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Innovation Fund Denmark

Investment Agreement

Innomission
Mission: 1: CCUS

INNO-CCUS

Innovationsfonden Europahuset, Europaplads 2, 4. sal 8000 Århus Innovationsfonden.dk

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The following parties:

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(hereinafter referred to as “IFD”)

and

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(hereinafter referred to as “the Partnership”)

have with effect of 01.06.22 concluded this Investment Agreement relating to research, development and/or commercialisation based on an investment by IFD in the Partnership *INNO-CCUS*.

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1. Exhibits

Exhibit 1: Revised roadmap

Exhibit 2: Partnership plan

Exhibit 3: Organisation and management

Exhibit 4: Rules of Procedure for the Partnership Board of Directors

Exhibit 5: Partnership Budget

Furthermore, a Partnership Agreement is a condition for, but not an integral part of the Investment Agreement

2. Definitions

The following definitions shall apply:

2.1.1. *"Administrator"*: has the meaning given to it in Clause 5.2.

2.1.2. *"Agreement"*: the entire agreement comprising this Investment Agreement and its Exhibits, and subsequent amendments to such documents.

2.1.3. *"Annual Report"*: has the meaning given to it in Clause 6.3.1.

2.1.4. *"Partnership Budget"*: the aggregate Partnership Budget and the Parties' respective contributions thereto, annexed to the Investment Agreement as Exhibit 5.

2.1.5. *"Partnership Agreement"*: the agreement concluded between the Partnership Participants governing their collaboration.

2.1.6. *"Final Report"*: has the meaning given to it in Clause 6.4.1.

2.1.7. *"IFD"*: the Innovation Fund Denmark, as established by the Minister for Higher Education and Science pursuant to Act no. 306 of 29th of March 2014 and consolidated Act no.1660 of 12th of August 2021.

2.1.8. *"Investment Agreement"*: this investment agreement with subsequent amendments, but exclusive of its Exhibits. See also the definition of "Agreement".

2.1.9. *"Investment Criteria"*: the terms and conditions and criteria, including assessment criteria, and prerequisites on which IFD has based its decision to invest in the Partnership. These criteria can be found, inter alia, in IFD's "Guidelines for Grand Solutions and Innomission Partnerships", published August 20th 2021.

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2.1.10. *"Investment Officer"*: the representative(s) of IFD appointed by IFD under Clause 8.1.13 who keep(s) an ongoing dialogue with the Partnership Leader during the Partnership and participate(s) in the Partnership Board of Directors meetings.

2.1.11. *"Investment Period"*: the period defined in the Partnership Plan during which IFD invests in the Partnership.

2.1.12. *"Investment Review"*: the annual review of the Partnership, including scientific, Partnership Budget-related and administrative aspects, as detailed in Clause 6.2.

2.1.13. *"Milestones"*: the milestones described in the Partnership Plan.

2.1.14. *"Party"*: each of the Partnership Participants and IFD.

2.1.15. *"Partnership"*: the Partnership described in the Partnership Plan .

2.1.16. *"Partnership Contributor"*: each of the legal entities and/or persons besides the Partnership Partners who participate in the performance of the Partnership, see the Partnership Plan and signs or subsequently accedes to the Agreement as a "Partnership Contributor", see Clause 3.3.

2.1.17. *"Partnership Leader"*: the Partnership leader appointed by the Partnership Board of Directors and approved by IFD, see Clause 8.2.1.

2.1.18. *"Partnership Participant"*: each of the Partnership Partners and Partnership Contributors.

2.1.19. *"Partnership Partner"*: the legal entities and/or persons who sign or subsequently accede to the Agreement as "Partnership Partners", individually, see Clause 3.3.

2.1.20. *"Partnership Plan"*: plan with information on IFD's investment and Partnership Participants as well as description of the content of the Partnership, including Milestones and success criteria, annexed to the Investment Agreement as Exhibit 2, with subsequent amendments, see Clause 6.2 and Clause 7.3.

2.1.21. *"Partnership Board of Directors"*: the Partnership Board of Directors appointed by the Partnership Partners and approved by IFD, see Clause 8.1.

Unless otherwise specifically stated, references to clauses in this document shall be understood as references to clauses in the Investment Agreement. Unless otherwise specifically stated, references to exhibits are references to exhibits to the Investment Agreement. References to acts and rules shall be understood as references to acts and rules in force with subsequent amendments.

3. Background, purpose and accession of additional Partnership Participants

3.1. The purpose of the Agreement is to describe the Partnership Participants' collaboration regarding the Partnership, see the Partnership Plan, and to describe the conditions governing IFD's investment and the Partnership Participants' receipt and use of IFD's investment. As stated in Clause 13.2, the Investment Agreement is conditional upon the Partnership being commenced within a given deadline.

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3.2. The Partnership Participants have entered into a Partnership Agreement, governing their collaboration, including in relation to exploitation and distribution of any results and derived intellectual property rights arising in connection with the Partnership. See also Clause 11 below.

3.3. It is a condition for a Partnership Participant's entitlement to a share of IFD's invested funds, and for the Partnership Participant's acquisition of rights under this Investment Agreement, that the Partnership Participant signs this Investment Agreement in connection with its conclusion or subsequently accedes to the Investment Agreement as a Party by signing an accession agreement. When a Partnership Participant has signed such an accession agreement, and when the accession agreement has also been signed by IFD, the chairman of the Partnership Board of Directors and the Partnership Leader, the Partnership Participant in question is a Party to the Agreement. The decision to include new Partnership Participants as Parties to the Agreement shall be made by the Partnership Board of Directors in accordance with Clause 8.1.5. Inclusion of any new Partnership Participants shall, however, be valid only with the prior consent of IFD, confirmed by the signature of IFD on the accession agreement. IFD requires that new Partnership Participants meet the conditions on which IFD based its assessment of the Partnership and the existing Partnership Participants, i.e. the Investment Criteria, and hence IFD may refuse to approve a new Partnership Participant if the latter does not, in the assessment of IFD, meet the criteria. See also Clause 11.

4. Investment and Partnership funding

4.1. IFD invests DKK 201,650,000 in the Partnership in the Investment Period, however, see Clause 6.2 regarding adjustment of IFD's investment. The total Partnership costs and the distribution of the investment between the various Partnership Participants appears from the Partnership Budget. See also Clause 5 and Clause 6.2.

4.2. If the Partnership Participants obtain full or partial funding of their contributions to the Partnership from other public- or private-sector councils, foundations, entities, etc., IFD shall be notified thereof in writing. IFD shall have the right, but no obligation to offset such other funding against its investment. However, IFD has an obligation to perform set-off in its investment if a Partnership Participant that is an entity obtains aggregate public-sector co-funding that exceeds the permitted maximum according to the EU rules on state aid. A Partnership Participant's entitlement to receive funds from IFD is conditional upon the prior signing and submission by the Partnership Participant to IFD of any such statements and such information as IFD may require in relation to ensuring compliance with the EU rules on state aid.

4.3. No Party shall be ordered to contribute further resources to the Partnership or otherwise to bear costs beyond what is the responsibility of that Party in accordance with the Partnership Budget in force at any time. Hence, without the prior written consent of the Partnership Participant in question, amendments to the Partnership Budget, see e.g. Clause 6.2, shall not result in such Partnership Participant being ordered to contribute further resources to the Partnership or otherwise bearing costs beyond what is the responsibility of the Party as per the Partnership Budget applying at the time, or in any change of the size of the Partnership Participant's sub-payments or the time of their payment/contribution to the disadvantage of the Partnership Participant. Each Partnership Participant shall ultimately bear any costs incurred by such Partnership Participant in excess of the Partnership Budget. Throughout the Partnership, Partnership Participants shall avoid unnecessary consumption of resources and shall specifically justify extraordinary acquisitions, etc. during the last six (6) months of the

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Investment Period. The Partnership Budget shall not be amended without the prior approval of IFD.

4.4. Investments under pool 2 budget shall follow the process described in exhibit 3 to this agreement.

5. Disbursement and use of the investment

5.1. The investment by IFD may be used for direct Partnership-related costs, i.e. costs that are directly attributable to the Partnership, see IFD's "Guidelines for Grand Solutions and Innomission Partnerships", published August 20th 2021.

5.2. Disbursement of IFD's investment shall take place by transfer to one of the Partnership Partners appointed by the Partnership Board of Directors and approved by IFD as administrator in terms of receiving and distributing the funds invested by IFD (the "Administrator"). The Administrator shall be responsible for ensuring that the sums disbursed by IFD are paid out to the Partnership Participants in accordance with the Partnership Budget and Partnership Plan.

5.3. IFD may lay down a number of requirements in connection with the appointment of the Administrator as conditions for approving the Administrator, including that the Administrator's financial solvency is acceptable to IFD, that one or more relevant third parties guarantee the Administrator's compliance with its obligations under the Agreement, or that the Administrator is organised in a manner that is reassuring to IFD in terms of the Administrator's obligations under the Agreement. IFD may at any time demand that a new Administrator is appointed if the existing Administrator does not, in the opinion of IFD, meet its obligations under the Agreement or if, in the assessment of IFD, there is a risk that the existing Administrator will be unable to meet its obligations under the Agreement.

5.4. Disbursements from IFD shall take place in accordance with IFD's "General Terms and Conditions for Grand Solutions" in force at any time, which can be found at IFD's website, www.innovationsfonden.dk. Disbursements shall take place on the basis of the most recently approved Partnership Budget; however, disbursements shall be reduced by the amount of funds previously disbursed by IFD but not used, see the "General Terms and Conditions for Grand Solutions". See also Clause 5.8 regarding IFD's option to demand repayment of funds disbursed but not used. No Partnership Participant shall be entitled to a share of the funds invested by IFD unless such entitlement is stated in the Partnership Budget.

5.5. As described in Clause 13.4 and Clause 14, IFD shall be entitled permanently to discontinue all disbursement of funds if IFD on the basis of an Investment Review under Clause 6.2 or another review under Clause 6.5 finds that the Partnership is not making sufficient progress, or minutes of Partnership Board of Directors meetings or Annual Reports have not been received on time, or if the said minutes or reports have not been prepared in accordance with the applicable rules and guidelines, see Clause 6.3.1. IFD may choose to, but need not, temporarily discontinue disbursement of funds, in full or in part, until such matters have been rectified.

5.6. Furthermore, IFD shall be entitled permanently to discontinue all disbursements of funds to a Partnership Participant if the latter becomes subject to insolvency proceedings as detailed in Clause 13.4, 2nd paragraph. IFD may choose to, but need not, temporarily discontinue disbursement of funds, in full or in part, if IFD receives information, see this Clause 5.6, giving IFD reason to assume that the Partnership Participant will become subject to such insolvency

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proceedings. If a Partnership Participant becomes aware that a petition has been filed for financial restructuring or insolvency proceedings in relation to the Partnership Participant, or the Partnership Participant becomes aware that one or more of the situations referred to in section 18 of the Danish Insolvency Act applies in relation to the Partnership Participant, the relevant Partnership Participant shall immediately inform IFD, the Partnership Leader and the Administrator thereof, and the Administrator shall not subsequently disburse any funds to that Partnership Participant without the prior written approval of IFD.

5.7. Disbursement of the Final Instalment, see IFD's "General Terms and Conditions for Grand Solutions" in force at any time, shall be conditional upon IFD having received the Final Report on time, on such Final Report having been prepared in accordance with all applicable rules and guidelines, and on IFD having approved the Final Report. Furthermore, disbursement of the Final Instalment shall be conditional upon IFD having received and approved the final Annual Report for the Partnership.

5.8. IFD reserves the right during the course of the Partnership to demand repayment of unused funds, and all unused funds shall always be repaid to IFD after the expiry of the Investment Period. If IFD demands repayment of funds during the course of the Partnership, this shall be done by contacting the Partnership Leader and the Administrator. The relevant Partnership Participants shall, without undue delay, transfer funds to the Administrator so that repayment to IFD can take place. See also the "General Terms and Conditions for Grand Solutions" regarding repayment of funds disbursed.

5.9. The Partnership Participants shall, without undue delay, provide the Administrator with all necessary information for disbursement and transfer of IFD's investment. If such materials and information are not provided on time, IFD's investment cannot be disbursed.

6. Reporting to IFD and review of the Partnership

6.1. *Partnership Board of Directors meeting documents and minutes*

6.1.1. IFD shall monitor the progress of the Partnership throughout the Investment Period via an ongoing dialogue with the Partnership Leader and the Partnership Participants and via participation in Partnership Board of Directors meetings, including by receiving minutes of Partnership Board of Directors meetings.

