.ipcc.ch/sr15/
[10] https://irena.org/publications/2021/Jun/World-Energy-Transitions-Outlook
[11] https://iea.blob.core.windows.net/assets/beceb956-0dcf-4d73-89fe-1310e3046d68/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf
[12] https://www.globalccsinstitute.com/about/what-is-ccs/
[13] Ibid.

materials) or non-conversion processes (e.g., food, beverages or in greenhouses).[14] While such use does not remove or reduce CO_2, it can be justified in a short-term to increase economic feasibility of capture plants

Besides the carbon capture and storage, **transport** of CO_2 is a necessary step to connect the place of capture to the place of storage or utilisation. Although there is a focus to find the nearest storage points, in reality, the most suitable storage sites are usually offshore and transport of more than thousand kilometers is inevitable.

Once this full-chain CCS is deployed from the industrial facility to the storage site, it is possible to count the amount of CO_2 abated. It is crucial to distinguish when one reads about CCS how much of CO_2 one can store ("CO_2 stored"), compared to how much of CO_2 emissions are released during the process, too. The final measurement of how much atmospheric CO_2 was abated is simply called "CO_2 abated". Finally, "CO_2 removed" refers to the actual removal of CO_2 from the atmosphere – the key concept for the upcoming decades according to the European Commission Communication – carbon removal through BECCS and DACCS.[15]

CCS seems like optimal solution for hard-to-abate industries such as cement production, chemicals, refineries, or steel production. It is predicted to play a significant role in waste-to-energy plants and BECCS. However, both high CAPEX and OPEX make it difficult to finance such industrial technology and to persuade stakeholders about its deployment. Finally, many issues are connected to the social and political acceptance of this technology. Yet, in the light of recent CCUS Forum and planned Commission Communication regarding carbon cycles, it seems that the European Union will start to tackle these concerns conceptually.[16]

[14] https://zeroemissionsplatform.eu/about-ccs-ccu/what-is-ccu/
[15] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13066-Climate-change-restoring-sustainable-carbon-cycles_en
[16] https://ec.europa.eu/info/events/carbon-capture-utilisation-and-storage-forum-2021-oct-11_en

What is the current state of play in the V4 countries?

Selected expert study dealing with V4 climate policy and sustainable finance consider CCS the least feasible way of energy sector decarbonization.[17] It mainly points to the fact that CCS technology is still perceived as immature and costly. In some articles, CCS is not considered the part of energy sector debate at all.[18] It is not conducive to progress in terms of policymaking. Therefore, lack of attention and human capital has been oriented towards the deployment of CCS in the V4 so far. However, as the price of EU ETS allowances rises and net-zero target has been stressed many times by respective governments, the debate has been renewed and new projects are targeted at the CEE region and its opportunity to deploy CCS, too.[19] The socio-economic perspectives of CCS deployment seem positive in the light of current events as described in the next chapter.

(scale from 0 to 100)	Czech Republic	Hungary	Poland	Slovakia
Policy Indicator	21	20	23	28
Storage Indicator	48	58	68	39
Legal and Regulatory Indicator	56	56	51	54
CCS Requirement Indicator	29	29	51	24
CCS Readiness Index	41	44	47	40

Table 1 – Global CCS Institute: CCS indicators (as of October 2021)[20]

[17] https://europeum.org/data/articles/paper-sustainable-finance-energy-v4.pdf
[18] https://www.amo.cz/wp-content/uploads/2015/11/Energy-security-of-the-V4-countries-How-do-energy-relations-change-in-Europe.pdf
[19] https://bellona.org/news/ccs/2021-01-the-future-of-ccs-in-the-central-and-eastern-european-region
[20] https://co2re.co/

As of October 2021, CCS deployment is far from commercial projects in the V4 countries, although CO_2 injection as a method for EOR has been pioneered in Hungary in the 1960s.[21] Table 1 shows the current levels of CCS indicators, based on the Global CCS Institute rating. Clearly, Poland is the most prospective country for CCS. Both the storage indicator and the CCS requirement indicator are much higher compared to other V4 countries. However, the CCS readiness index is not that different due to low legal and regulatory and policy indicators.

