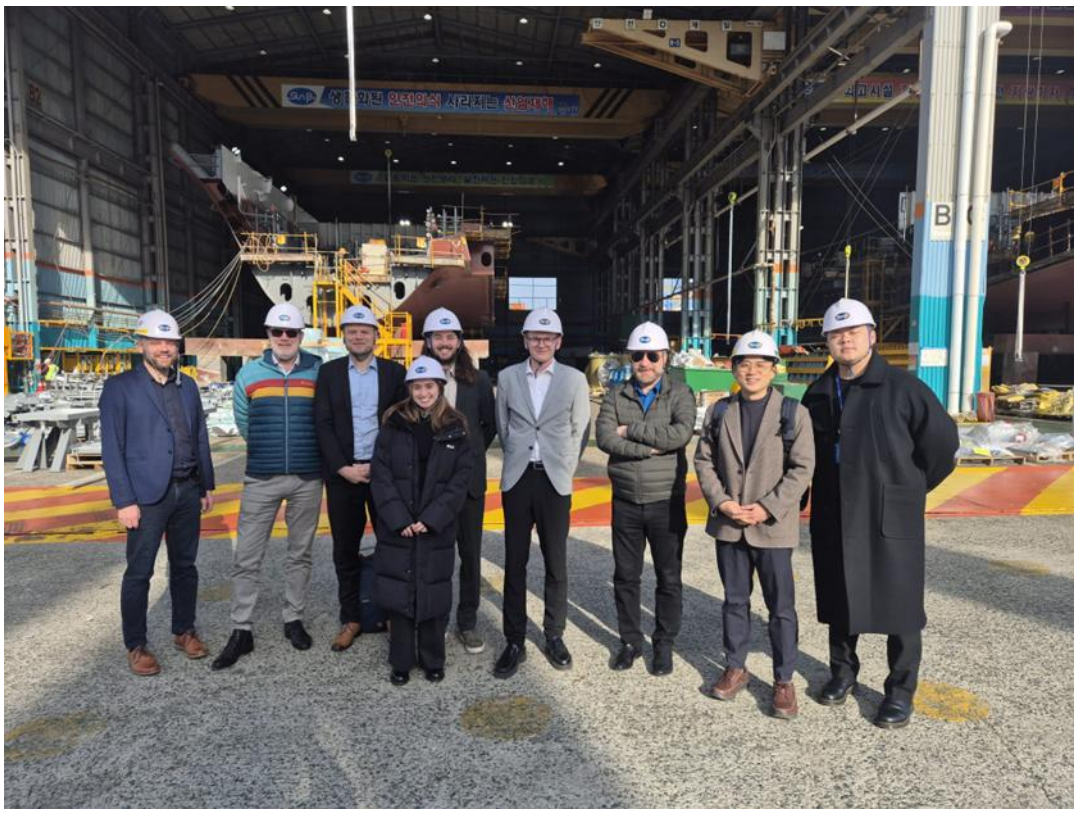
Final Report

CCUS FACT-FINDING MISSION TO KOREA November 2025



Clean
The Danish Water
& Environmental Cluster

GREEN HUB DENMARK

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The Danish government's climate plan has led to a strong focus on the need to capture and store CO_2, as well as on the utilization of CO_2 for Power-to-X applications and the development of future alternative materials. The development of CCUS technologies in Denmark has gained momentum, supported by targeted initiatives such as national research and innovation programmes, industrial lighthouse projects, direct public funding for CCS and pyrolysis, and regulatory measures including fuel blending mandates. These initiatives have generated valuable experience, accelerated technological development, and strengthened collaboration between public and private stakeholders. The experiences from Denmark's CCUS development provide a relevant reference framework for countries such as South Korea, which similarly face the challenge of significantly reducing CO_2 emissions towards 2030 and 2050 while promoting a more circular economy.

FOREWORD

It is with great pleasure that we present the outcomes of the mission to South Korea, which has provided valuable insights into the country's advancing CCUS ecosystem. South Korea has, in recent years, established a strong foundation for the development and deployment of carbon capture, utilization and storage (CCUS) technologies, supported by a highly developed industrial base and close collaboration between industry, research institutions, and public authorities. South Korea is making targeted investments in large-scale demonstration projects, infrastructure development, to support the commercialization and scaling of CCU(S) solutions.
The experiences and knowledge gained from the mission are expected to be of value to Danish companies and universities engaged in the CCUS field, offering inspiration for technology development and future international collaboration.

We would like to express our sincere appreciation to Energistyrelsen for their financial support and commitment, which made this important exchange of knowledge and strengthening of ties between Denmark and South Korea possible.

EXECUTIVE SUMMARY

This final report summarizes the outcomes of the C2K Market Study, the subsequent CCU fact-finding mission to South Korea, and the technical report prepared by the Danish Technological Institute (TI). Together, these activities provide a consolidated understanding of South Korea's CCU(S) ecosystem and identify concrete opportunities for strengthening Denmark-Korea collaboration. The report highlights the complementarity between South Korea's strong capabilities in industrial capture, utilization technologies and large-scale

demonstrations, and Denmark's strengths in system integration, PtX, CO_2 transport and offshore storage frameworks. Based on this, the report identifies six key findings and three recommendations outlining the most relevant pathways for future collaboration.

6 Key Findings:

1. **CO_2 utilization over geological storage**
   Korean stakeholders prioritize CCU for value creation (fuels, chemicals, materials, maritime), driven by limited domestic storage capacity and a market-led approach where storage is seen mainly as a cost.

2. **Korea emerging as a leader in onboard carbon capture (maritime)**
   Korea has strong industrial and R&D capabilities in shipboard carbon capture, including compact and containerized solutions, supported by leading maritime institutes and shipbuilding actors.

3. **Emerging CDR opportunities: Direct Ocean Capture and enhanced rock weathering**
   CDR is early stage but gaining interest, with potential collaboration tracks including biogenic CO_2 capture/pyrolysis, enhanced weathering (e.g., steel slag), and DOC requiring R&D, pilots, and robust MRV.