6.1.2. IFD shall receive documents for Partnership Board of Directors meetings at least one (1) week before each meeting and shall receive the minutes of Partnership Board of Directors meetings within fourteen (14) days after the meeting was held.

6.1.3. IFD may at any time request, via the Partnership Leader, that the Partnership Partners report in detail on the progress of the Partnership. The deadline for such reporting which does not take place in connection with a Partnership Board of Directors meeting shall be ten (10) weekdays from the request.

6.2. *Investment Review*

6.2.1. Once a year, IFD shall perform an Investment Review together with the Partnership Board of Directors and any experts that IFD wishes to involve. The Partnership Leader and the Administrator shall assist IFD and the Partnership Board of Directors in connection with the

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Investment Review(s). An Investment Review shall comprise a review and assessment of the Partnership status and expected development from a scientific perspective, including in relation to results, and from a financial/Partnership Budget-related, time-related and administrative/organisational perspective as specified by IFD. An Investment Review shall be based on input from the Partnership Board of Directors, the Partnership Leader and the Administrator as well as any further information requested by IFD or the Partnership Board of Directors from the Partnership Participants in connection with the review. The Partnership Participants shall provide all required information and assistance in connection with the performance of the review.

6.2.2. Unless IFD finds that there is no basis for continuing the Partnership, see Clause 13.4 and Clause 14, IFD and the Partnership Board of Directors shall, based on the annual Investment Review, jointly decide whether there is a need to amend the Partnership Plan and/or the Partnership Budget, including whether there is a basis for reducing IFD's investment, or whether it is relevant for the Partnership Participants to apply for further investments by IFD, and whether it is relevant to extend or shorten the Investment Period. The Partnership Plan and/or the Partnership Budget shall be updated to reflect such decisions, and the amendments made shall be binding on all Partnership Participants, however, see Clause 4.3 and Clause 7.3.

6.3. ***Annual Report***

6.3.1. IFD shall annually receive a report (the "Annual Report") containing:

(i) financial reporting in the form of accounts for the Partnership. The financial year shall be the calendar year. The accounts shall be prepared and presented in accordance with IFD's "General Terms and Conditions for Grand Solutions" in force at any time, see Clause 5.4, which, inter alia, state whether the accounts and the sub-accounts of the respective Partnership Participants shall be audited prior to submission, and

(ii) scientific reporting in relation to Partnership status and progress, including descriptions and documentation of results achieved and status relative to observance of Partnership Milestones and Partnership status relative to the success criteria laid down, see the Partnership Plan. The scientific reporting shall be based on the Investment Review described in Clause 6.2.

6.3.2. The Annual Report for a given financial year shall be received by IFD within the deadline stated in IFD's "General Terms and Conditions for Grand Solutions" in force at any time, and shall be approved by the Partnership Board of Directors prior to submission to IFD.

6.3.3. The Partnership Participants shall ultimately be responsible for the Annual Report and its preparation. Partnership Participants shall, without undue delay, supply the Partnership Leader with all necessary materials for use in connection with the preparation of the Annual Report. The Partnership Leader shall be responsible for ensuring that the Partnership Board of Directors receives a draft Annual Report for approval and that IFD subsequently receives the approved Annual Report by the deadline stated, see Clause 6.3.2. The Administrator shall assist the Partnership Leader in the preparation of the draft Annual Report.

6.4. *Final Report and follow-up*

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6.4.1. Immediately after the completion of the Partnership and not later than three (3) months after the expiry of the Investment Period, the Partnership Leader shall submit a written final report in respect of the Partnership (the "Final Report"). The Partnership Participants shall contribute to the preparation of the Final Report, and the principles stated in Clause 6.3.3 shall apply relative to the preparation of the Final Report. The Final Report shall be prepared in accordance with IFD's "General Terms and Conditions for Grand Solutions" in force at any time, see Clause 5.4. As part of the evaluation of the Partnership and the preparation of the Final Report, the Partnership Participants undertake to be at the disposal of IFD.

6.4.2. For up to three (3) years after the completion of the Partnership, the Partnership Participants undertake to participate in IFD's annual Partnership follow-ups.

6.5. *IFD's current reviews of the Partnership*

6.5.1. In addition to the annual Investment Reviews, see Clause 6.2, IFD may at any given time during the Investment Period decide to perform a review of the Partnership in relation to scientific aspects, including in relation to results, and in relation to financial/Partnership Budget-related, time-related and administrative/organisational aspects. In connection with such reviews, IFD may involve one or more independent external assessors. The independent external assessors may e.g. be involved in assessing whether one or more of IFD's Investment Criteria and/or Milestones and/or tasks laid down in the Partnership Plan have been fulfilled by the Partnership Participants, see Clause 7.1. The Partnership Participants, the Partnership Leader and the Administrator shall provide all required information and assistance in connection with the performance of the review. See Clause 13.4 regarding IFD's right to terminate the Investment Agreement and Clause 14 regarding IFD's right to terminate the Investment Agreement for breach.

7. Implementation of the Partnership

7.1. The Partnership Participants shall observe the Milestones and perform the tasks described in the Partnership Plan.

7.2. The Partnership Participants shall perform their respective Partnership tasks with a view to the Partnership contributing to promoting the objectives on the basis of which IFD has made the investment, see the Act referred to in Clause 2.1.7, and which are reflected in the Investment Criteria.

7.3. If IFD and the Partnership Partners, either in connection with Investment Review(s), see Clause 6.2, or otherwise, agree that it is appropriate to amend the Milestones, Investment Period, Partnership Budget or the tasks described in the Partnership Plan, the Partnership Partners shall, via the Partnership Board of Directors, prepare an amended Partnership Budget and/or a revised Partnership Plan describing the new Investement Period or the new Milestones and tasks. The revised Partnership Plan and/or amended Partnership Budget shall be subject to approval by IFD. The Partnership Participants shall observe the Milestones and perform the tasks described in the Partnership Plan applying at any time.

7.4. The Partnership Participants shall contribute the required materials, staff, facilities, equipment, etc. to the Partnership as described in the Partnership Plan, however, see Clause 4.3. The Partnership Participants shall drive forward the Partnership, making the best possible use of the resources allocated to the Partnership.

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7.5. The Partnership shall be carried out and financial contributions made in accordance with the guidelines stated in the Partnership Plan, the Partnership Budget and IFD's "General Terms and Conditions for Grand Solutions" in force at any time, see Clause 5.4.

7.6. IFD attaches importance to Responsible Research and Innovation (RRI), which aims to strengthen the links between research and innovation processes and results and societal values and needs. IFD advances RRI in its overall strategies and in connection with its Partnerships. The European Commission's definition and implementation of RRI and IFD's encouragement to Partnership Participants to abide by RRI can be found here.

7.7. IFD also supports the principles outlined in the Danish Code of Conduct for Research Integrity. The Partnership Participants shall observe the Code of Conduct and hence accept and subscribe to these principles.

7.8. IFD has adopted the rules laid down in "Open Access policy for public-sector research councils and foundations". This means that published scientific articles which are the result of full funding or co-funding by IFD are to be made freely available to the public domain via Open Access if the publisher consents. The Partnership Participants accept and subscribe to these principles. The wording of these policies can be found via links from IFD's website, www.innovationsfonden.dk.

7.9. The Parties accept that although the Partnership is completed satisfactorily, this does not necessarily mean that the results stated in the Partnership Plan, expected or desired are achieved or realised. Hence, the Parties assume no responsibility for such achievement or realisation of results via-à-vis one or more of the other Parties or any other responsibility in relation to the other Parties' expectations in terms of Partnership results. See Clause 13.4 regarding IFD's right to terminate the Investment Agreement with reference to the Investment Criteria.

8. Partnership management

8.1. *Partnership Board of Directors*

8.1.1. The Partnership Partners shall appoint a Partnership Board of Directors, according to the plan described in the Rules of Procedure annexed to the Investment Agreement as Exhibit 4.

. The Partnership Board of Directors shall appoint a chairman and a vice-chairman, who together with the Partnership Leader represent the Partnership vis-à-vis the outside world. The IFD shall approve the members of The Partnership Board of Directors and the Partnership Leader. The Partnership Board of Directors shall operate on the basis of the Rules of Procedure annexed to the Investment Agreement as Exhibit 4.

8.1.2. The Partnership Board of Directors is the supreme decision-making body in relation to the Partnership and responsible for its completion. The Partnership Board of Directors shall serve the overall interests of the Partnership and the Partnership Participants. Within the framework of the Investment Agreement, the Partnership Plan and the Partnership Budget, the Partnership Board of Directors shall lay down the strategy for the Partnership and its implementation.

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8.1.3. Decisions of the Partnership Board of Directors shall have binding effect, not only on the Partnership Partners but also on the Partnership Contributors, however, see Clause 4.3 and Clause 7.3.

8.1.4. The Partnership Board of Directors shall monitor the development and progress of the Partnership and make decisions to ensure that interaction between the Partnership Participants as well as the organisation, management and resource allocation of the Partnership facilitate realisation of the Milestones and tasks described in the Partnership Plan, and to ensure that the Partnership is making sufficient progress. Among other things, the Partnership Board of Directors shall ensure that Partnership Participants collaborate in relation to common targets throughout the Investment Period and, if necessary, initiate adjustments to the Partnership Plan and Partnership organisation, see Clause 6.2 and Clause 7.3.

8.1.5. The Partnership Board of Directors shall make decisions regarding the inclusion of new Partnership Participants, including whether they shall accede to the Agreement as “Partnership Partners” or as “Partnership Contributors”. The Partnership Board of Directors shall observe the provisions of the Partnership Plan regarding the inclusion of new Partnership Participants. Pursuant to the Investment Agreement, the existing Partnership Participants authorise the chairman of the Partnership Board of Directors and the Partnership Leader jointly to sign accession agreements with binding effect on all Partnership Participants, however, see Clause 3.3. Inclusion of new Partnership Participants shall be subject to observance of the provisions of Clause 4.3 and Clause 7.3. The Partnership Plan shall be updated to reflect the accession of new Partnership Participants.

8.1.6. The Partnership Board of Directors shall ensure that both Partnership management and administration are taken into account throughout the Investment Period.

8.1.7. The Partnership Board of Directors shall supervise the work of the Partnership Leader and may lay down guidelines for and instruct the Partnership Leader in his/her work. The Partnership Board of Directors may at any time require that the Partnership Leader report to the Partnership Board of Directors, either in writing or at a meeting, on issues of relevance to the Partnership.

8.1.8. The Partnership Board of Directors shall supervise the Administrator and – if so requested by IFD – may at any time require that the Administrator provides information about disbursements by IFD and about the Administrator’s distribution of the funds to Partnership Participants.

8.1.9. The Partnership Board of Directors may decide to replace the Partnership Leader and/or the Administrator. Appointment of a new Partnership Leader or Administrator shall require the prior approval of IFD. The Partnership Board of Directors shall replace the Partnership Leader and/or the Administrator if IFD requires this, see Clause 8.2.1 and Clause 5.3.

8.1.10. The Partnership Board of Directors shall ensure the financial and scientific management of the Partnership and approve minutes of Partnership Board of Directors meetings and Annual Reports in connection with Partnership Board of Directors meetings. The Partnership Board of Directors must also approve the Final Report.

8.1.11. The Partnership Board of Directors shall meet at least twice a year, once in each half of the year.

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8.1.12. IFD shall monitor the progress of the Partnership and supervise use of the funds invested in the Partnership; however, this shall not limit the liability of the Partnership Board of Directors and the Partnership Participants in relation to use of the funds invested.

8.1.13. IFD shall appoint one or two (1-2) Investment Officers to monitor the work of the Partnership Board of Directors. The Investment Officers appointed by IFD shall not be members of the Partnership Board of Directors but purely observers, and hence such Investment Officers shall not be entitled to vote at Partnership Board of Directors meetings. The Investment Officers appointed shall, however, have the right to attend and speak at all Partnership Board of Directors meetings, and IFD or any Investment Officer may convene a Partnership Board of Directors meeting and put separate items on the agenda of a Partnership Board of Directors meeting.

8.1.14. IFD and any Investment Officer(s) appointed may require that not only Partnership Board of Directors members and Investment Officers but also relevant specialists attend Partnership Board of Directors meetings and that these specialists are given the right to speak at the meetings.