Table 2 shows that Poland has the largest total CO_2 emissions in the V4 countries, while it possesses the largest estimated CO_2 storage capacity. As we will see later, Poland, as a coastal state, also wants to use the opportunity to join an international offshore storage project in the North Sea CCS hub.[22] In the long run, such an advantage will be key for the transport of CO_2, if onshore storage units are not deployed in V4. See Figure 1, where possible onshore storage units are depicted.

Although the storage units in Slovakia might seem almost unnoticeable, the estimated storage capacity in saline aquifers is large (Table 2). Finally, see Figure 2 where the large-scale CO_2 emitters are highlighted by the red dots. The map is not up-to-date, but the location of emission intensive industries can be considered very similar to the current one. Once we turn our attention to possible clusters and industrial hubs, the location of emitters is essential for CCS scale-up to benefit from economies of scale.

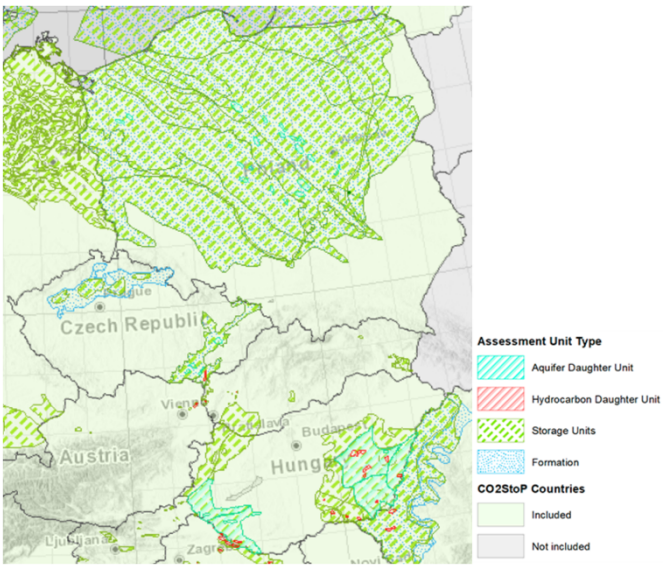

Figure 1 – CO2StoP: Map of storage units[23]

[21] CC4CEE WP3 Summary Report, available soon at: https://ccs4cee.eu/.
[22] https://zeroemissionsplatform.eu/about-ccs-ccu/css-ccu-projects/
[23] http://www.europe-geology.eu/map-viewer/

($MtCO_2$)	Czech Republic	Hungary	Poland	Slovakia
2019 CO_2 emissions[24]	116	44	306	28
CO_2 storage capacity in deep saline aquifers	766	140	1,761	1,716
CO_2 storage capacity in hydrocarbon fields	33	389	764	-
CO_2 storage capacity in coal fields	54	87	415	-
CO_2 storage capacity – total estimate	833	616	2,940	1,716

Table 2 – EU GeoCapacity conservative storage estimates[25]