4. **Complex funding landscape**
   Korea offers substantial innovation funding, but access and collaboration pathways are complex, often top-down, and relationship-based—making long-term engagement and trust-building essential.

5. **Demonstration-led innovation with conditional market scale-up**
   Korea is strong in pilots and demonstrations, but scaling beyond pilot depends on clear economic/regulatory drivers; utilization pathways with market demand scale faster than storage-led solutions.

6. **Industry-driven innovation ecosystem anchored in strong R&D–industry links**
   Close integration between large corporations, universities, and RTOs enables rapid technology maturation and deployment, best leveraged when collaborations are framed around industrial relevance and competitiveness.

3 Recommendations:

1. **Collaborate on integrating Maritime Carbon Capture systems**
   Establish joint pilots and roadmaps linking Korean onboard capture technologies with Danish system integration, CO_2 logistics, and offshore storage to build a full ship-to-storage value chain.

2. **Use clusters and technoparks as key brokers for collaboration**
   Strengthen structured matchmaking via Danish clusters and Korean technoparks/innovation hubs to identify partners, align needs, and mature collaborations into project-ready pipelines.

3. **Foster collaboration through European funding programmes (Horizon Europe)**
   Use Horizon Europe as a stable framework for long-term Denmark–Korea projects, leveraging complementary roles (DK system integration/analysis; Korea engineering, pilots, scale-up) and building 1–2 flagship proposals annually.

Together, the findings and recommendations offer a structured foundation for strengthening bilateral collaboration and translating identified opportunities into concrete projects and long-term partnerships.

BACKGROUND

The Danish government's climate plan has, among other things, led to a strong focus on the necessity of capturing and storing CO2, as well as utilizing CO2 for Power-to-X applications and for the development of future alternative materials. The development of CCUS technologies in Denmark is accelerating, supported by initiatives such as the INNO Missions (funded by Innovation Fund Denmark), the business lighthouse CO2Vision (funded by the Danish Board of Business Development and the Just Transition Fund), direct state funding for CCS and pyrolysis, as well as blending mandates for fuels.

There are many valuable lessons to be learned, new technologies to be developed, and new collaborations to be established in order for Denmark to succeed in achieving its goal of reducing CO_2 emissions by 70% by 2030 and in creating a more circular economy as part of the carbon value chain.

70 % by 2030

WHY KOREA?

Prior to the Danish CCUS delegation's study visit to South Korea, Energy Cluster Denmark and CLEAN conducted the C2K Market Study to establish a shared strategic foundation for dialogue and subsequent technical analysis. The study mapped South Korea's CCU(S) policy and regulatory framework, market potential, industrial project pipeline, and stakeholder ecosystem, with the aim of identifying concrete opportunities for Denmark- Korea collaboration.

The Market Study confirms that both countries view CCUS as a critical enabler for decarbonising hard-to-abate sectors and reaching carbon neutrality by 2050. It highlights a strong complementarity between South Korea's large-scale industrial capture and utilization initiatives and Denmark's advanced capabilities in CO_2 transport, offshore storage, system integration and PtX. While South Korea has developed a broad portfolio of CCU pilots and megaprojects across petrochemicals, steel, cement, power and maritime sectors, Denmark is further advanced in cross-border CO_2 transport and offshore storage frameworks.

In addition, the study identifies key policy drivers and emerging market mechanisms in South Korea, alongside structural barriers related to storage capacity, permitting complexity and project-level bankability. These insights provide the strategic context for the present report, which builds on the Market Study by translating identified opportunities into focused technical feasibility assessments of selected CCU value chains and collaboration models.

South Korea has strong prerequisites for developing an advanced CCU/CCUS ecosystem. The country combines a large and technologically mature industrial base in steel, cement, petrochemicals, energy, and shipping.

South Korea has also established a broad portfolio of pilot, demonstration, and megaprojects, supported by a strong innovation and research environment where industry, universities, and public actors work closely together. This makes the country an attractive partner for Denmark, which can contribute complementary strengths in areas such as CO2 transport, storage, and system integration.

The purpose of engaging with South Korea was therefore to examine:

- Investigating the status of South Korea's CCU(S) ecosystem.
- How frameworks and market mechanisms support investment and scaling.
- Collaboration models between industry, research institutions, and public actors.
- How Denmark and South Korea can strengthen cooperation on CCU and sustainable technologies for mutual benefit.

- Which applications of captured CO2 Korean stakeholders consider most promising.

PROGRAMME

The delegation visit to South Korea was structured around a series of meetings with leading industrial companies, research institutions, public authorities and innovation organisations, providing a comprehensive overview of the Korean CCU ecosystem and its priorities.

The first day of meetings took place in Seoul and Daejeon. In Seoul, the delegation participated in a roundtable with key CCUS stakeholders, including GS Caltex, Hyundai Engineering, CIP, KIGAM and the Korean CCUS Association. The discussions focused on Korean companies' CCU project portfolios and ongoing R&D activities, as well as an exchange on opportunities for future Denmark-Korea technology cooperation. The roundtable provided an initial overview of how CCU is positioned within Korean industry and highlighted areas of shared interest between Danish and Korean stakeholders.

Later the same day, the delegation visited the Korea Research Institute of Chemical Technology (KRICT) in Daejeon. The visit included presentations on national CCU projects and funding schemes, followed by a guided tour of laboratories and pilot facilities. This visit offered insight into Korea's national research priorities within CCU and how applied research and pilot activities are organised and supported.

The second day was dedicated to meetings and site visits in Daejeon. The delegation visited KAIST and KIER, where meetings and lab tours provided an overview of ongoing research activities within CCU, Power-to-X and related energy technologies. These visits illustrated how research institutions contribute to technology development and scale-up. The day concluded with meetings at Innopolis and selected SMEs, where discussions focused on innovation support structures and opportunities for international cooperation within the Korean innovation ecosystem.

On the third day, the delegation continued with meetings and site visits in Pohang and Ulsan. Visits to POSTECH and UNIST included meetings and laboratory tours, highlighting the close link between academic research and industrial application. The day also included a seminar at POSCO, Korea's largest steelmaker, providing insight into how CCU and related technologies are being explored within large industrial point sources and heavy industry.