8.1.15. IFD and/or the Investment Officer(s) appointed by IFD can in no way be held liable for the work of the Partnership Board of Directors, including for decisions made by the Partnership Board of Directors at its meetings, irrespective of whether any Investment Officers have participated in the Partnership Board of Directors meetings or have otherwise participated in the work of the Partnership Board of Directors. This shall also apply to any non-observance by the Partnership Board of Directors of its obligations under the Agreement.

8.2. *Partnership Leader*

8.2.1. The Partnership Board of Directors shall appoint a Partnership Leader, who must be approved by IFD. In this context, IFD may lay down a number of requirements as conditions for approving the Partnership Leader, including that the Partnership Leader has relevant professional experience and relevant Partnership management experience. IFD may at any time require that a new Partnership Leader be appointed if the existing Partnership Leader does not, in the assessment of IFD, meet his/her obligations under the Agreement or if, in the assessment of IFD, there is a risk that the existing Partnership Leader will be unable to meet his/her obligations under the Agreement.

8.2.2. The Partnership Leader is supervised by and receives instructions from the Partnership Board of Directors. The Partnership Leader participates in the meetings of the Partnership Board of Directors with the right to speak but not to vote.

8.2.3. The Partnership Leader shall have the day-to-day responsibility for the Partnership and its implementation, including coordination of activities between Partnership Participants.

8.2.4. Dispositions which are of an unusual nature relative to the Partnership content or have a major impact on the Partnership shall be made only by special authority from the Partnership Board of Directors.

8.2.5. In relation to IFD, the Partnership Leader shall always represent and act on behalf of the overall Partnership.

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8.2.6. In current communication with the Partnership Leader regarding the Partnership and its implementation, all notices and information given by IFD to the Partnership Leader shall be deemed to have been given to all Partnership Participants at the same time. However, see Clause 15.3 on notices to Partnership Participants in relation to the Investment Agreement.

8.2.7. In addition to the responsibilities arising out of the Investment Agreement and the Partnership Board of Directors's instructions, the Partnership Leader shall be responsible for ensuring:

- that an initial Partnership Board of Directors meeting is held with the participation of the Investment Manager(s) and all Partnership Partners within one (1) month from the commencement of the Partnership,
- that the Partnership Board of Directors is kept informed of Partnership progress,
- that an ongoing dialogue is maintained with IFD; in this connection the Partnership Leader shall, without undue delay, inform IFD of any material circumstances of significance to the Partnership and/or IFD's investment,
- that optimum use is made of Partnership resources,
- that information from IFD is passed on to all other Partnership Participants,
- that the minutes of Partnership Board of Directors meetings described in Clause 6.1 are prepared and submitted to IFD in a timely manner,
- that he/she assists the Administrator in connection with disbursements from and repayments to IFD, and
- that drafts are prepared for the Annual Reports and the Final Report and that the Annual Reports and the Final Report approved by the Partnership Board of Directors are submitted to IFD in a timely manner. The Partnership Leader shall collaborate with the Administrator in connection with the preparation of the Annual Reports and in connection with other reporting on financial aspects of the Partnership.

9. Dissemination

9.1. Partnership Participants shall ensure that references to Partnership activities in various media clearly indicate that this is a Partnership that has received IFD funding.

9.2. Any publication, report or other material published by Partnership Participants and containing references to the Partnership and/or results achieved in connection with the Partnership shall state that the Partnership has received funding from IFD, and the IFD logo shall be included in the material. However, the IFD logo may be omitted in scientific publications, etc. to the extent that it is not customary to use logos.

9.3. The Partnership Participants shall once a year during the Investment Period and in the calendar year after the completion of the Partnership provide assistance for the preparation of a short description of the Partnership and the Partnership status and make illustrations available for IFD's publication of the annual report, for IFD's website, etc. The material shall be produced in Danish and English. The deadline for submission of such material shall be determined by IFD, and the Partnership Board of Directors and the Partnership Leader shall, on behalf of the Partnership Participants, be responsible for ensuring that IFD receives the material on time.

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9.4. Any publication, report or other material published by Partnership Participants in connection with the Partnership as described in Clause 9.2 shall be submitted to IFD electronically before its publication. Unless otherwise stated in the Investment Agreement, no party may use the logos, trademarks or other features of the other Parties in press releases or for marketing purposes without the prior written approval of the relevant Party.

9.5. IFD may lay down more detailed guidelines for the rights and obligations stated in this Clause 9. Furthermore, IFD may require that Partnership Participants set up and maintain a website providing information about the Partnership. The Partnership Board of Directors and the Partnership Leader shall be responsible for the set-up and maintenance of such website on behalf of the Partnership Participants.

10. IFD's communication about the Partnership

10.1. In accordance with IFD's "Guidelines for Grand Solutions and Innomission Partnerships", published August 20th 2021, IFD will publish an overview of the applications receiving investment commitments, and the Partnership Participants agree that, irrespective of this Clause 10, IFD may, in connection with the publication described in the guidelines, use the text from the application form with the short popular description. Furthermore, the Partnership Participants consent to IFD disclosing the names of the Partnership Participants, the Partnership title and duration, and key figures regarding the investment, including its size, in the Danish Research Database (http://www.forskningsdatabasen.dk), on IFD's website (www.innovationsfonden.dk) and in its publications.

10.2. Should IFD otherwise wish to communicate about the Partnership and/or results achieved in connection with the Partnership to the public, IFD shall inform the Partnership Leader thereof in writing, stating the information that IFD plans to communicate.

10.3. Communication to the public by IFD, see Clause 10.2, of the Partnership and/or results achieved in connection with the Partnership shall require the approval of all Partnership Participants. If no Partnership Participant has within thirty (30) days from receipt of written notice from IFD, see Clause 10.2, approved or rejected IFD's request to communicate information, IFD may in writing give the Partnership Participants fourteen (14) days to approve IFD's request or to reject it in writing, in which connection the grounds for such rejection shall be stated. If IFD's request has still not been replied to, this shall be deemed to be acceptance of IFD's planned communication to the public.

10.4. The scope or content of IFD's communication of information about the Partnership and/or results achieved in connection with the Partnership to the public shall never prevent or impede protection, including protection of intellectual property rights, of results achieved in connection with the Partnership.

10.5. In accordance with the "Guidelines for the Public on the Private Financing of Research at State Institutions" of 13 January 2000, state research institutions must disclose certain details relating to private co-funding of their research. In addition to the contents of Clause 10.1, the Partnership Participants accept that the Partnership title, the names of the Partnership Participants and size of the investment/funding is disclosed in accordance with the said guidelines.

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11. Partnership Agreement

11.1. It is a condition for obtaining investment from IFD that the Partnership Participants have entered into and signed a Partnership Agreement on ownership and exploitation of the results and derived intellectual property rights arising in connection with the Partnership.

11.2. Furthermore, it is a condition that the Partnership Agreement includes provisions ensuring that a Partnership Participant's accession to the Investment Agreement, see Clause 3.3, entails that the Partnership Participant accedes to the Partnership Agreement at the same time, so that the Partnership Participant becomes a Party to the entire Agreement. A Partnership Participant cannot accede to the Partnership Agreement without acceding to the Investment Agreement at the same time.

11.3. In the Partnership Agreement, the Partnership Partners shall ensure that any Partnership Contributors undertake obligations vis-à-vis the Partnership Partners that will allow the Partnership Partners to observe the special obligations imposed on the Partnership Partners under the Investment Agreement and its other Exhibits.

11.4. IFD is not a party to and assumes no liability in relation to the Partnership Agreement, see Clause 12.2. However, the Partnership Agreement may only be amended with the prior written consent of IFD.

12. Liability and indemnification

12.1. Each Partnership Participant warrants to IFD:

12.1.1. that the Partnership Participant in question is not aware of and to the best of its knowledge does not in connection with its performance of and participation in the Partnership in any way violate or contribute to infringement of any third party's rights, including in relation to consultancy, information or other contributions made by that Partnership Participant, its employees or students in connection with the Partnership,

12.1.2. that the Partnership Participant in question has, to the best of its knowledge, acquired all necessary authorisations, licences, approvals and consents required in order to enter into this Agreement and participate in the Partnership,

12.1.3. that the Partnership Participant in question will at all times observe the basic legal, regulatory and ethical principles applying to the specific Partnership area and execution, including, but not limited to, the principles listed in Clauses 7.6 and 7.7, and

12.1.4. that the Partnership Participant in question will comply with the legislation in force at any time in connection with the Agreement and the execution of the Partnership, including, but not limited to, legislation and regulation concerning state aid, competition law, legislation on and regulation of corruption and money laundering, any national, foreign and international export control legislation, regulation, convention and sanction and any instructions from IFD aimed at ensuring such compliance.

12.2. The Partnership Participants shall never and cannot hold IFD responsible for circumstances unrelated to IFD's obligations as specifically stated in the Investment Agreement. For example,

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Partnership Participants cannot hold IFD responsible for circumstances relating to the Exhibits to the Investment Agreement and/or the Partnership Participants' rights and obligations under these Exhibits, irrespective whether the IFD logo is printed on the Exhibits and irrespective of whether IFD was aware of, had reviewed, assessed, approved, accepted, signed or otherwise contributed to the drawing-up of the Exhibits.

13. Commencement, duration, expiry and termination

13.1. The Investment Agreement and Investment Period shall commence on 01.06.2022. The Investment Period is 5 year(s), unless amended in accordance with Clause 6.2 or Clause 7.3. Unless terminated earlier, see this Clause 13 and Clause 14, the Investment Agreement shall continue in force until the expiry of the Investment Period, when it shall cease immediately and without notice. Termination of the Investment Agreement, irrespective of the cause, shall entail immediate expiry of the Investment Period.

13.2. Irrespective of Clause 13.1, the Investment Agreement shall automatically be terminated if the Partnership has not been commenced within three (3) months from the date when the Investment Agreement enters into force, see Clause 13.1. If IFD prior to the expiry of the said period of three (3) months has received from the Partnership Leader an account approved by the Partnership Board of Directors stating the reasons for the delay, and IFD on the basis of this account finds that the grounds for the delay are reasonable and that the Partnership is still relevant, IFD may decide that the Investment Agreement shall not be terminated, despite the delay. However, if the Investment Agreement is terminated in accordance with this Clause 13.2, IFD will require that any funds disbursed are repaid by the Partnership Participants, and the Partnership Leader and the Administrator shall assist IFD in connection with such repayment.

13.3. Partnership Participants may terminate the Investment Agreement and depart from it giving three (3) months' notice to the end of a month. A Partnership Participant who terminates and departs from the Investment Agreement in accordance with this provision shall provide written reasons for such termination, but the right of termination shall not be conditional thereupon.

13.4. IFD may terminate the Investment Agreement in writing (for one or more Partnership Participants) giving three (3) months' notice to the end of a month if IFD – based on its free assessment, including a scientific assessment – finds

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(i): on the basis of a review under Clause 6.2 or Clause 6.5, (A) that the Partnership does not meet one or more of IFD's Investment Criteria or (B) that the Partnership is not making sufficient progress; this shall include, but not be limited to, situations where the Partnership in general is not making progress as assumed in the Partnership Plan timeline, or situations where it turns out that the basic assumptions on which the Partnership is based no longer exist, or

(ii) that one or more of the Partnership Participant(s) do(es) not observe the Milestones and/or perform the tasks described in the Partnership Plan and/or the Partnership Budget, or

(iii) a change in the Partnership Participant's/Participants' circumstances, including e.g. professional, scientific, financial and/or organisational circumstances entails that the Partnership Participant(s) no longer meet(s) IFD's Investment Criteria.

IFD may terminate the Investment Agreement in writing with immediate effect vis-à-vis a Partnership Participant which is subject to insolvent liquidation or to financial restructuring proceedings.

After the expiry of the period of notice, final accounts shall be prepared for the Partnership or the Partnership Participant(s) departing. On the basis of these accounts, the funds due/owing shall be disbursed or charged by IFD, and the terminated Partnership Participant(s) shall not receive any further share of the funds invested by IFD. The Partnership Leader and the Administrator shall jointly prepare the final accounts and present them for approval by IFD and the Partnership Board of Directors by a deadline set by IFD.

IFD may also terminate the Investment Agreement in the event of breach as described in Clause 14.

13.5. In connection with termination of the Investment Agreement, IFD shall to an appropriate extent take into account any obligations the Partnership Participants may have to finance PhD students.

13.6. If the Investment Agreement is terminated under Clause 13.3 or Clause 13.4, all Parties shall, unless otherwise agreed, continue to work loyally on the Partnership until the period of notice expires.