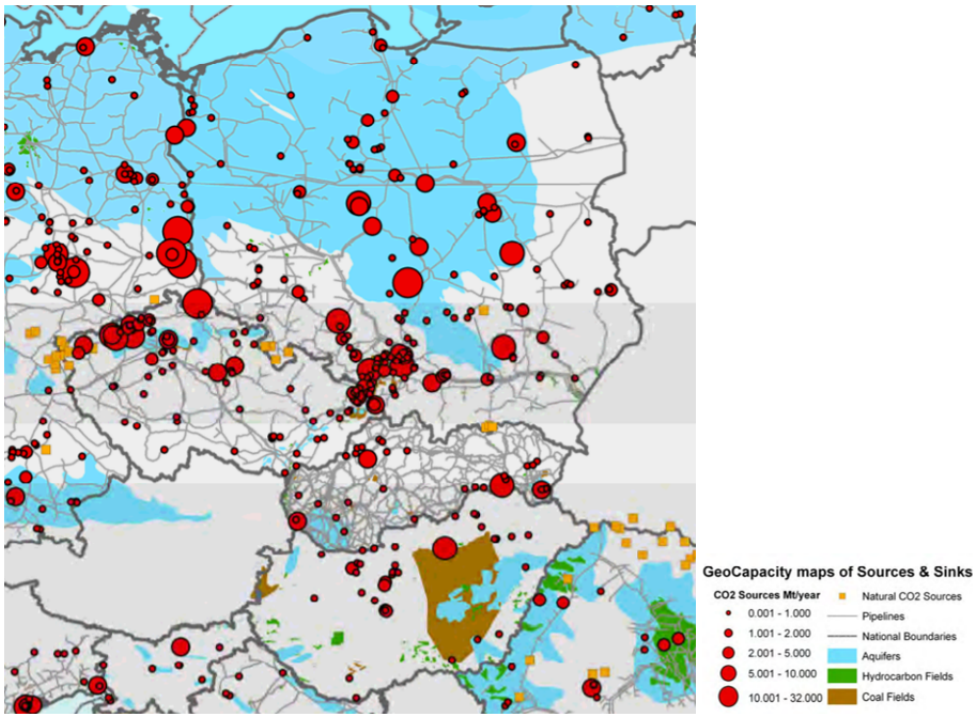

Figure 2 – EU GeoCapacity: Map of CO_2 sources and sinks in V4 countries[26]

[24] https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer
[25] http://www.geology.cz/geocapacity/publications/D42%20GeoCapacity%20Final%20Report-red.pdf
[26] http://www.geology.cz/geocapacity/publications/D42%20GeoCapacity%20Final%20Report-red.pdf

Although it is not publicly widespread, all the countries have done vast research and geological works towards the CCS deployment since 2004 (joining the CASTOR[27] project at that time). Unfortunately, no CCS commercial projects have been successfully realized in the region. This paper starts the analysis of the Czech Republic, followed by Poland and its huge storage and transport potential, Slovakia with the large aquifer storage capacity estimates and Hungary, actively using the EOR method of CO_2 injection for enhanced oil recovery.

Czech Republic

Although the Czech Republic does not have a clear 2050 net-zero plan, it has been stressed by the McKinsey company that CCS will play a role in achieving the climate neutral economy by 2050.[28] Figure 3 represents the estimated CCS requirement to abate 8 $MtCO_2$ by 2050. Until 2020, it was prohibited to start any commercial carbon storage project, and the political background was not really in favor of the storage technology. Since then, commercial projects can only be operated with a limitation of 1 $MtCO_2y^{-1}$ stored in a single site.

As of October 2021, there are 5 running projects in different research areas in the Czech Republic. Probably the most important project is the CO2-SPICER – CO_2 Storage Pilot in a Carbonate Reservoir, under the KAPPA programme supported by Norway Grants.[29] The project focuses on a depleted hydrocarbon field and aims to prepare the field for a pilot storage project. If finished successfully in 2024, this could lead to a first-of-its-kind CCS project in the Czech Republic. Another project, BIO-CCS, focuses on the use of biomass for bioenergy power and heat production coupled with CCS[30], which is foreseen as one of the most prospective sectors for CCS deployment due to the negative emissions potential.[31] METAMORPH project aims to develop new and innovative capture technology using a special membrane system.[32] CCUS CZ-NO project aims to disseminate the know-how and build better Czech-Norwegian

[27] https://cordis.europa.eu/project/id/502586/reporting
[28] https://www.mckinsey.com/cz/our-work/pathways-to-decarbonize-the-czech-republic
[29] https://co2-spicer.geology.cz/cs
[30] http://energetika.cvut.cz/bio-ccs-projekt/
[31] https://www.nature.com/articles/s41558-020-0885-y
[32] https://www.metamorph.cz/cz/

connections in the field of CCS technology.[33] Last but not least, CCS4CEE aims to seize the momentum for CCS in the CEE region.[34] The last 3 projects are all supported by Norway Grants.