The fourth day focused on CCU companies and maritime-related technologies in Busan. The delegation visited facilities demonstrating water electrolysis and rotating packed bed pilot systems, followed by a meeting at SB Sunbo's headquarters. This was complemented by a company visit to Panasia, where the delegation received an

overview of shipboard CO_2 capture projects. The day concluded with a visit to the Korea Research Institute of Ships and Ocean Engineering (KRISO), including presentations on maritime CCU solutions and ongoing development activities within the sector.

The final day of the visit included meetings with Busan Metropolitan City and Busan Technopark. Discussions with Busan Municipality focused on current CCUS activities and regional priorities in Busan, while the meeting at Busan Technopark addressed clean technology development and the role of regional innovation hubs in supporting industrial deployment.

6 FINDINGS

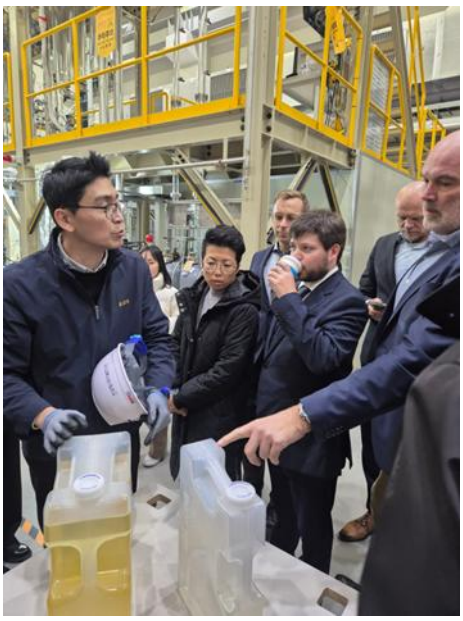
1. **CO2 utilization over geological storage**
2. **Korea emerging as a leader in onboard carbon capture for maritime applications**
3. **Emerging CDR opportunities: Direct Ocean Capture and enhanced rock weathering**
4. **Complex funding landscape**
5. **Demonstration-led innovation with conditional market scale-up**
6. **Industry-driven innovation ecosystem anchored in strong R&D–industry links**

Key Finding 1: CO2 utilization over geological storage

Across meetings and dialogues during the delegation visit to South Korea, it became clear that Carbon Capture and Utilization (CCU) play a far more prominent role in the Korean discourse than Carbon Capture and Storage (CCS). In research environments, industrial companies, innovation hubs, and public institutions alike, the focus is primarily on the use and value creation of captured CO2, while permanent storage plays a more secondary role. This prioritization of CCU over CCS reflects not only technological preferences but is deeply rooted in the structural, market, and policy frameworks shaping the Korean economy.

Market-Driven Approach to CCUS:
A defining characteristic of the Korean approach is that CCU is largely viewed as a business and industry-driven tool rather than a primary climate policy instrument. Environmental and climate benefits are rarely the starting point of discussions,

instead, CCU technologies are assessed based on their potential to generate commercial value. Captured CO2 is regarded as a resource that can be integrated into value chains for fuels, chemicals, materials, and maritime solutions. Consequently, discussions focus on market opportunities and scalability. In this context, utilization is prioritized over storage, as CO2 use offers the potential for direct revenue streams and industrial integration, whereas storage is primarily perceived as a cost with no immediate value creation. For storage to be attractive incentives such as tax credits and emissions trading schemes need to be wider implemented – these initiatives are not yet developed to support this type of CCUS roll-out. Therefore, Danish stakeholders focusing on storage will have limited collaboration potentials in South Korea.



Limited Domestic Storage Capacity: The lack of domestic CO2 storage capacity plays a decisive role in shaping these priorities. South Korea has limited geological potential for permanent storage and therefore relies heavily on prospective storage solutions in neighbouring countries such as Australia and Indonesia. This dependence introduces technical and logistical uncertainties, making CCS less attractive as a standalone solution. As a result, Korean stakeholders seek to minimize the need for storage by focusing on technologies that enable the direct use of CO2 in industrial processes or its conversion into products with market value. Further, the political reality of South Korea being effectively an island that needs to import most of its energy, makes research into fuel synthesis and the productions of SAF and other fuels a topic that has much attention and where large R&D facilities are being developed.

Policy-Driven CCS to Market-Led CCU:
European countries increasingly rely on CO2 subsidies, contracts for difference, and regulatory requirements to improve the economic viability of CCS, the Korean framework is far more driven by market logic and big conglomerate such as Samsung, Lotte etc. There is limited direct support for CO2 storage, and without clear and stable policy incentives, CCS becomes difficult to justify economically. In this context, CCU

emerges as a more attractive alternative, as utilization can deliver a viable business case even without extensive public support. At the same time, the lack of strong political prioritization of CCS means that Korean companies must increasingly justify CCU(S) investments to management and investors on commercial grounds. Projects are evaluated based on their ability to generate returns, rather than solely on their contribution to national climate targets. This creates an environment in which CCU technologies that can be integrated into existing industrial value chains and produce globally demanded products enjoy far more favourable conditions than solutions focused exclusively on permanent CO2 storage.

Implication for International Collaboration:
The observed focus on CCU over CCS in South Korea should not be taken as a lack of climate ambition, but rather as an expression of a market-driven approach to decarbonization. In a system characterized by limited storage capacity and weaker political incentives (Than DK and EU), utilization becomes the most rational pathway for combining emissions reduction with industrial competitiveness. This difference in approach between South Korea and the EU/Denmark creates significant potential for complementary collaboration, where Danish strengths in storage, regulation, and system integration can be combined with Korean strengths in capture and utilization technologies, including South Korea's proven ability to develop and operate large-scale demonstration facilities and mega pilot projects. These large industrial pilots provide a critical bridge between laboratory-scale innovation and commercial deployment, offering valuable platforms for joint testing, scaling, and validation of CCU solutions in real industrial environments.