14. Breach and termination

14.1. If one or more Partnership Participants commit material breach of the Investment Agreement, IFD may terminate the Investment Agreement in writing with immediate effect for the Partnership Participant(s) in question, however, see Clause 14.3. In the event of material breach of the Investment Agreement by one or more Partnership Participant(s), Partnership Participants not in breach may request IFD to terminate the Investment Agreement in relation to the Partnership Participant(s) in breach. If IFD, in a situation where termination is possible, does not, within one (1) month from the request, comply with the request to terminate the Investment Agreement in relation to one or more Partnership Participants which are in material breach, the requesting Partnership Participants not in breach may terminate their own participation in the Investment Agreement giving a short notice of five (5) days. If IFD commits material breach of the Investment Agreement, the Partnership Participants may terminate the Investment Agreement in writing with immediate effect, however, see Clause 14.3.

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14.2. The situations that constitute material breach shall be determined in accordance with the general provisions of Danish law, but the following shall always be deemed to be material breach: Partnership Participants' non-payment of financial contributions in accordance with the Partnership Plan or the Partnership Budget, non-timely submission of an Annual Report, see Clause 6.3, non-timely submission of other reports to be submitted by the Partnership Participants to IFD or submission of reports that are not in compliance with the rules and guidelines laid down by IFD, infringement by Partnership Participants of third-party rights, non-fulfilment by Partnership Participants of the indemnities stated in Clause 12.1, and misuse of Confidential Information.

14.3. However, if the breach can be rectified, the Investment Agreement shall be terminated only if the Party in breach has received a registered letter demanding it to do so, stating the nature of the breach, and has not rectified the matter within fourteen (14) days from the date when the demand was sent.

14.4. In the event of material breach on the part of a Partnership Participant, IFD may demand that all funding received by the Partnership Participant in breach from IFD be repaid within a deadline set by IFD. The Partnership Leader and the Administrator shall assist IFD in connection with such repayment.

15. Precedence, amendments, notices and assignment

15.1. The Investment Agreement shall be mandatory and shall in all respects take precedence over other documents and agreements, including the Partnership Agreement.

15.2. No amendments to the Investment Agreement shall be valid unless they have been approved in writing by all Parties.

15.3. Notices and amendments to the Investment Agreement shall be in writing and addressed to the respective representatives of IFD and the Partnership Participants as stated in the Partnership Plan.

Notices exchanged between the Parties shall be sent by email to the email addresses of the representatives of the respective Parties as stated in the Partnership Plan. It is the responsibility of each Party to inform IFD and the Partnership Leader on an ongoing basis of any changes to the email address provided. Notices of termination, see Clause 13, including for breach, see Clause 14, shall, however, be sent by registered letter on the same day as the email regarding the issue in question was sent.

15.4. The rights and obligations of the Partnership Participants under the Investment Agreement cannot be assigned to a third party. Mergers of public-sector institutions shall not constitute assignment under this provision.

15.5. Irrespective of the provisions of this Clause 15, Clause 15 shall not limit the powers arising from Clause 8.1.3 (regarding the Partnership Board of Directors's decision-making powers), Clause 3.3 and Clause 8.1.5 (regarding inclusion of new Partnership Participants) and Clause 6.2 and Clause 7.3 (regarding amendments to the Partnership Plan and/or the Partnership Budget).

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16. Governing law and legal venue

16.1. The Agreement shall be governed by Danish law, with the exception of Danish conflict of laws rules where such rules would lead to application of the law of another country.

16.2. Any dispute arising between the parties concerning this Agreement, including its interpretation and application, and which cannot be amicably settled must, in so far as is possible under the Administration of Justice Act, section 225 and section 227 be brought before the Maritime and Commercial High Court as court of first instance.

17. Signatures

Each Partnership Participant receives one (1) electronic copy of the Investment Agreement and its Exhibits.

For Innovation Fund Denmark:

Date: 20 / 06 2022



Annemarie Munk Riis
Acting CEO

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17. Signatures

Each Partnership Participant receives one (1) electronic copy of the Investment Agreement and its Exhibits.

For Innovation Fund Denmark:

Date: / 2022

Name
Title

Partnership Participants:

For Danmarks Tekniske Universitet:

Date: 17/6 2022

Anders O. Bjarklev
President

For Aalborg Portland A/S:

Date: 6/2/2022

DocuSigned by:
Søren Holm Christensen
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Name Søren Holm Christensen
Title CEO

For Pentair - UNION ENGINEERING A/S:

Date: 5/24/2022

DocuSigned by:
Michael Bove
00426[illegible]...

Name Michael Bove
Title Site Leader

For Ørsted Bioenergy & Thermal Power A/S:

Date: 5/25/2022

DocuSigned by:
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Name Bogi Bech Jensen
Title Director

For Aalborg Universitet:

Date: 9/6-22

Name
Title RECTOR

For FORCE Technology:

Date: 5/28/2022

DocuSigned by:
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Name Hanne Christensen
Title CEO

For Teknologisk Institut:

Date: 5/24/2022

DocuSigned by:
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Name Sune Dowler Nygaard
Title Executive Vice President

For FLSmidth A/S:

Date: 6/7/2022

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Name Bodil Recke
Title VP Cement R&D

For Faxe Kalk A/S:

Date: 5/25/2022

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Name Finn Holmsø
Title Salgsdirektør

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For EuroWind Energy A/S:

Date: 5/25/2022

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Name Jens Rasmussen
Title CEO

For COWI A/S:

Date: 6/12/2022

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Marius Noer
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Name Marius Noer
Title Vice President

For Port of Aalborg A/S:
Research and Development

Date: 5/25/2022

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Jesper Raakjær
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Name Jesper Raakjær
Title Group Chief Visionary Office

For Syddansk Universitet:

Date: 6/10/2022

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Name Jens Ringmose
Title Rector

For DHI GRAS A/S:

Date: 5/24/2022

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Name Anders Liechti
Title CTO

For DHI A/S:

Date: 5/24/2022

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Name Anders Liechti
Title CTO

For Copenhagen University:

Date: 17. juni 2022

Name Henrik C. Wegener
Title Rektor

For Roskilde University:

Date: 5/25/2022

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Name Peter Kjær
Title Prorektor

For GEUS:

Date: 5/25/2022

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Name Flemming Larsen
Title CEO

For Stiesdal Fuel Technologies A/S:

Date: 5/25/2022

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Peder Nickelsen
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Name Peder Nickelsen
Title CEO

For Aquagreen ApS:

Date: 5/26/2022

DocuSigned by:
Henning Smidt Petersen
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Name Henning Smidt Petersen
Title CEO

For MASH Makes ApS:

Date: 5/24/2022

DocuSigned by:
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Name Jakob Andersen
Title CEO

Innovation Fund Denmark

For SEGES Innovation P/S:

Date: 6/7/2022

DocuSigned by:
Ejnar Schultz
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Name Ejnar Schultz
Title CEO

For Aarhus Universitet:

Faculty of Technical Sciences

Date: 5/26/2022

DocuSigned by:
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Name Eskild Holm Nielsen
Title Dekan

For Aarhus Universitet:

Faculty of Natural Sciences

Date: 5/30/2022

DocuSigned by:
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Name Kristian Pedersen
Title Dekan

For HedeDanmark A/S:

Date: 5/26/2022

DocuSigned by:
Torben Friis Lange
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Name Torben Friis Lange
Title CEO

For MUSHOLM A/S:

Date: 5/30/2022

DocuSigned by:
Jan Mousing
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Name Jan Mousing
Title Konsulent

For GUBRA ApS:

Date: 5/24/2022

DocuSigned by:
Jacob Jelsing
C1A719E7DF8F4DC...

Name Jacob Jelsing
Title Chairman of the Board - co-founder

For Naturstyrelsen:

Date: 5/25/2022

DocuSigned by:
Lars Bendix Poulsen
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Name Lars Bendix Poulsen
Title Specialkonsulent

For Miljøstyrelsen:

Date: 5/24/2022

DocuSigned by:
Katrine Hahn Kristensen
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Name Katrine Hahn Kristensen
Title Kontorchef

For Samsø Kommune:

Date: 5/24/2022

DocuSigned by:
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Name Lars Skovgaard
Title Forvaltningschef

For Foresting Tomorrow ApS:

Date: 5/24/2022

DocuSigned by:
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Name Jens Isbak
Title Adm. Direktør

KW Plan ApS

Date: 6/3/2022

DocuSigned by:
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Name Klaus Wunsch
Title direktør

For NaturIT ApS:

Date: 6/8/2022

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Name Mikkel Ewais-Bremer
Title Direktør

For Styrelsen for Dataforsyning og Effektivisering:

Date: 30/5 2022

Name THERESA KJÆRSIDE
Title HEAD OF OFFICE

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For TotalEnergies:

Date: 5/25/2022

DocuSigned by:
Christina Sjøberg Heineke Petersen
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Name Christina Sjøberg Heineke Petersen
Title Adm. Direktør

For Noreco Oil Denmark A/S:

Date: 5/29/2022

DocuSigned by:
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Name Erik Borg
Title Director

For Gas Storage Denmark A/S:

Date: 6/16/2022

DocuSigned by:
Martin Christensen
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Name Martin Christensen
Title COO

For Explicit ApS:

Date: 5/25/2022

DocuSigned by:
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Name Bettina Knudsen
Title COO/CMO

For Dansk Gasteknisk Center A/S:

Date: 5/24/2022

DocuSigned by:
Thea Larsen
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Name Thea Larsen
Title CEO

For Technion – Israel Institute of Technology:

Date:

Name
Title

For Welltec A/S:

Date: 5/26/2022

DocuSigned by:
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Name Jacob Faurskov
Title SVP Manufacturing & Development

For Rambøll Danmark A/S:

Date: 5/29/2022

DocuSigned by:
Asmus Dalsgård Nielsen
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Name Asmus Dalsgård Nielsen
Title Technical Director

For Nordsøenheden:

Date: 5/25/2022

DocuSigned by:
Birgitta Jacobsen
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Name Birgitta Jacobsen
Title CEO

For Alexandra Instituttet:

Date: 5/24/2022

DocuSigned by:
Martin Møller
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Name Martin Møller
Title CSO

For VERDO Produktion A/S:

Date: 5/24/2022

DocuSigned by:
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Name Jens Ole Hougaard
Title Kraftvarmeværkschef

For Hafnium Labs ApS:

Date: 5/27/2022

DocuSigned by:
Jon Christensen
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Exhibit 1 - Revised roadmap

INNO-CCUS

This Exhibit contains the following sections:

- The INNO-CCUS project structure
- Challenges and assumptions
- Overall goals for INNO-CCUS
- Vision: Creating a CO_2-neutral society
- Value creation
- Goals for the Partnership

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The INNO-CCUS project structure

The INNO-CCUS project portfolio for pool 1 is divided in five strategic research and innovation areas, referred to as workstreams. The combined contribution from the project portfolio defined in pool 1, and the projects to be defined in pool 2, are selected to secure the most significant contribution to the goals defined in the INNO-CCUS roadmap. The five workstreams are:

Workstream 1: Chemical CO_2 capture
Workstream 2: Biological CO_2 capture and Storage
Workstream 3: Geological Storage
Workstream 4: CO_2 utilisation
Workstream 5: Society and Systems Analysis

Additionally, three workstreams are allocated to build a strong Partnership; these workstreams contains all non-research activities and tasks:

Workstream 6: Crosscutting actions and Capacity building
Workstream 7: Communication, Dissemination and Outreach
Workstream 8: Mission Management

Figure 1 shows an overview of the workstreams in Pool 1:

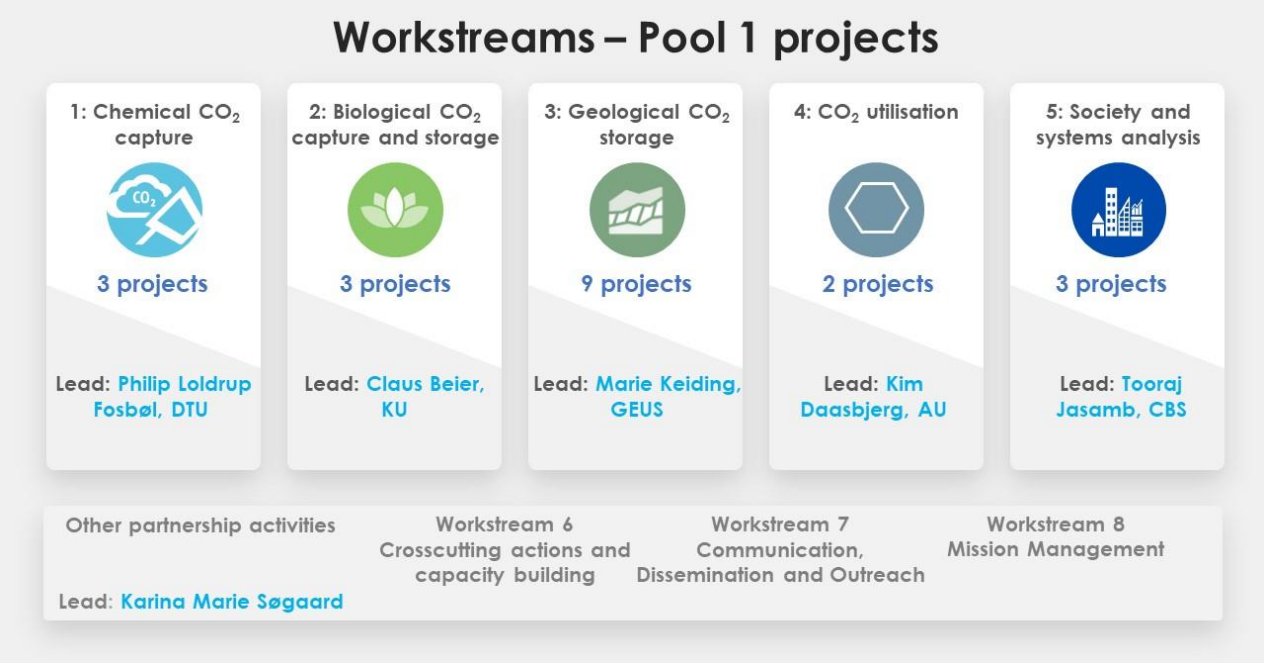

Figure 1 Overview of workstreams in INNO-CCUS, pool 1

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The detailed project portfolio is described in "*AD Exhibit 2, project charter*". A list of project titles is available in the section "*Pool 1 projects – contribution to roadmap*" of this exhibit.

The projects in pool 1 are selected for their expected contribution to achieve the best possible practices for capture, storage and utilisation of CO_2. This applies to potential, safety, most suitable technologies, and implementation. At the same time, pool 1 contains essential projects concerning the societal readiness and acceptance of CCUS-solutions, i.e. increase the SRL, as there is a need to prepare for the implementation of CCUS on a large scale.
The overall goals and KPI's are complex to define for one single project, since the whole value chain of CCUS are depending on a range of conditions and still unsettled laws and regulations that have to be in place before the full impact of the technological solutions can be measured. For this reason, a range of challenges and assumptions apply for the goals defined for INNO-CCUS.

Challenges and assumptions

Besides innovation and development of the capture, storage and use technologies there are a number of sector coupling, regulatory and social science aspects of relevance to the entire transition. The key challenges are:

The complexity of solutions increases when different value streams are combined and coordinated. Existing sector coupling experiences relate largely to the energy sector. In a fossil free future, the energy market as well as the drivers for carbon flow in society will look much different from today and involve new sectors. Consequently, there is a need to (1) identify new sector coupling demands and potentials, (2) establish regulatory, control and documentation means to facilitate responsibilities and incentives and (3) to agree on long term prices on the exchanged products/resources**.**
For sector coupling and smart energy systems to work, reuse of heat and resources must be economically viable.
The price of electricity needed for hydrogen production or electrochemistry, in relation to CO_2 conversion, is too high and must be reduced in order to convert CO_2 into fuels or chemicals economically.
Establish regulatory systems with clear rules for accounting and clear rules for counting import/export of CO_2 and carbon holding chemicals and materials in the national emissions.
The Danish government expects a new technology basis to support emission reduction. There must be a financial structure in place which fertilizes SME or basic technology development allowing for new methods in the market.
Law and policy to support widespread implementation of new CCS and CCU technologies, changed land use patterns, and altered consumption patterns internationally.
Regulation needs must be investigated by addressing relevant externalities arising from current and future CCUS strategies, and global standards needs to be developed.
Establish a common and cross-sectorial value/price and/or tax/credit of carbon, providing incentives for removing/replacing fossil CO_2 and storing CO_2.
Societal acceptance of CCUS.

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Overall goals for INNO-CCUS

CCUS is virtually the only technology solution capable of deep emission reductions, especially within hard-to-abate industries, such as cement and steel, and hence will play an important role in meeting global energy and climate targets. Though there are existing CCUS technologies commercially available, the vast majority of these promising solutions require further development, testing and advancement. This calls for dedicated research and development, prototype building, pilot testing and demonstration projects across the various technologies and focus areas of chemical capture, biological capture and storage, geological storage as well as utilisation. In addition, significant efforts are needed beyond technology development to support creation of the social, financial and legal frameworks required for successful CCUS rollout. This includes education and training modules to prepare for the need for a highly-skilled CCUS workforce, dissemination and communication to the general public to encourage societal acceptance of these new technologies, as well as fiscal and legal reforms to address current barriers to CCUS technology adoption.

Vision: Creating a CO_2-neutral society

The vision for INNO-CCUS partnership is to contribute substantially to the Danish and global climate goals in 2030 and 2050 by developing and demonstrating sustainable CCUS solutions and value chains to benefit socio-economic development and the environment.

The Partnership will do this by:

- Engage national and international partners from the entire CCUS value chain
- Within the Partnership define high impact research and innovation needs in parallel with developing technology/solutions
- Secure a dynamic partnership towards 2050 to include the strongest and most active partners continuously
- Ensure the best pathway for demonstration realisation and implementation as technologies mature
- Ensure dissemination of knowledge gained in the Partnership to the benefit of the global CCUS community

The Partnership has the ambition to achieve a fundamental change in the way we view, value, and use carbon resources to enable a complete shift of the current system from fossil-based to biogenic carbon sources. The Roadmap will outline solutions that generate a wealth of new industries, export opportunities, growth, and jobs through multi-stakeholder and cross-sectoral collaboration.

The role of the CCUS partnership will be to coordinate efforts towards achieving the Danish climate goals in 2030 and 2050 by fulfilling the goals of the CCUS roadmap. The CCUS Partnership will generate the proper knowledge, networks, development, regulation, and support mechanisms required for realising the CO_2-reduction, job creation, export, and environmental improvement opportunities represented in the CCUS roadmap.

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Value creation

Short term
Before 2025 the Partnership will offer concrete activity tracks for capacity building at master and Ph.D.-level and lifelong learning educational tracks. Additionally, Innovation activities based on existing infrastructure and knowledge at universities, industrial hubs, and incubators, involving SME's and start-ups at various levels, are a priority. In connection with innovation transfer and business development in Pool 1 projects, the activity tracks are built during the first period of the Partnership.

Alongside the Partnership activities, GEUS as sector research institution from the Danish Ministry of Climate, Energy and Utilities will have mapped Denmark's most suitable geological storage sites by 2025. This mapping will be a valuable resource when considering the short to middle term impact, as it provides a decision tool for further planning.

Medium term

CO_2 reduction impact
There is a significant potential for CO_2 reductions via CCUS. However, the reduction potential is conditioned by having the proper prerequisites in place. Examples are well-defined financial terms, technologies at the right TRL and SRL levels, a supporting regulatory framework, etc.
The Climate Program by the Danish Government 2021 states the potential of multiple methods for reducing CO_2 emissions, including expected potential contributions towards 2030. For the CCUS technologies,[1] the potential contribution is 7-15 mill. Tons CO_2e per year.
The numbers estimated by the Danish Government are based on available CO_2 sources in Denmark. However, the geological storage potential of the Danish underground is considerably larger and can potentially be used for storing captured CO_2 from other countries.

Job creation
CCUS is likely to be a driver for growth and employment across numerous value chains, e.g. carbon capture from existing large combustion facilities and biogas upgrading, carbon storage in depleted oil and gas fields or new geological structures, and utilisation of carbon from CO_2. This will transform existing value chains to adapt, e.g. oil and gas sector companies to injection rather than extraction and create new companies born out of the acceleration and implementation of CCUS technologies. As an example, the Ten Point Plan for a Green Industrial Revolution by the United Kingdom government aims to capture 10 Mt of CO_2 per year by 2030, which is estimated to support up to 50,000 jobs. Applying this scale to the Danish goal of capturing 4-9 Mtpa, job creation of between 20,000 and 45,000 can be expected.
The generated jobs cover a wide variety of professions ranging from engineers researching and developing the necessary state-of-art technology, geologists identifying suitable subsurface structures for permanent storage, financial and legislative professionals creating and maintaining the necessary framework and not least labourers putting words into action.

Export potential
The export potential for CCUS technologies is immense. CCUS technologies will most likely be a necessity for the majority of countries in reaching their commitment to the Paris Agreement. The

[1] The following categories (in Danish): 1) CCS: El og fjernvarme og biogas, 2) CCS: Industri og rafinaderier, 3) CCS: Affald, 4) Pyrolyse, 5) Yderligere skovinitiativer, 6) Direct air capture.

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market is developing rapidly, and by entering the scene of CCUS technology development early, Denmark has a unique possibility of establishing the pioneering organisation and private companies exporting vital technology. Direct export of 5 billion DKK is achievable by 2050, with turnover volumes significantly higher if Danish companies can achieve positions similar to Vestas within wind or FLS within cement and mining.
In addition to technology export, a business case of importing and storing neighbouring countries' CO_2 has significant potential. The Danish underground has ample potential for storage of CO_2 making it relevant not only to store Danish emissions but also to act as a storage hub for Northern Europe. This could provide opportunities to develop CO_2 storage to create a new industry with growth and employment in Denmark.

Goals for the Partnership

The INNO-CCUS Partnership is established as a mean to secure a significant contribution to achieve the Danish government's climate goals on CO_2 reduction, through CCUS solutions. Through 20 Research and Innovation projects in pool 1, and a significant contribution from projects in pool 2, the Roadmap's ambition towards 2025 will be fulfilled.
During the IFD funding period, the partnership will work towards the following high-level qualitative goals:

1) **Build a value adding partnership where national and international partners from the entire CCUS value chain are engaged in the partnership.**
    - To fulfil this goal, the Partnership has defined the following objectives:
        - Partnership engagement: The partnership will ensure a strong engagement across the partners, by designing a partnership based on their needs and wishes. A workshop inviting for partners input to shape the partnership will be held during the first 6 months.
        - Partnership communication and trust: Transparency in processes and decisions is key to achieve trust. The partnership will define a communication plan, where Partnership information is shared equally with all project partners. The frequency of communication will be decided in the communication plan.
        - Outreach to non-partners: The Partnership will create an overview of CCUS-activities in Denmark and neighbouring countries and apply this to build a communication and knowledge sharing community within and beyond the Partnership.
        - Activities to stimulate technological and knowledge synergies: The Partnership will invite non-Partners to an Innovation network, where network activities are conducted to support synergy and collaboration within the CCUS area.

2) **Contribute significantly towards the 2030 and 2050 CO_2 reduction goals, through CCUS solutions with technological, economical and societal considerations in place.**
    - The Partnership has defined 20 projects, which are described in the Partnership Plan. They will collectively achieve significant progress towards achieving and exceeding the 2025 goals described in the roadmap.
    - The Partnership has defined a separate workstream for Society and Systems Analysis projects, to secure the societal focus on the technological development.

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- The roadmap will be updated annually, as projects develop, and new knowledge and technology is reported from the projects. Progress in non-partnership CCUS activities in Denmark and neighbouring countries contributes to the roadmap update.

3) Strengthening green transition competencies within CCUS solutions

- The Partnership will build Ph.D.- and Master training network as coordination points. Each network will in collaboration with the individual universities establish training and educational activities.
- To maintain and increase the competences within CCUS, a lifelong learning programme will be developed in collaboration with participating companies.