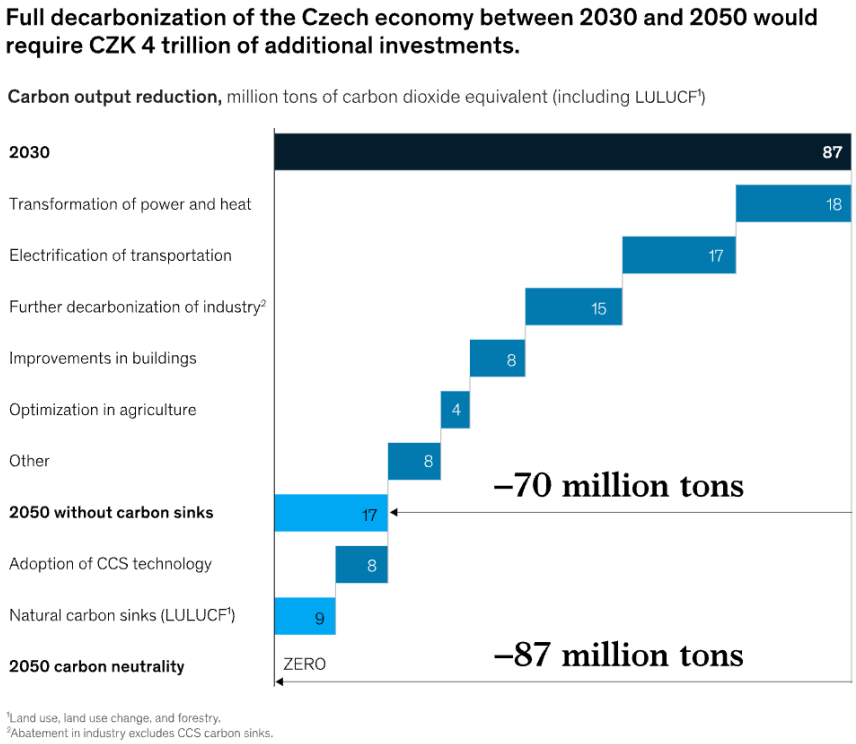

Figure 3 – 2050 carbon neutrality in the Czech Republic with the adoption of CCS[35]

As we mention in the CCS4CEE project report for the Czech Republic[36], there were around 20 previous research projects both in the field of capture and storage stages. These were usually led by academia or Czech Geological Survey, but not many private actors were involved. Although the knowledge and experience of researchers is very competitive, both the support of the government and the demand from the private sector were relatively low to initiate any further steps towards CCS. However, this seems to be changing in a way, mostly due to the grants from Norway, which are perceived as an impulse for further research and a future pilot

[33] https://beepartner.cz/konference.php
[34] https://ccs4cee.eu/
[35] https://www.mckinsey.com/cz/our-work/pathways-to-decarbonize-the-czech-republic
[36] CCS4CEE country report: Czech Republic, available soon at: https://ccs4cee.eu/.

project.[37] During the CCS4CEE project, it became publicly known that Českomoravský cement (part of the HeidelbergCement parent group) plans a pilot CCS project at Mokrá plant with local CO_2 storage and 400 $ktCO_2y^{-1}$ stored.[38]

Poland

Poland is responsible for the highest share of emissions in V4 countries. Although there were attempts to show that 2050 net-zero targets could be achieved and would be beneficial for the Poland economy[39], no commitments to the 2050 target were made on behalf of Poland. 70% of the Polish largest emitters (>0.1 $MtCO_2eqy^{-1}$) are power plants, predominantly lignite-fired.[40] The Bełchatów power plant is by far the largest CO_2 emitter in the whole EU ETS with over 30 $MtCO_2eq$ emitted in 2020[41] and also, a plant with cancelled CCS projects in the past.[42]

Although Table 2 gives a conservative estimate of less than 3 $GtCO_2$ storage capacity, new estimates found by Poland national assessment programme shows an approximate capacity of around 15.5 $GtCO_2$.[43] Not only the CO_2 storage units and sources of CO_2 are feasible for CCS deployment, but also the general path towards CCS looks the most promising from all V4 countries. Already in 1996, the gas field Borzęcin started to use CO_2 for enhanced gas recovery (EGR). Two demonstrations CCS projects have been abandoned yet very close to realization. Two carbon capture projects were operated in coal-fired power plants and one carbon storage project was realized with CO_2 injection into coal seams.[44]

Today, project ACCSESS under the EU's Horizon 2020 programme aims to establish a pilot CCS project at the HeidelbergCement facility of Górażdże plant and create a full-chain CCS infrastructure, transporting the captured CO_2 to the Northern Lights facility, offshore Norway.[45] Furthermore, Poland aims at the realization of CO_2 transport hub project under the Projects of

[37] Ibid.
[38] Ibid.
[39] https://www.wwf.eu/?961391/Poland-2050-climate-neutrality-feasible-and-beneficial---report
[40] CC4CEE WP3 Summary Report, available soon at: https://ccs4cee.eu/.
[41] Ibid.
[42] https://sequestration.mit.edu/tools/projects/index_cancelled.html
[43] Ibid.
[44] CCS4CEE Country Report: Poland, available soon at: https://ccs4cee.eu/.
[45] https://www.heidelbergcement.com/en/pr-17-09-2021