Collaboration on CCU-based Sustainable Aviation Fuel (SAF):
An illustrative example of Korea's CCU-oriented approach is the collaboration between the Korea Institute of Energy Research (KIER) and Danish research actors on CO_2-based SAF. KIER has signed a Memorandum of Understanding (MoU) with the Technical University of Denmark (DTU), reflecting a shared interest in CCU pathways that combine climate impact with industrial value creation.

The cooperation focuses on the conversion of captured CO_2 into SAF, an application that aligns well with South Korea's strong emphasis on utilization over storage, its high

energy import dependency, and its ambitions within fuels and petrochemicals. The partnership combines Korean capabilities in fuel synthesis and large-scale demonstration with Danish strengths in catalysis, PtX and system integration, and illustrates how CCU-based SAF can serve as a concrete and mutually beneficial entry point for Danish-Korean collaboration.

Key Finding 2: Korea is emerging as a leader in onboard carbon capture for maritime applications

The visit to South Korea demonstrated that several of the leading stakeholders in the development of carbon capture solutions for vessels are based there. This reflects a deliberate strategic decision to maintain South Korea's position as one of the world's leading shipbuilding nations.

In relation to the design and optimisation of future vessels, South Korea has a strong innovation infrastructure supporting this space, as evidenced by the capabilities of the Korean Research Institute of Ships and Ocean Engineering (KRISO). The development of onboard carbon capture technologies is currently being driven primarily by industrial competitiveness and regulatory compliance. At present, this agenda is somewhat in limbo due to ongoing discussions within the International Maritime Organization (IMO). Nevertheless, it was noteworthy to learn that KRISO estimates that approximately 30% of the maritime sector's greenhouse gas emissions reductions by 2050 could come from onboard carbon capture systems. This underscores the need for Denmark to proactively engage with and initiate this agenda.

For Denmark, carbon capture within the maritime sector is highly relevant. Despite its small geographical size, Denmark is among the world's top ten maritime nations, with Danish vessels transporting up to 10% of global cargo volumes. By integrating carbon capture and storage (CCS) technologies on Danish-registered vessels, there is significant potential to decarbonise a substantial share of global goods transport. This would also enable meaningful Scope 3 emissions reductions for companies that rely on maritime transport within their supply chains.

What we observed in South Korea was that Scope 3 emissions reductions and the UN Sustainable Development Goals were, to a limited extent, drivers for the development of onboard CCS solutions. Instead, the primary focus—exemplified by the technology developed by Panasia—was on the retrofit market. These solutions are designed to extend the operational lifetime of older vessels, thereby prolonging asset life for shipping operators. As a result, the systems are typically configured to capture only the amount of CO_2 required to comply with regulatory requirements, rather than to fully decarbonise the vessel.

Another key takeaway from the visit was the speed and effectiveness with which technology readiness levels (TRLs) are advanced. CarbonValue, a spin-out from

UNIST, for example, progressed from lab-scale development (TRL 2) to TRL 6–7 in just 2.5 years. Their concept is particularly relevant for the maritime sector, as it is based on a containerised solution that could become a future standard for onboard carbon capture on ships. Traditional capture systems based on absorber and desorber towers are generally a poor design fit for most vessels due to space constraints and impacts on cargo optimisation. In contrast, CarbonValue's rotating packed bed technology (see illustration) represents a highly relevant alternative worth further exploration in a Danish context.

A clear example of this market-led CCU approach is the development of Rotating Packed Bed (RPB) carbon capture technology in South Korea. RPB systems are compact and efficient, making them well suited for space-constrained environments such as ships and existing industrial facilities. During the delegation visit, companies such as Carbon Value / SB Sunbo presented pilot-scale RPB capture units already in operation, with plans for larger demonstrations, including onboard installation on vessels.

This technology should be further developed in collaboration with Danish stakeholders, including GTS institutes and the broader Danish maritime sector, to ensure that Danish operational insights, design preferences, and system requirements are incorporated into the next generation of onboard CCS solutions.

The key stakeholders in the Korean onboard CCS ecosystem that were visited included Panasia, KRISO, UNIST, and CarbonValue.

Key Finding 3: Emerging CDR opportunities: Direct Ocean Capture and enhanced rock weathering

Carbon Dioxide Removal (CDR) technologies and related innovation activities are still at an early stage in South Korea. Nevertheless, the delegation identified several emerging areas where collaboration with Denmark could support technology development, validation and future scale-up. CDR refers to a broad set of approaches that remove CO2 from the atmosphere and enable negative emissions, complementing conventional mitigation efforts.

Based on meetings with Korean research institutions, companies and innovation hubs, as well as on existing Danish projects and sector experience, three CDR tracks were identified as relevant for potential collaboration between Denmark and South Korea. These tracks differ in technological maturity, but all present realistic pathways for joint research and early demonstration: (1) biogas-based CO_2 capture combined with pyrolysis, (2) enhanced mineral weathering, and (3) Direct Ocean Capture (DOC).

Biogas-based CO2 capture represents the most mature pathway identified. Denmark has accumulated significant experience in integrating biogas systems with CO2 capture, biochar production and negative emissions accounting. At the same time, South Korea is expanding its biogas sector. This creates opportunities for collaboration on system integration, optimisation and replication of proven Danish concepts in a Korean context. The gradual development of a more structured and regulated carbon emissions trading scheme in South Korea could further strengthen the business case for biogenic CO2 capture and pyrolysis-based solutions.

Enhanced mineral weathering emerged as a CDR opportunity, particularly linked to South Korea's steel industry. POSCO, one of the largest single-point emitters in the country, produces very large volumes of steel slag as a by-product. This material is of interest because it can undergo natural mineral weathering, a process in which CO2 from the atmosphere is gradually converted into stable carbonate minerals over time. In principle, this means steel slag could serve as a widely available and potentially low-cost medium for carbon uptake.

However, no data were presented on actual carbonation rates of POSCO slag under South Korean conditions. Key uncertainties remain regarding particle size, surface area, moisture exposure and mineral composition, critical in determining whether this pathway could contribute meaningfully to carbon removal at scale. A joint Danish-South Korean research effort could address these gaps by assessing real-world carbonation rates an exploring acceleration pathways, including enzymatic weathering approaches.