Extending this, the following quantitative goals are defined for INNO-CCUS, as shown in Figure 2 and Table 1:

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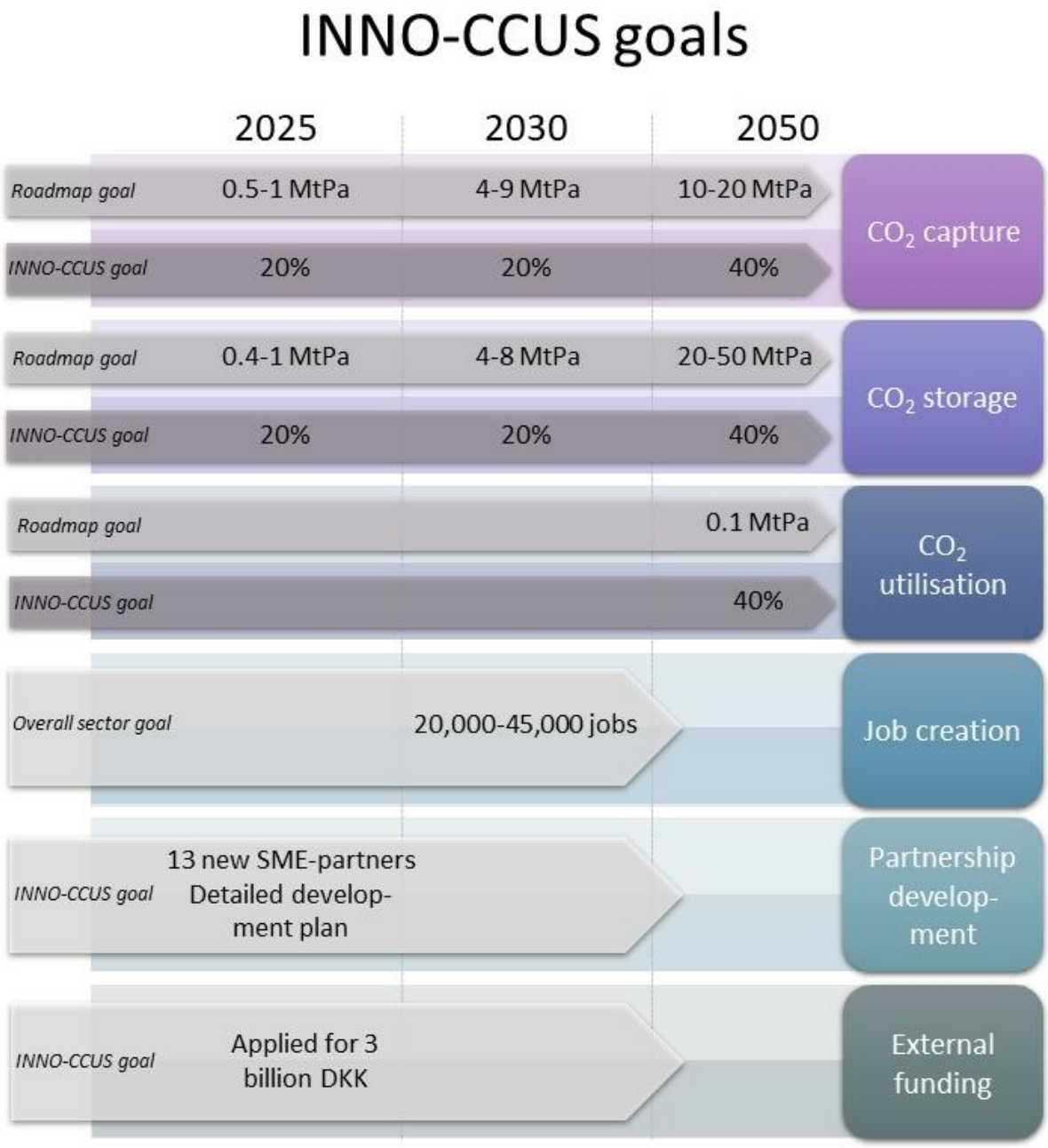

Figure 2 An overview of the technical and developmental goals for INNO-CCUS in 2025, 2030 and 2050.

Table 1 Detailed information for the technical and developmental goals for INNO-CCUS in 2025, 2030 and 2050.

Area	Overall goal
CO_2-capture	Existing technologies will be optimized regarding cost, efficiency, and environmental impact. Less mature technologies will explored, developed, and compared to state-of-the-art solutions. If the planned activities in pool 1 and prospect activities in pool 2 are successful a 10% increase in cost efficiency for chemical CO_2 capture is expected. For biological CO_2 capture improved monitoring and validation methods will be a main goal. The quantities of CO_2

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	captured in 2025, 2030, and 2050 depend on a combination these achievements and the actual legal/regulatory framework. The INNO-CCUS ambition for contributions to the goals defined in the roadmap are described here: **2025** *Roadmap goal: 0.5-1 MtPa* INNO-CCUS contribution: 20%, equal to 0.1-0.2 MtPa. **2030** *Roadmap goal: 4-9 MtPa.* INNO-CCUS contribution: 20%, equal to 0.8-1.8 MtPa. **2050** *Roadmap goal: 10-20 MtPa* INNO-CCUS contribution: 40%, equal to 4-8 MtPa
CO_2-storage	Different geological storage options will be explored and important tools for storage site validation will be developed. These will support other national and international efforts to provide secure CO_2 storage in Denmark and/or elsewhere. The goal is to lower the operational cost of geological storage by 5% by securing more efficient injection processes and fewer shutdowns due to well impairment. For biological storage the goals are to improve the monitoring and validation methods to secure safe and sustainable long term storage. The Partnerships goals are considered in relation to the roadmap goals, and with the consideration that there will be a significant development in the Partnership funding and activities in a long term perspective. The storage goals takes chemical and biological storage into consideration, the highest emphasis on biological storage is in the 2050 goals. The numbers are detailed in Table 4. A ramp-up model for the contribution, from 20% in 2025, to 40% in 2050 is reflected in the goals presented here: **2025** *Roadmap goal: 0.4-1 MtPa* INNO-CCUS contribution: 20%, equal to 0.08-0.2 MtPa. **2030** *Roadmap goal: 4-8 MtPa* INNO-CCUS contribution: 20%, equal to 0.8-1.6 MtPa **2050** *Roadmap goal: 20-50 MtPa* INNO-CCUS contribution: 40%, equal to 8-20 MtPa.
CO_2-utilisation (long term focus)	The biggest potential for utilisation of large quantities of CO_2 is related to Power-to-X applications. This is addressed in Innomission 2. A strong link between the two partnerships is a success criterion. Non-fuel applications are being addressed in INNO-CCUS. The goals are to improve biogas upgrading and explore the potential for production of sustainable chemicals or materials from medium size

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	sources at locations where neither storage nor transport infrastructure of CO_2 is feasible. The efforts must be coordinated with the other national efforts in this area **2050** *Roadmap goal: 0.1 MtPa in 2050 for non-fuel applications.* INNO-CCUS contribution: 40%, equal to 0.04 MtPa *The largest application regarding fuels is addressed in Innomission 2*.
Job creation	With the Danish ambition of capturing 4-9 Mtpa by 2030, a job creation of between 20,000 and 45,000 can be expected. The generated jobs cover a wide variety of professions ranging from engineers researching and developing the necessary state-of-art technology, geologists identifying suitable subsurface structures for permanent storage, financial and legislative professionals creating and maintaining the necessary framework and not least labourers putting words into action.
Biodiversity	All projects are designed to protect our climate and nature, and will do no harm to nature. An increase in biodiversity is expected especially from the projects in workstream 2, biological CO_2 capture and storage. We will not focus specifically on biodiversity, but remain very conscious about ecosystems and sustainable land/sea use, including the challenge around coexistence of several activities within CO_2 storage, energy production and extraction/production of raw materials
Partnership development	The goal is that the partnership can develop into a national platform for collaboration and knowledge sharing within CCUS. In order for INNO-CCUS to reach this goal a stable long- term funding must be secured since all partners are simultaneously working in other projects, partnerships, networks, and consortia. During the first 6 months, the detailed plan for attracting international partners will be created, including a model for international collaboration, in co-creation with IFD. The INNO-CCUS goal for SME-participation is 100% increase by 2025, equal to 13 new SME partners.
External funding	The Partnership will prioritise to attract external funding, and consider both national and international funding sources. The numbers are detailed in **Error! Reference source not found.**. **2025** The INNO-CCUS goal is to apply for 3 billion DKK external funding.

The goals for each workstream 1-5 are defined below.

Workstream 1: Chemical CO_2 capture

The primary objective in chemical capture is to reduce the cost, energy consumption and environmental impact of capture processes. INNO-CCUS will contribute significantly to this process through the projects included in Pool 1. It is also an important benchmark to have a part of Pool 2 to

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contribute to the objectives of the national reduction targets. Other aspects of the roadmap will be addressed to a greater extent in future pools, including capture processes based on electrochemistry, alternative solvents, membranes, etc.

Table 2 KPI's for workstream 1

Indicator	Comment	2025 target	2030 or 2050 target
Chemical CO_2 Capture	-	Carbon capture projects realised in 2025 and the period immediately after will be based on current technology as the FID needs to be taken in 2022/2023. However the partnership and these capture projects will benefit mutually in the process of construction and commissioning capture facilities.	Chemical CC is the only CC technology which can be up-scaled and implemented widely before 2030. With a significant contribution from project 1-P1, chemical carbon capture is expected to result in 0.5 million ton CO_2 captured per year at ARC alone.
Cost reduction	-	No significant cost reduction will be achieved by 2025	By **2030**, the technology advancements within Chemical CO_2 capture enables a reduction in CAPEX and OPEX of 10%
TRL progression	-	The projects in workstream 1 have a duration of 36-39 months, and will advance between 1 and 4 levels on the TRL-scale, depending on the project content.	-

Workstream 2: Biological CO_2 capture and Storage

The primary objective of all projects is to help document the carbon sequestration in afforestation, biochar, and coastal ecosystems, and subsequently projects will benefit from this documentation to focus the effort in areas where the highest climate impact can be achieved. Therefore, the projects themselves do not sequester carbon, but will assist in guiding and documenting effect of afforestation, biochar and coastal ecosystem management as means for biobased CCS and CCUS.

Table 3 KPI's for workstream 2

Indicator	Comment	2025 target	2030 or 2050 target
CO_2 storage in coastal ecosystems	Restoring blue carbon ecosystems could remove 0.5% of current emissions, with co-benefits for local	The technology is at TRL 1-2 hence the impact in 2025 is expected to minimal	Coastal ecosystem restoration and conservation storing blue carbon has a huge potential (234 Tg C per

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	ecosystems and livelihoods, including increased marine and terrestrial biodiversity.		year globally) which scaled to Denmark accounts for carbon sequestration of potentially 250 Mt CO_2e by 2050.
CO_2 emission reduction as a result of afforestation	The indirect contribution is indirect, is secured securing via documentation, project 2-P3. The global market for carbon credits is expected to increase by factor 15-100 within 10-30 years reaching values of 300+ billion DKK annually. With this, carbon credits from afforestation to be transparent, verifiable, and environmentally robust, requiring uniform and reproducible methods for documentation of impacts on carbon and other ecosystem services.	The technology is at TRL 1-2 hence the impact in 2025 is expected to minimal	Estimation of up to 100.000 ha afforestation in 2050.
CO_2 emission reduction potential via biochar production	The aggregated climate effect of Danish production and use of biochar may be more than 5 million tons CO_2-eq per year.	The technology is at TRL 1-2 hence the impact in 2025 is expected to minimal	Mitigation potential of around 2.5 million tons CO_2-eq if all the straw that is currently amended directly back to soil was used for biochar production instead. This corresponds to 35% of the 7.1 million tons CO_2-eq the Danish agricultural sector targets to save until 2030.
TRL progression	-	The projects in workstream 2 have a duration of 36-48 months, and will advance between 1 and 4 levels on the TRL-scale.	-

Workstream 3: Geological CO_2 Storage

The goals for INNO-CCUS state an estimated CO_2 reduction figure of a maximum of 1 MtPA for 2025 for onshore storage and a 1-4 MtPA for offshore storage. These estimates remain valid. It must be emphasized that it is the total effort, and thus include activities in addition to pools 1, 2 and

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subsequent funds for INNO-CCUS, that contribute to the reduction targets. This includes, but is not limited to, the 3D, BIO CO_2, GreenCEM, Greensand 2 and Bifrost projects.