Common Interest of EU. "Poland EU CCS Interconnector" should be an open access multi-modal CO_2 Export Hub close to the North Sea basin, connecting the nearby emitters in Poland and potentially other emitters in the CEE region.[46] Lastly, the PilotSTRATEGY project under the EU's Horizon 2020 programme aims to enable large-scale CCS projects in different regions across the EU, one being in Poland, Upper Silesia, a vastly industrial area on the border with the Czech Republic.[47]

Slovakia

Slovakia has a rich natural environment and, for a country with the lowest CO_2 emission in V4, relatively large storage potential in saline aquifers (see Table 2). However, as reported during the CCS4CEE project, there is a large area with prohibited geological survey and, also, some potential storage units lie under areas of protected water zones.[48] Although Slovakia participated in EU projects such as CASTOR or EU GeoCapacity (other V4 countries participated, too), there were only a few projects on CCS and its deployment. The latest EU project, ENOS, studied the opportunity for cluster-based CCS projects with the use of EOR in the Vienna Basin. Yet the storage potential was only examined in the Czech Republic.[49]

A Further interest of Slovak stakeholders is a necessary step towards CCS deployment. Although the Slovak economy is based on hard-to-abate industries, such as steel, refinery and cement, not much support for CCS is seen from the government.[50]

Hungary

Compared to Table 2, based on the EU GeoCapacity storage capacity estimates, the subsequent review during the CGS Europe project in 2013 estimated the overall storage capacity to be 847 $MtCO_2$, consisting of 750 $MtCO_2$ capacity in deep saline aquifers, 97 $MtCO_2$ capacity in

[46] https://zeroemissionsplatform.eu/about-ccs-ccu/css-ccu-projects/
[47] https://pilotstrategy.eu/explore-the-regions
[48] CCS4CEE Country Report: Slovakia, available soon at: https://ccs4cee.eu/.
[49] http://www.enos-project.eu/media/22618/enos-d67_final-version.pdf
[50] CCS4CEE Country Report: Slovakia, available soon at: https://ccs4cee.eu/.

hydrocarbon fields and no potential in coal fields.[51] More optimistic theoretical capacity estimates point to the capacity of 2 $GtCO_2$ in saline aquifers.[52]

Although Hungary has neither pilot nor demonstration CCS projects[53], the country has a rich history of EOR and EGR. The main oil & gas company in Hungary, MOL, has been operating a facility for CO_2-EOR in the Szank oil field since 1992 and permanently stored already 2 $MtCO_2$.[54]There is also a possibility for scaling up its activities, since the MOL Strategy 2030+ counts on deploying CCS. This would help to initiate the debate in Slovakia, as MOL has a large market share and runs the operations there, too. Otherwise, the private sector is still awaiting more pro-CCS oriented support on the EU level.[55]

To wrap up the V4 countries analysis, Table 3 shows the very basic precondition for CCS deployment in the region – permission for storing CO_2 and subsequent implementing decree approval. In the Czech Republic and Slovakia, implementing decree (regarding the financial guarantees) is missing and should be adopted soon to enable the large CCS commercial projects.

	Czech Republic	**Hungary**	**Poland**	**Slovakia**
CO_2 storage permitted?	Only up to 1 $MtCO_2y^{-1}$	Yes	Onshore, demonstration only	Yes
Implementing decree in place?	No	Yes	Yes	No

Table 3 – Storage permission in V4 countries (as of October 2021)[56]

[51] CCS4CEE WP3 Country Report: Hungary, available soon at: https://ccs4cee.eu/.
[52] http://www.cgseurope.net/UserFiles/file/News/CGS%20Europe%20report%20_D2_10_State%20of%20play%20on%20CO2%20storage%20in%2028%20European%20countries(1).pdf
[53] CCS4CEE WP3 Country Report: Hungary, available soon at: https://ccs4cee.eu/.
[54] https://co2re.co/FacilityData
[55] CC4CEE WP3 Summary Report, available soon at: https://ccs4cee.eu/.
[56] Ibid.