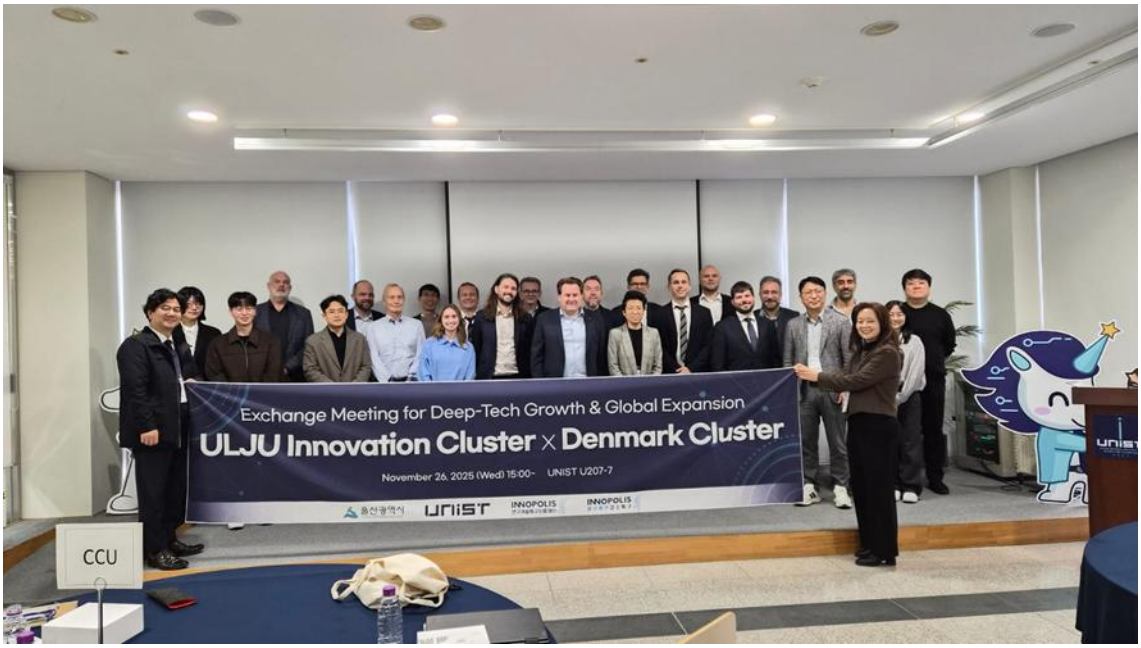
Direct Ocean Capture (DOC) represents one of the least mature but strategically interesting pathway identified during the mission. Research institutions such as UNIST, along with companies such as BlueCarbon, are exploring DOC concepts that remove dissolved inorganic carbon from seawater, indirectly enabling additional

atmospheric CO2 uptake through natural air-sea equilibration. While DOC is not yet a mainstream topic in Korea, it was raised repeatedly across meetings, indicating growing early-stage research interest, particularly given the country's strong maritime and offshore innovation base.

Given the low technology readiness levels of DOC concepts, near-term collaboration is most realistic in the form of joint R&D, feasibility studies, lab research, MRV development and pre-commercial pilots, rather than immediate large-scale deployment. Ensuring environmental integrity, regulatory alignment and scientific robustness will be essential for any future marine-based CDR pathway.

Key Finding 4: Complex funding landscape

Korean innovation funding is substantial but characterized by a high degree of complexity. While the scale of available funding is significant, further work is required to fully understand how lasting international R&D collaborations can be established within the Korean system. This includes a need to better understand and accommodate cultural differences in how research and innovation projects are managed. Although Korean partners are generally friendly and open, it is evident that building meaningful collaboration takes time. Trust based relationships are not formed immediately, and successful collaboration typically depends on sustained engagement over longer periods rather than on single, short-term project interactions. For instance, a Memorandum of Understanding (MoU) was signed as a formal signal of intent to collaborate. In the Korean context, an MoU is an important trust-building instrument that demonstrates commitment and long-term interest, even though it is non-binding and does not in itself lead to concrete projects.



During the mission to Korea, interactions with Korean partners were often structured around long and highly technical PowerPoint presentations. These presentations were typically detailed and focused on specific technical solutions, reflecting a strong

emphasis on precision and predefined content. As a result, there was limited room for off-script discussion or dialogue about broader technological technologies or potential areas for future collaboration. Conversations tended to remain anchored in the presented material rather than evolving into more open exchanges about strategic technology alignment or jointly identified research opportunities.

Historically, Korean innovation funding has been primarily targeted at Korean innovation partners and nationally defined projects. Funding is generally allocated through government directed tasks rather than through open calls or competitive funding pools that external partners can easily apply to. This structure has shaped the nature of collaboration with international actors and has limited opportunities for joint project initiation and co-design.

Collaboration and research activities with international partners are relatively new in the Korean context. Traditionally, Korea has focused on optimising solutions to clearly defined tasks, with Western partners primarily acting as purchasers or end-users rather than as co-developers in the innovation process. While most organisations we met are still exploring how to initiate international collaborative innovation, institutions such as UNIST and KIER stand out as having more experience in this area. This legacy continues to shape expectations and working practices, underscoring the need for additional efforts to build long-term, collaborative R&D partnerships within existing funding and cultural frameworks. Korea's recent association with the EU Horizon Europe programme offers a timely opportunity for such collaboration, which should be actively utilised.

Key Finding 5: Demonstration-led innovation with conditional market scale-up

South Korea demonstrates strong capabilities in developing and operating large-scale CCU pilots and demonstration projects, supported by significant industrial participation and public R&D investment. However, experience from both industrial and research-driven initiatives shows that progression beyond the pilot stage is highly dependent on the presence of a clear and credible economic driver. This insight directly relates to Key finding 1, which identifies South Korea's market-led approach to CCU and its strong prioritisation of utilization pathways that enable direct value creation.

Projects that can be integrated into existing industrial value chains and generate marketable products, such as fuels, SAF, and chemical feedstocks, are significantly more likely to advance from demonstration to scale-up. In contrast, solutions focused primarily on permanent CO_2 storage, where value creation relies on policy support rather than market revenues, often struggle to move beyond the pilot phase under current Korean framework conditions. This dynamic explains both South Korea's strong CCU focus and the importance of aligning international collaboration with applications that combine emissions reduction with commercial viability.