Table 4 KPI's for workstream 3

Indicator	Comment	2025 target	2030 or 2050 target
CO_2 storage potential	The projects in workstream 3 all play a role in the technological development of geological storage with different technology advancements.	Significant support, an estimated 20%, to achieve storage of 0.4 million tonnes CO_2 in 2025, mainly at Stenlille.	The projects in workstream 3 form the basis for implementation, and contributes with up to 20% to the goal of 4-8 MtPa in 2030.
Facility run-time	An indirect but important effect of developing technologies, is improvement in the running stability of a facility. With minimized downtime, economic and environmental effects are directly derived.	The partnership will contribute to first national reliable and safe CO_2 injection with project 3-P4, where an assessment of thermal stress impact on the Stenlille well(s) is carried out.	An improvement of 5% in facility runtime. Minimized downtime is ensured via a broad contribution to improved safety for CO_2 injection, new materials understanding, ensure the monitoring process and long term storage.
TRL progression	-	The projects in workstream 3 have a duration of 12-48 months, and will advance between 2 and 3 levels on the TRL-scale, depending on the project content. The majority of the projects will advance to TRL 4/5 from TRL 2. In addition, project 3-P2 will advance to TRL 6/7.	-

Workstream 4: CO_2 utilisation

The balance between storage and utilisation of CO_2 will develop over time as technologies and industries mature and grow. The early phase (2020-2030) has a strong focus on combining capture from industrial point sources with geological storage, but it also involves natural CO_2-storing processes by photosynthesis in biomass and soils (including biochar), as well as innovative CCU projects and utilisation for fuels (Power-to-X) or chemicals.
Direct utilisation of CO_2 to chemicals via electrolysis has a significant promise and a strong hold in Denmark. CO_2 electrolysis can produce carbon monoxide through two methods: SOEC (Solid Oxide Electrolysis Cell) and heterogeneous catalysis. Alternatively, carbon monoxide, ethylene, ethanol, and methane can be produced using membrane-based electrolysis.

Table 5 KPI's for workstream 4

Indicator	Comment	2025 target	2030 or 2050 target
Carbon capture from biogenic sources	Project 4-P1 is a 2-phase project, where phase 1 is completed within pool 1. A research	No significant contribution in 2025.	Phase 2 (not covered in pool 1) is the completion of the physical testbed/pilot plant,

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	platform will be investigated, designed, and planned to enable the development of second-generation technologies for flexible CCU. The plan covers a pilot scale plant to investigate new methods for conversion of CO_2, at a 50 kW boiler output. The project doesn't directly reduce CO_2 emissions, but paves the way for unlocking a reduction of 19.2 million tons, if Denmark were able to remove the CO_2 from combustion of biomass.		including coupling with an improved co-electrolysis process. The focus there will be on research of new, aspiring methods for conversion of CO_2.
Methanation of biogas-derived CO_2	Project 4-P2 develops a platform for future biological utilisation methods	No significant contribution in 2025.	Biogas and CO_2-utilisation for high value chemicals: Biogas production is expected to double from now 25 PJ to ca. 51 PJ by 2030, and methanation of biogas-derived CO_2 with hydrogen has the potential to increase output further by up to 40%.
TRL progression	The selected CO_2 utilisation projects focus on bioenergy carbon capture and utilisation/sequestration and methanation of biogas-derived CO_2 to demonstrate fermentation of biomethane for bioplastics.	The project periods are between 19-36 months, and the technologies will advance from TRL 3 to TRL 4-5 in this period.	-

Workstream 5: Society and Systems Analysis

The projects in pool 1 contains important projects concerning the overall development in societal acceptance of CCUS-solutions, as there is a need to prepare for the implementation of CCUS on a large scale.
Implementation of carbon capture, storage and utilisation technologies rest on both acceptance and demand for the technologies and their associated products. Detailed information of consumers'

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willingness to accept and pay for CCUS technologies and products will help to gear the green energy transition.
The projects focus on systemic and societal challenges, and they are interlinked with the technical part of the project portfolio, to ensure a synergistic contribution in the areas.
The projects will not advance on the TRL-scale, as they are not technical projects, but the specific milestones for each project is described in the Gantt-like chart provided with Exhibit 2, Partnership Plan.

Table 6 KPI's for workstream 5

Indicator	Comment	2025 target	2030 or 2050 target
Public perception and acceptance of CCUS	Implementation of CCUS rests on a general and site-specific acceptance of the technology in the population.	A large-scale survey will be linked to present and historical Danish administrative data, including energy consumption, distance to energy infrastructure, health data etc.	Enhanced understanding of involvement processes to ensure legitimacy in decisions regarding carbon storage. Through case studies the project will collect experiences from other, similar processes, e.g. local protests against the placement of wind turbines.
Integration of CCUS in the energy system	The project will assess technology and economy issues for carbon capture deployment, consolidated into recommendations for how carbon capture can efficiently be system integrated	Preliminary map of point sources suitable for carbon capture	In 2030 the economic consequences of implementing carbon capture at point sources and direct air capture will be evaluated. This includes investment costs in the technology and in associated energy infrastructure, but also the resulting savings in biomass consumption
Local value creation in carbon capture, storage and use	Project 5-P3 aims to accelerate the Danish development of CCU/CCS in a locally and socially acceptable way, supporting a just transition of the energy system	Analysis of the market potential for CCUS plants in the Thy-Mors area	The knowledge from all the work packages will be synthesized. Concrete recommendations for further exploitation of the business set-ups, locally and nationally, will be developed

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Pool 1 projects – contribution to roadmap

Pool 1 contains 20 projects divided in 5 workstreams. The detailed overview of the projects is found in "AD Exhibit 2 – project charter", and here, a list of project numbers and titles are proved in Table 7.

Table 7 Overview of projects in pool 1, divided by workstreams and with project number linked to project title.

Project number	Workstream	Project title
1-P1	Chemical CO_2 capture	Carbon capture Open tests and Review of Technologies
1-P2		CO_2 capture by oxyfuel combustion at cement plants
1-P4		Large scale integration of DAC in Energy Systems
2-P1	Biological CO_2 capture and Storage	Blue Carbon - a mission to maximise C storage in Danish marine ecosystems
2-P2		Biochars for soil carbon storage and sustainable agriculture
2-P3		Innovative forests for curbing climate change while integrating biodiversity, nutrient retention, and recreation
3-P1	Geological Storage	Compositional Simulation of Reactive Transport in CO_2 Storage
3-P2		Experimental study and modelling of CO_2 propagation in geological storage
3-P3		Monitoring Fugitive emissions
3-P4		Risk assessment of the CO_2injection well damage due to thermal stresses
3-P5		BOrehole Monitoring Solutions for CO_2storage wells
3-P6		The adaption of existing infrastructure for CO_2 storage in reservoirs
3-P7		Corrosion protection for CO_2 storage facilities using nanofilament coatings
3-P8		Evaluation of residual hydrocarbons effect on CO_2 injectivity in depleted chalk reservoirs
3-P9		Chalk– CO_2reactions at reservoir conditions
4-P1	CO_2 utilisation	Research and development platform for flexible BECCU/S
4-P2		Biotechnology for converting CO_2 to platform chemicals
5-P1	Society and Systems Analysis	Public acceptance of CCUS
5-P2		Large Scale Integration of Carbon Capture in Energy Systems
5-P3		Local value creation in carbon capture, storage and use: the development of cross-sectorial business set-ups and pathways

Below are Table 8, Table 9 and Table 10, which are adapted from the roadmap. They show which areas of the roadmap are addressed in the pool 1 project portfolio.

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Table 8 is adapted from the INNO-CCUS roadmap. The table contains the overall goals as defined in the roadmap, within CO_2 capture, for 2025, 2030 and 2050. The left pane shows how the pool 1 projects contribute to the roadmap within CO_2 capture. The development defined from baseline to 2025, is the progression the Partnership expects to achieve in this period. The correlation between the table and the project is not in a 1:1 relationship, as one project can affect progression within several areas, and several projects can contribute to the development within one area.

INNO-CCUS pool 1	Capture	Baseline				2025 goal			2030 goal		2050 goal
	Finance and SRL	Subsidiaries									
Not adressed in pool 1 projects			Sector coupling	Investment strategy		Subsidiary system in place					
		Societal readiness level									
Workstream 5		SRL 2	Assessment of current and social acceptance and challenges	Involvement of general public	Outreach activities	SRL 6	Environmental study for specific sites		SRL 9		
	Implementation	Thermal driven carbon capture									
1-P1		TRL 9	Brown/green field feasibility	FEED study	Demonstration	0.5 MtPA	Large scale heat pumps	Heat integration	4-9 MtPA	Export and Gigantic scale	5bn DKK export
		Export and SME creation									
1-P1		Low export	Support for SME's	Legal and IP strategy	Business plans	3 SME, export ambition	Seed capital	Sales	10-20 SME, initial export	Overseas customers	Export
		Cost reduction									
1-P2		LCA and CAPEX analysis	Alternative building materials	Corrosion tests	10% reduction in CAPEX	Volumetric optimization	Process parameter optimization	20% reduction in CAPEX	Deep sector coupling & flexible operation	<35€/ton	
	Innovation	Electricity driven carbon capture									
Not adressed in pool 1 projects		TRL 4	New solvents	New materials		TRL 6	Solvent optimization	Demonstration	TRL 8	P2X integration	10-20 MtPA, export
		Biological capture									
2-P1, 2-P2, 2-P3		TRL 2-3	End-product analysis	Process optimization	Volumetric efficiency	TRL 6	Demonstration	Upscale and FEED	TRL 8	CCU and Hydrogen integration	1 MtPA
		Direct Air Capture (DAC)									
1-P4		TRL 2-3	Solvent loss optimization	New process development		TRL 4	Cost reduction	Cemonstration	TRL 7	Cost reduction	<100€/ton

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Table 9 is adapted from the INNO-CCUS roadmap. The table contains the overall goals as defined in the roadmap, within CO_2 storage, for 2025, 2030 and 2050. The left pane shows how the pool 1 projects contribute to the roadmap within CO_2 storage. The development defined from baseline to 2025, is the progression the Partnership expects to achieve in this period. The correlation between the table and the project is not in a 1:1 relationship, as one project can affect progression within several areas, and several projects can contribute to the development within one area.

INNO-CCUS pool 1	Storage and Transport	Baseline				2025 goal			2030 goal		2050 goal
		Regulatory framework and business model									
Workstream 5	Regulation, business model and SRL	Unclear regulatory framework. Business model not established	Regulatory framework	Business model and market mecha nisms	Internatio-nalisation	CCS Directive imple-mented; business models established			Danish transport and storage business model compe-titive in European context		Compe-titive advantage to Danish process industries and society
		Societal readiness level									
Workstream 5		SRL 2	Assessment of current social acceptance and challenges	Involve-ment of general public	Outreach activities	SRL 6	Environmental study for specific sites		SRL 9		
	Implementation	**Offshore storage - depleted O&G sandstone fields**									Provide storage of 20-50 Mtps for all DK sites. Integrated with PtX/Utility
3-P1, 3-P2 (and contribution from 3-P6, 3-P7)		TRL 5	De-risk for final investment decision	Full scale demons-tration project		Provide storage of 1-2 Mtpa	Expansion of storage capacity	Reduce cost based on initial learning	Provide storage of 4-8 Mtpa	Expansion to other sites	
		Offshore storage - depleted O&G chalk fields									
3-P8, 3-P9 (and contribution from 3-P6, 3-P7)		TRL 3	Mapping of oppor-tunities	Studies of CO2 behaviour in		TRL4	Initiate pilot	Pilot completed	First implementatio n	Expansion to other sites	
		Offshore storage - saline aquifer									
3-P1, 3-P2		TRL 2	Identify 1-3 sites and perform first pass mapping	Geological/lab oratory investiga-tions		Potential mapped	Data acquisition	De-risk for final investment decision	Provide storage of 1-2 Mtpa	Expansion to other sites	
		Near-shore/onshore storage									
3-P1, 3-P2		TRL 2	Seismic and well data acquisition over known structures	Solidify portfolio of national storage potential	Initiate pilot for storage at gas storage site	Near-shore/onshore pilot	Temporary CO2 storage for PtX/Utility	Full scale demonstration project	Provide storage of 2-4 Mtpa. Integrated with PtX/Utility	Expansion to other sites	
		Existing onshore gas storage site									
3-P5 (and contribution from 3-P1, 3-P2, 3-P4)		TRL5	Final assessment of reservoir and de-risk	Initiate onsite pilot for storage	Full scale demonstration project	Provide storage of 1 Mtpa	Investigate feasibility for CO2 storage at gas storage	Expansion of storage capacity	Provide storage of 1-2 Mtpa		
		Infrastructure for transport - ships									
Not adressed in pool 1 projects		Existing infra-structure for natural gas	Qualifying existing ships and infra-structure	Develop hub strategy	Adapting ship designs	National infra-structure developed	Connect national and interna-tional infra-structure				
		Infrastructure for transport - pipelines									
Not adressed in pool 1 projects		Existing infra-structure for natural gas	Mapping options and needs (also for hydrogen and PtX) in internatio-nal perspective	Technical quali-fication (enginee-ring and lab tests)	Develop hub strategy	Final strategy for new and existing infra-structure	Develop-ment of national infra-structure	Connect national and inter-national infra-structure			
	Innovation	**Alternative non-liquid storage (immobilisation)**									
2-P2		Initiate investiga-tions in minerali-sation processes	Application of storage in biochar	Storage in high value solid materials		TRL3, sector coupling	Evaluate feasibility of new innovations		TRL8		
		R&D to reduce costs - storage									
3-P3, 3-P4, 3-P5, 3-P6, 3-P7 (and 3-P1, 3-P2, 3-P8, 3-P9)		Reservoir rigs, geological knowledge base	Testing and qualifica-tion of well products for CO2 injection	Simulations, reaction models and injectivity of CO2 in reservoir and seal.	Optimise operational and monitoring procedures	Provide cost reduction catalogue	Strengthen monitoring strategies and risk assessment tools				
		R&D to reduce costs - transport									
Not adressed in pool 1 projects		Pipelines / ships, TRL level initially high				Optimised ship design	Shuttle ships		Zero emission ship		

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Table 10 is adapted from the INNO-CCUS roadmap. The table contains the overall goals as defined in the roadmap, within CO_2 utilisation, for 2025, 2030 and 2050. The left pane shows how the pool 1 projects contribute to the roadmap within CO_2 utilisation. The development defined from baseline to 2025, is the progression the Partnership expects to achieve in this period. The correlation between the table and the project is not in a 1:1 relationship, as one project can affect progression within several areas, and several projects can contribute to the development within one area.