What makes the CCS deployment a long-term goal and an unattainable wish in the short term is the complexity of all three stages of the chain – capture, transport and storage. Capture technologies are mature and have been applied in many projects.[57] Storage research and geological survey have a long history. All the experience may be applied for onshore storage primarily implementing the global EOR experience. However, building new linear construction and building the right CO_2 infrastructure for large scale projects is something that practically slows down the CCS deployment. EU-level investments are necessary for CCS deployment and policy and other instruments need to incentivise investors to invest in this technology, too.

Opportunity to seize the momentum?

The main barriers of CCS deployment are usually lack of finance and low political will. As it was highlighted during the current CCUS forum by the European Commission[58], there is now much stronger agreement on the necessity of applying CCS to reach the net-zero target. 2050 is just the beginning and some countries might well go for net-negative emissions and help to reach the global net-zero balance. 14% of the total emissions reduction by 2060 must come from CCS.[59]

During the CCS4CEE Slovenia seminar[60], Chris Bolesta – CCUS policy lead at DG Energy[61] – highlighted the main EU policy tools for CCS. Table 4. highlights policies that are currently under revision (in italics), policies that are new (bold), and already existing policies.

[57] Capture technologies are not in the scope of this paper.
[58] https://ec.europa.eu/info/events/carbon-capture-utilisation-and-storage-forum-2021-oct-11_en
[59] https://www.sintef.no/en/shared-research-areas/ccs/
[60] https://ccs4cee.eu/event/invitation-the-current-landscape-of-ccs-in-slovenia/
[61] Directorate-General for Energy, European Commission.

Policy	Effect
CCS Directive	Ensures CCS is operated safely
Horizon Europe, Innovation Fund, CEF	Project support
EU ETS	*Sets the carbon price – allowances not surrendered in case of CCS*
TEN-E	*Supports investments in CO_2 pipelines*
RED II	**Supports CCU fuels**
EU Sustainable Taxonomy	**CCS approved as green investment**
Carbon removal certificates	**Certificates for Carbon Dioxide removals**
NewGenerationEU	**Countries can spend on CCUS recovery fund**

Table 4 – EU policy tools for CCS/CCU[62]

We have many supporting policies at our disposal, yet some are perceived as the cornerstones for CCS deployment. As Christian Busoi – Chair of Committee on Industry, Research and Energy[63] – mentioned during the European Commission CCUS forum[64], TEN-E regulation should be newly aligned with the ultimate goal of the Green Deal by including a full-chain CCS infrastructure.[65] The goal of inclusion of all transport modes for CO_2 and retrofitting the existing gas infrastructure has been also stressed by the Zero Emissions Platform[66] - one of the key initiatives to boost CCS deployment. Furthermore, it is predicted that the Innovation Fund (as well as the Modernization Fund) could almost double due to the rising price of EU ETS allowances.

[62] Ibid. CEF – Connecting Europe Facility, EU ETS – EU Emission Trading System, TEN-E – Trans-European Networks for Energy, RED II – Renewable Energy Directive II.
[63] European Parliament.
[64] https://ec.europa.eu/info/events/carbon-capture-utilisation-and-storage-forum-2021-oct-11_en
[65] https://bellona.org/news/eu/2021-09-ten-e-regulation-moving-to-trilogues-important-steps-in-right-direction-on-governance-co2-storage-and-transport-but-door-still-left-open-to-fossil-gas-projects
[66] https://zeroemissionsplatform.eu/wp-content/uploads/CO2-Transport-report-infographic-1.pdf

Before the EC CCUS forum, The Industry, Research and Energy Committee of the EP approved its position on the selection process of energy PCIs[67] and highlighted the need to invest in CO_2 infrastructure to achieve the net-zero goal.[68] One of the currently proposed projects is the "Poland EU CCS Interconnector" (see the previous chapter).

Highly awaited Commission Communication Restoring Sustainable Carbon Cycles will be published in Q4 2021.[69] Currently in the feedback period, the proposal aims to set clear and specific rules for carbon accounting, data collection, carbon farming – all of these aligned with the Fit for 55 goals by 2030. Ultimately, it should develop a long-term vision for sustainable carbon cycles – including capture, storage and use of CO_2. This initiative represents another necessary step towards new CCS business models.[70]

Coming back to the V4 countries and the CEE region, it is exactly the business model that private sector is missing, according to the results of the CCS4CEE project.[71] As the EC and the EP seem to set the pace and the path towards confirmation of CCS as a necessary decarbonization tool, this unanimous decision could lead by example and help the local V4 governments to follow the path. Such words were confirmed by Frans Timmermans on the EC CCUS forum.[72] Many great projects are run around the world, and it is only up to the V4 group to realize how important the CCS market can be.