This pattern is clearly reflected in the technology cases analysed in the **Technical Report.** In Case 1 (Onboard Carbon Capture Systems), Korean OCCS solutions progress beyond pilot scale primarily where clear regulatory and commercial drivers are present, notably through the IMO Carbon Intensity Indicator (CII) regime and upcoming compliance costs under the EU ETS and FuelEU Maritime. In this context, OCCS is positioned as a bridging solution, enabling near-term emissions reductions on existing vessels while large-scale fuel switching remains constrained. The presence of these concrete drivers increases the likelihood that pilot installations evolve into repeatable and scalable solutions.

A similar dynamic is observed in Case 2 (e-fuels and SAF). Here, binding European instruments such as ReFuelEU Aviation, FuelEU Maritime and the revised Renewable Energy Directive create early demand and price signals for CO_2-based fuels, particularly SAF. As highlighted in the reflections of this report, e-fuels are therefore most likely to scale first in higher-value and compliance-driven market segments. Together, these cases illustrate the core finding of this study: while South Korea excels at piloting CCU technologies, sustained scale-up is most feasible where utilization pathways are underpinned by clear economic incentives and market demand.

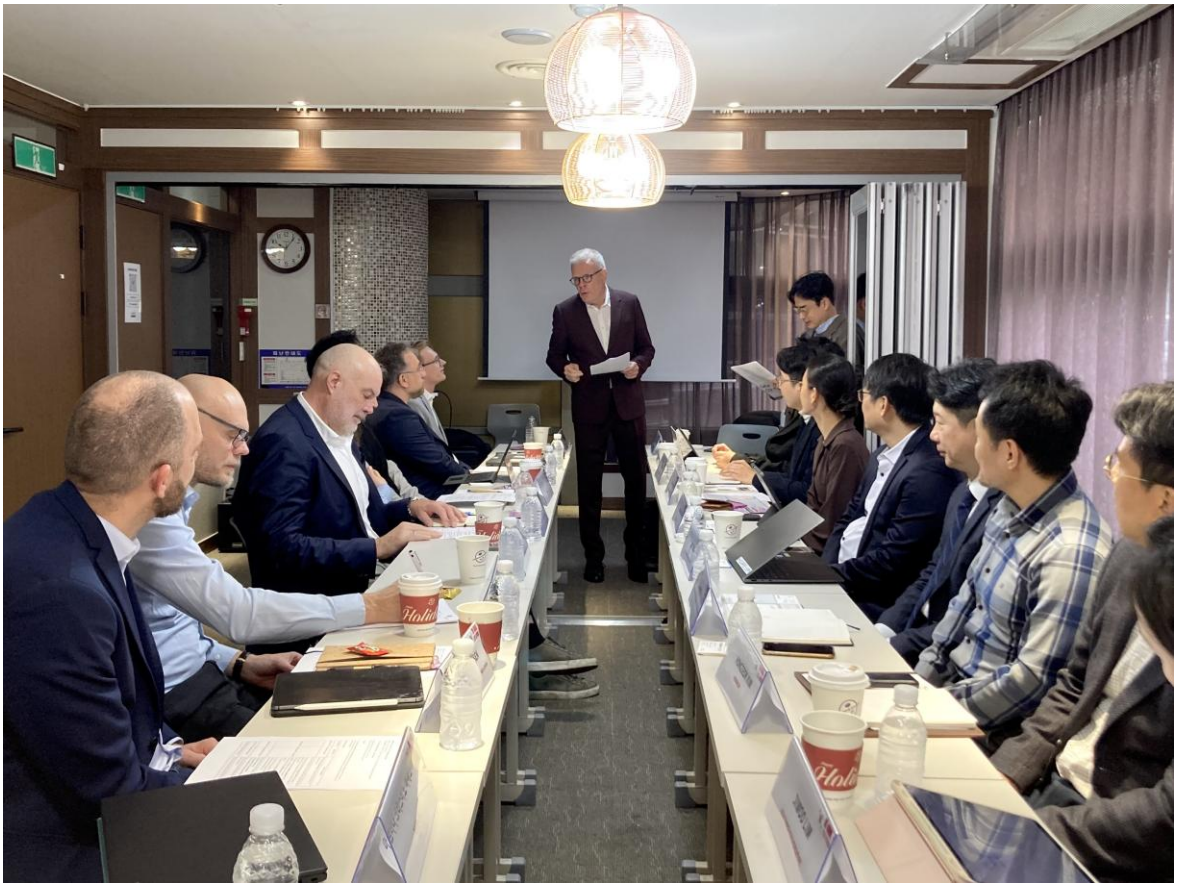
To sum up, South Korea has strong capabilities in developing and operating large-scale CCU pilots, but progression from demonstration to full-scale deployment is highly dependent on the presence of clear economic and regulatory drivers. Technologies and applications that enable direct value creation, such as fuels, SAF and CO_2-based chemicals, are significantly more likely to scale, while solutions relying primarily on policy support, particularly permanent CO_2 storage, often stall at the pilot stage. The technology cases in this Technical Report confirm that concrete compliance mechanisms and market demand are decisive for scale-up, underscoring that successful CCU collaboration with South Korea must align emissions reduction objectives with robust commercial incentives.

Key Finding 6: Industry-driven innovation ecosystem anchored in strong R&D–industry links

In the Korean context, close and long-standing collaboration between universities, research institutions and major corporations enables rapid technology development, scale-up and commercialisation. This model supports not only the deployment of technologies for domestic markets but also positions Korean actors as technology providers for Western companies. Large industrial conglomerates play a central role in setting research agendas, providing funding stability and absorbing innovation into real industrial applications.

A distinctive feature of this ecosystem is the deep institutional link between industry and academia. Major corporations have historically established or strongly supported universities and research and technology organisations (RTOs), shaping academic and research pathways that align with their long-term technological and commercial objectives. This is the case of Postech (Pohang University of Science and Technology),

established by POSCO, one of South Korea's leading steel companies, to support advanced research and talent development closely connected to industrial needs.



The close alignment between government, industry and academia has enabled Korea to define staggered and strategic pathways towards industrialisation, leveraging national technological leader. Education and research systems have therefore been closely oriented towards developing skills and knowledge that directly serve industrial competitiveness and economic growth.

Another example of this model is the Ulsan National Institute of Science and Technology (UNIST), founded in 2007 in response to a growing demand for advanced education and research in the Korean industrial capital of Ulsan, a region that clusters major industries including automotive manufacturing (Hyundai Motor), shipbuilding (Hyundai Heavy Industries), petrochemical (SK Energy), and secondary battery production. UNIST plays a strategic role in supplying research, innovation and talent to these clustered industries, reinforcing the strong industry-academia linkage.

Historically, environmental and climate-related R&D has not been a primary funding priority in Korea, particularly compared to objectives linked to industrial competitiveness, export capacity and economic growth. In a context characterised by political cycles and periodic shifts in domestic policy priorities, large corporations have often provided a more stable and predictable framework for long-term innovation than public funding programmes alone.

This industry-led innovation model represents a clear strength for Korea, as it supports fast decision-making, strong execution capacity and market-oriented technology development, enabling rapid progress from research to deployment. At the same time, it can act as a partial constraint for international collaboration, as research agendas, governance structures and timelines are often closely aligned with domestic industrial strategies, which may limit flexibility for externally driven, policy-led international research collaborative initiatives.

As a result, sustainability-related technologies, including CCUS, tend to advance most effectively in Korea when collaboration frameworks are aligned with industrial competitiveness, value creation, cost reduction and scale-up potential, rather than being driven primarily by environmental policy objectives alone.

For Danish stakeholders, this implies that collaboration with Korean partners is more likely to succeed when initiatives are anchored in clear industrial relevance rather than framed solely through environmental or policy-driven objectives. Given the central role of large corporations in Korea's innovation ecosystem, Danish actors may benefit from engaging early with R&D institutions linked to industry and positioning collaboration around clear industrial use cases, pilot and demonstration activities, and pathways towards commercial deployment.

3 RECOMMENDATIONS

1. **Denmark and Korea should collaborate on the integration of Maritime Carbon Capture systems**

2. **Clusters and technoparks as key brokers for industry–research collaboration**

3. **Fostering collaboration through European funding programmes (Horizon Europe)**

Recommendation 1: Integration of Maritime Carbon Capture systems

Denmark and Korea should collaborate on the integration of Maritime Carbon Capture systems

The technical report identifies onboard carbon capture systems (OCCS) as one of the most promising areas for Danish Korean technological collaboration in maritime decarbonisation. South Korea has developed strong capabilities in the development, manufacturing and demonstration of OCCS technologies, supported by its global leadership in shipbuilding, offshore engineering and large-scale maritime test facilities, including full-scale pilots on commercial vessels. Denmark contributes complementary strengths through major international shipping companies, advanced system integration capabilities, CO_2 logistics, and the development of a coherent CCS value chain encompassing port infrastructure, transport and offshore storage in the North Sea. The report concludes that a structured collaboration should focus on technical optimisation of OCCS units (energy efficiency, footprint, solvent performance), integration across different vessel types, and the establishment of a complete liquefied CO_2 value chain from shipboard capture to permanent storage.

In parallel, the report highlights the importance of coordinated Danish Korean regulatory engagement to achieve international recognition of OCCS as an accepted decarbonisation measure within the IMO framework. Overall, the report finds that close collaboration between Denmark and South Korea can significantly accelerate the deployment of maritime carbon capture as an effective transitional solution towards climate-neutral international shipping

The proposed collaboration on maritime carbon capture provides a concrete anchor for co-creating a bilateral CCUS pilot pipeline and roadmap. An OCCS-based maritime pilot, linking onboard capture on commercial vessels with port reception, CO_2 liquefaction, transport, and permanent storage, should be defined as one of the

priority pilots in a joint Denmark Korea CCUS pipeline. For this pilot, a shared roadmap can specify target TRLs, vessel and port hosts, relevant funding instruments, and clear lead partners on both sides.

Formalising such pilots through memoranda of understanding between clusters, research institutions, shipping companies, shipyards, and port and storage operators would ensure continuity beyond individual projects. This approach directly supports both technical development of OCCS and the establishment of a full ship-to-storage value chain, while providing a stable framework for coordinated regulatory engagement and international recognition within the IMO context.

Recommendation 2: Clusters and technoparks as key brokers for industry–research collaboration

Clusters and technoparks should be positioned as active and formal brokers that systematically facilitate matchmaking between industry and research institutions across Denmark and Korea. On the Danish side, organisations such as Energy Cluster Denmark, CLEAN and Green Hub Denmark have strong networks spanning companies, universities and applied research organisations. These should be deliberately aligned with key Korean counterparts, including Innopolis, regional technoparks and specialised initiatives such as K-CCUS.

Rather than relying on informal introductions or company-led outreach, these intermediaries can provide a structured entry point into the Korean innovation ecosystem. This includes organising thematic brokerage missions, delegation visits and recurring online matchmaking sessions focused on priority sectors such as ports, steel, cement, maritime transport, e-fuels and CCUS value chains. By framing matchmaking around concrete industrial challenges and use cases, clusters and technoparks can significantly increase the relevance and maturity of partnerships formed.

This brokered approach is particularly effective in the Korean context, where many innovation initiatives are launched through top-down industrial and policy-driven frameworks. While this enables scale and rapid execution, it can make it difficult for foreign actors to identify the right entry points, decision-makers or complementary partners. Clusters and technoparks can help navigate this complexity by translating institutional logic, aligning expectations and supporting early-stage partner matching.

Overall, strengthening the brokerage role of clusters and technoparks reduces transaction costs, lowers partnership risk and accelerates the transition from initial dialogue to project-ready collaboration. Innovation Centre Denmark can further support this role by facilitating outreach and providing local insight into the Korean innovation landscape.