In the Czech Republic, progressive work is done in cooperation with the Norwegian partners and through the EEA & Norway Grants.[73] Many projects were done in the past years[74] and it is considered by our researchers as the new impulse for CCS.[75] Such local projects can lead to

[67] Projects of Common Interest.
[68] https://www.europarl.europa.eu/news/en/press-room/20210923IPR13404/energy-infrastructure-boost-hydrogen-and-carbon-capture-phase-out-natural-gas
[69] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13066-Climate-change-restoring-sustainable-carbon-cycles_en
[70] https://zeroemissionsplatform.eu/wp-content/uploads/Infographic-Europe-needs-robust-accounting-for-Carbon-Dioxide-Removal-January-2021.pdf
[71] CC4CEE WP3 Summary Report, available soon at: https://ccs4cee.eu/.
[72] https://ec.europa.eu/info/events/carbon-capture-utilisation-and-storage-forum-2021-oct-11_en
[73] https://www.forskningsradet.no/en/apply-for-funding/international-funding/EEA/eos-midlene-tsjekkia/
[74] https://www.eeagrants.cz/en/closed-programming-period/eea-and-norway-grants-2009-2014/programmes/norway-grants-2009-2014/cz08-carbon-capture-and-storage/cz08-approved-projects
[75] https://uefiscdi.gov.ro/resource-81064

bigger projects funded through the Innovation Fund or Horizon Europe. The CEE countries, including the V4 group, cannot build their own business case without international cooperation. Based on the findings in this paper, five recommendations are proposed to the policy makers and stakeholders across the V4 countries and industries.

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Recommendations

1. Build a knowledge sharing platform to advocate the voice of industrial and research stakeholders of the V4 unanimously.

2. Look for application opportunity for international project in order to create large-scale projects and industrial hubs, with Poland as a large transport hub potential.

3. Amend the currently incomplete legislative CCS framework and try to look for solutions to enable the V4-level projects and business models.

4. Start an extensive debate with responsible national Ministries to get the support for V4-level project application to Innovation Fund or Europe Horizon projects.

5. Start advocating the CCS technology publicly and show transparently both pros and cons of the CCS deployment so the public acceptance is not an issue in the future.

Conclusion

This paper aimed to 1) introduce the CCS technology 2) show the progress made in V4 and 3) stress new challenges and opportunities to decarbonise V4's vital industries and reach net-zero by 2050. As we have seen, the V4 countries are on a good track, especially Poland and the Czech Republic with ongoing projects towards first pilot projects of full-chain CCS or, as in the case of Poland, hopefully a future CO_2 transport hub on the very North of the country with the connection to another international project, Northern Lights. The EU CCS momentum is here and the V4 should use this opportunity. While the path set by the EC and the EP is clear, the financial instruments, including funding for CEE and V4, are still behind to help scale-up CCS projects. The demand for Innovation Fund is 20-times higher than available funding, and the potential for CCS projects in V4 has not been exploited yet. To address that, five recommendations were proposed focused on the common goal of the V4 group as a whole. Establishing a single strong voice of V4 and creating a common, large-scale project could help to allocate enough funding to the region. The technology is mature, the know-how of scientists is excellent, too, and, today, the financial incentives for the private sector also exist. Such momentum should be seized.

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About the author

Michal Hrubý has completed his master's degree in economics at Škoda Auto University and is now looking for an opportunity to pursue a PhD. His research focuses on green economics, industrial decarbonisation and consumer behaviour. He has been contributing to the student journal EkonTech since 2020. During his master's studies he participated in a student grant competition project focusing on sustainable consumption behaviour.

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In the first half of 2016, eight think-tanks from the Visegrad Group that have been cooperating in the Think Visegrad platform, agreed on the idea proposed by the EUROPEUM Institute for European Policy, to create a common representation office in Brussels. The main motivation for it is the need to encourage debate on issues of common interest to the EU and the V4 and explain the positions of the V4 to a wide audience. Think Visegrad in Brussels would like to project an image of constructive partners, to explain the dynamics of the debates within our regions and to highlight our active contributions to EU policy-making.

For more information about Think Visegrad and its members visit www.thinkvisegrad.org.

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