Recommendation 3: Foster collaboration through European funding programmes (Horizon Europe)

Danish clusters should strengthen collaboration with Korean innovation hubs by systematically using Horizon Europe as the primary framework for structured Denmark–Korea collaboration. During recent engagements, Korean research institutions, innovation hubs and industrial actors repeatedly highlighted Horizon Europe as a key mechanism for long-term funding stability, structured collaboration and access to European industrial networks. This creates a timely opportunity for Danish clusters to take a more proactive coordinating role.

Closer collaboration through Horizon Europe can enable the development of "twin" innovation projects with a clear division of roles aligned with national strengths. In such models, Danish actors can lead system analysis, early-stage research and energy system integration, while Korean partners focus on detailed engineering, component development, scale-up and industrial pilot implementation. This complementary structure increases the likelihood of developing Horizon proposals that are both scientifically robust and industrially implementable.

Rather than approaching Horizon calls on an ad-hoc basis, Danish and Korean stakeholders would benefit from a more coordinated engagement with the programme. One concrete mechanism could be the establishment of a small, informal joint task force involving Danish clusters, research organisations and selected Korean institutes and innovation hubs. This group could jointly scan upcoming calls, identify shared priorities and support the preparation of one to two flagship proposals per year.

In this context, clusters play a critical coordinating role by translating strategic priorities into concrete, fundable project concepts and ensuring alignment between research ambition, industrial relevance and policy objectives. A Horizon-led collaboration model allows Denmark and Korea to move beyond exploratory cooperation and build durable, impact-oriented partnerships at the intersection of research excellence, industrial competitiveness and climate action.

CCUS FROM DENMARK TO KOREA

Denmark has an ambition to reduce its greenhouse gas emissions by 70% by 2030 and to achieve climate neutrality no later than 2045. To realize these goals, the Danish government has established mission-driven research and innovation partnerships within, among other areas, CCUS and Power-to-X. These partnerships initiate targeted research and development projects in key technologies to accelerate innovation and the practical implementation of solutions.

In addition, Danish CCUS companies have established several regional collaborations focused on the deployment of CCUS, including the development of infrastructure for the transport of CO_2 and hydrogen. Denmark is investing broadly across the entire CCUS value chain, including CO2 capture at combined heat and power plants, waste-to-energy facilities, and cement production, as well as in energy-efficient Power-to-X facilities and CO_2 storage. In the coming years, an extensive CO_2 transport network from multiple point sources is expected to be developed to support CCS in the short term and CCU in the longer term. At the same time, Denmark has a strong tradition in research and development, which helps mature new technologies and industries.

Denmark's subsurface is well suited for CO2 storage, with both deep saline aquifers and depleted oil and gas fields available for this purpose. This provides a strong foundation for CO2 storage in the North Sea. South Korea, by contrast, has limited opportunities for onshore geological storage but possesses strong capabilities in CO2 capture, utilization, and transport, including maritime solutions. This creates a natural basis for cooperation between Denmark and South Korea, where Danish storage capacities can be combined with South Korean industrial and technological strengths.

Denmark also has a high share of renewable electricity, which is crucial to produce green hydrogen. Together with Danish competencies across the entire energy value chain, this provides a solid foundation for utilizing CO2 in the production of, for example, e-fuels and plastics. At the same time, South Korea has a strong industrial base in steel, petrochemicals, shipping, and energy, where CCUS plays a central role in the transition of hard-to-abate industries.

Taken together, these factors create strong conditions for Danish–South Korean cooperation on CCUS, supported by an ecosystem with decades of experience in energy, industry, and technology development. In both Denmark and South Korea, there is strong demand for research into CCUS technologies, including capture technologies, onshore and offshore CO2 storage, CO2 transport solutions, and Direct Air Capture. In addition, discussions are ongoing in both countries regarding the import and export of CO2 for storage, as well as the strengthening of financing and regulation for CCUS research areas that could be further advanced through closer bilateral cooperation.

The mission confirmed that future Danish-South Korean collaboration on CCUS should primarily be anchored in carbon utilization (U), where there is the strongest

strategic and industrial alignment between the two countries. In the Korean context, captured CO_2 is predominantly viewed as a resource that can be integrated into fuels, chemicals, materials, and maritime applications, rather than as a waste stream requiring permanent storage. This utilization-driven approach aligns well with Danish strengths in Power-to-X, e-fuels, system integration and circular carbon value chains, and offers a pragmatic entry point for collaboration that reflects Korean market and industrial incentives.

With South Korea's association to Horizon Europe, there is a timely opportunity to structure joint CCU projects within a stable and internationally recognised framework. Horizon Europe provides suitable instruments for utilization-focused research, development and demonstration projects that combine Korean strengths in capture technologies, engineering and large-scale pilots with Danish competencies in system-level analysis, lifecycle assessment and value chain integration. To maximise impact, collaboration should focus on clearly defined CCU applications with identifiable end-products and markets, and be designed from the outset with pathways towards industrial deployment and scale-up.

By prioritising utilization-based collaboration and using Horizon Europe as a core platform, Danish and Korean actors can develop joint CCU solutions that are commercially relevant, scalable and aligned with both countries' long-term climate and industrial objectives.

	Denmark	South Korea
Population	6 million	51.6 million
Area	42,933 km2	100.295 km2
GDP	US$ 425 billion	US$ 1.87 trillion
CO2 emissions	29,158,760 tons 4.86-ton pr. capita	635,502,970 tons 12.3-ton pr. capita

DELEGATION SECTION

The mission to Korea consisted of the following Danish profiles, representing a range of organizations and competencies across research, innovation, and industry:

Lasse Rosendahl – Director - CORC

Bezhad Partoon – PhD – Aarhus Universitet (AU)

Jan Boyesen – Market Director – Teknologisk Institut (TI)

Martina Cristino Hayez – Project Manager – Clean Cluster

Kasper Havemann – Senior Project Manager – Clean Cluster

Kiyeon Kim – Senior Innovation Officer – Innovation Centre Denmark

Jacob Ask Hansen – Head of Research Operations – CORC

Benjamin Schmidt – Project Manager – Energy Cluster Denmark