INNO-CCUS pool 1	Utilisation	Baseline				2025 goal			2030 goal		2050 goal
	Finance and SRL	Subsidiaries									
		Societal readiness level									
Workstream 5		SRL 2	Assessment of current and social acceptance and challenges	Involvement of general public	Outreach activities	SRL 6	Environmental study for specific sites		SRL 9		
	Implementation	International development									
Not adressed in pool 1 projects		Market extent: low	Bring technologies to DK	International development projects	EU	3 international projects on utilization	International demonstration of projects	Subsidiary system in place	Int. deployment of technology	Export finalized technologies	Export worth 1 bn DKK
		Start-ups and first-movers									
WP6-7		Low activity	Efficient tech transfer	Seed capital	Lower marked barriers	15-30 Danish start-ups	Legal support	First long-term contract	5-10 SMEs	Growth support funding	1-2 larger companies
		Catalysis									
Not adressed in pool 1 projects		TRL 8	Upscaling	FEED		TRL 8 demonstration	P2X integration	Smart Grids	Large scale construction intialized	Upscaling	5MtPA
	Innovation	Electrolysis conversion									
4-P1		TRL 2	Basic development	IPR		Demonstration	Upscaling	Reactor optimization	TRL 8	Investment	TRL 9, +100.000 MtPA
		Direct utilization									
Not adressed in pool 1 projects		Existent	New application	Feasibility studies		TRL 4 for new tech	Business cases	Proof-of-concept	Demonstration	Upscaling	TRL 9
		Thermo chemical technologies									
Not adressed in pool 1 projects		TRL 5	Demonstration	Reactor designs	Heat recovery	TRL 7	Industrial investment		TRL 9	Contract negotiations	International deployment
		Biological technologies									
4-P1, 4-P2		TRL 2	Proof of concept	New principles		TRL 5	Demonstration		TRL 8	Large scale demo	First large scale facility

Pool 2 priorities

The grant sum from Innovation Fund Denmark will be spent to realise as much of the roadmap as possible. For pool 2, a total sum of 79 million DKK is reserved for research and innovation projects. The future calls for pool 2 and subsequent pools will be defined with an offset in the roadmap, and a consideration of existing project's TRL-levels, as well as uncovered topics. We want to emphasize, that the roadmap is already covered to a great extent in terms of initiated activities. However, the pool 1 projects themselves plays a role in a greater innovation ecosystem, where the combined effort has a significant estimated impact.

As an example, the areas of Direct Air Capture and technologies within Biological Storage and Utilisation advances to TRL 5 or less, and there is a potential to move the technology further in pool 2. Additionally, the Partnership has identified key areas within capture, storage and utilisation, which are not covered by the current project portfolio. The areas are highlighted in tables 1-3, and includes:

- Transport of CO_2
- Near-shore storage
    - Partners from the partnership are involved in near-shore storage activities, and the technology advancement from these projects will be considered when updating the roadmap
- Direct CO_2 utilisation

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- Thermo-chemical utilisation technologies

The call text for pool 2 applications will be defined in collaboration with the 5 scientific workstream leads, to ensure the best progression possible of the roadmap.

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Exhibit 2 - Partnership Plan

INNO-CCUS

This Exhibit contains the following sections:

- Master plan for the whole Partnership
- The first year – establishing the Partnership
- Additional funding
- Capacity building
- Partnership activities
- Strategic capabilities of the partnership parties with regard to fulfilling the vision of the Partnership
- Barriers
- Strategy for overcoming barriers - Key inflection points
- Citizen involvement & social acceptability
- Partnership structure (activities and workstreams)
- Work package overview – key milestones
- Partnership placement (leading the Roadmap)
- International collaboration
- Society & Systems analysis
- Plan for communication

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Master plan for the whole Partnership

The first year – establishing the Partnership

Within the first year, the Partnership will establish itself and initiate a range of activities that support interconnectivity, relationship building, and coherence. It will also build a network for outreach, and as a pioneering organisation build a structure to understand, consider and connect with external CCUS-activities. The goal is to create synergy between the Partnership activities within research, innovation and cross-cutting activities, and external projects and stakeholders.

Assertive outreach and cross-cutting activities are the foundation of the Partnership to build trust and create a Danish platform for CCUS activities in research and innovation. The Partnership aims to create an attractive platform, where partners prioritise their participation, and see the added value of the Partnership. The Partnership should serve as a framework for innovation, with room for exploring, experimenting, testing, learning, failing, iterating.

The Board of Directors and Partnership Leader will meet at a high frequency during the first seven months, with an obligation to define the detailed execution of the Partnership, according to the process described in Figure 3.

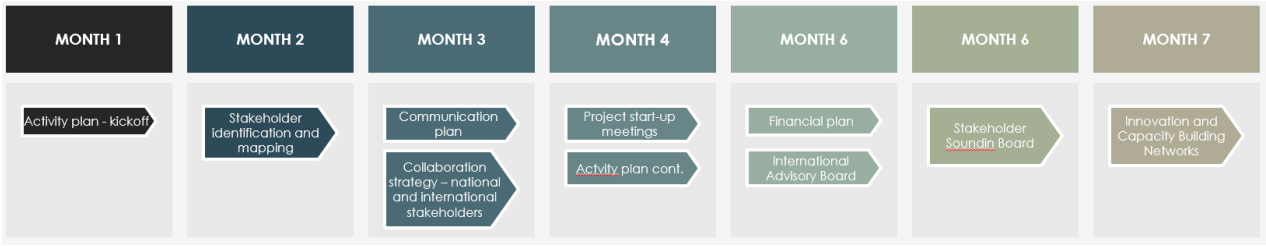

Figure 3 Tasks for the first seven months, for the Board of Directors and the Partnership Leader

. All activities are handled as meeting/workshops with the Partnership Board of Directors. Relevant participants are invited to ensure the right input for the specific activities. The Partnership Leader has the overall responsibility for the process, and the milestones and deliverables are shown in Table 11.

Table 11 Milestones to define the details in the Master plan for the whole Partnership.

Activity/objective	Purpose	Timeline	Deliverable
Stakeholder identification and mapping: - Types of stakeholders	The stakeholder overview is a tool for defining the execution of the Partnership. It's important for the communication plan, outreach activities, Advisory Board planning.	Month 2	A prioritized stakeholder map, which serves as an important tool for subsequent activities. The stakeholder map is updated continuously.

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- Specific named stakeholders - Stakeholder relevance for the Partnership			
Defining the important stakeholders in the national and international ecosystem and write a collaboration strategy	The ecosystem around CCUS development in Denmark and abroad is important for future collaboration. This requires a plan for collaboration, to ensure the right actions are taken in due time.	Month 3	A list containing the top ten most important stakeholders in the CCUS ecosystem, and a collaboration strategy with first contacts to each stakeholder planned, and a suggestion for a collaboration form.
Create a communication plan: Internal and external communication, levels of information, responsibility	To ensure a transparent Partnership with a suitable flow of relevant information to relevant groups	Month 3	A communication plan with internal and external communication groups, and levels of information assigned
Activity plan for the first 18 months. The first part of the activity plan will be settled immediately after the Partnership initiation (month 1), as kick-off and General Assembly should be executed early.	The Partnership activities are important to build a synergistic partnership – inspiration for participants, to engage and share knowledge	Month 1 and Month 4	After 1 month, we have a detailed plan for the kick-off and General Assembly. At 4 months, the activity plan for the first 18 months is scheduled. Activity responsible, participant types, date and venue for all activities.
Start-up meetings with all projects - Specific and measurable deliverables	To monitor the progression of the projects, a set of specific and measurable deliverables must be defined for each project. A project cannot initiate before the deliverables are approved by the Partnership BoD.	Month 4	When all project deliverables are approved by the Partnership BoD, they are reported to IFD at 4 months.

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Detailed plan for the Innovation and Capacity Building Networks	The Partnership will secure the future talent base by offering capacity building at several levels	Month 7	A process plan for building: Ph.D.- and master training networks, and lifelong learning programs, with first actions specified and quantified, and subsequent actions qualified and time bound, to achieve the goal of starting before 2025.
Define role of the International Advisory Board, and suggest potential members	The international Advisory Board is important to the Partnership, as they will help guiding the Partnership in the right direction for achieving the long term goals. The role of the International Advisory Board must be described in detail, before potential members are contacted	Month 6	A role description for the International Advisory Board members. A list of key competences needed in the Board, and a subsequent list of potential members to contact.
A detailed plan for funding the Partnership with focus on Research and Innovation projects	One of the core activities of the Partnership is to gear the funding for CCUS R&D, to achieve the necessary progress described in the roadmap, to achieve the 2030 and 2050 goals	Month 6	A list of potential national and international funding sources, and action points for contact/application. The list will contain funding opportunities for at least 3 billion DKK unlocked before 2025.
Stop/go milestone	The Partnership Leader will meet with IFD and present the KPI's after Month 7.	Month 7	Specific KPI's for the activities described in this table.

With an active and committed Board of Directors, the Partnership will be in a strong position, with a broad representation nationally and internationally, through collaborations and networks. The significant outreach will shape the Partnership and build trust and credibility – both crucial for developing the Partnership and achieving the vision.

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Additional funding

One of the core activities of the Partnership is to gear the funding for CCUS R&D, and before 2025 we will be actively involved in EU projects on a large scale starting from 2022 with Horizon Europe calls. The Partnership Leader and the Steering Committee develop a financial plan during the first year and contacts the first national foundations.

The Innomission partnership will unlock additional investment by industrial partners as the business case for processing CCUS are matured and proven positive. The Innomission partnership will utilise and further build up the capacity to gear private investment with international research, innovation and demonstration funds to complete the mission towards 2030, 2050, and beyond. The Partnership want to formalize an ongoing funding dialogue with the strategic important foundations such as IFD, EUDP, and Novo Nordisk Foundation.

Table 12 Possible external funding options, which will serve as the basis for the development of a detailed financial plan.

Funding opportunity	Total amount	Estimated amount for INNO-CCUS	Time period	Theme/option
IFD	-	N/a	n/a	Pool 2-n.
MUDP	-	-	-	-
EUDP				
EU Innovation Fund	25 billion Euro towards 2030	100 million Euro	2024 and forward	A large common project on Danish land, executed by Partnership Participants
Horizon Europe	-	100 mio Euro	2023 and forward	PtX, sustainable fuels, RIA, IA, climate partnerships
Just Transformation Fund	-	-	-	Industry lighthouse projects and regional fund projects
Novo Nordisk Foundation	10 billion DKK annually	500 million DKK equal to a new center	2024; 5 years forward	New CCU center, focus on theme 3 and 4 in the sustainable strategy. Focus on biobased solutions coupled to agriculture.
The Danish government's CCS pool	16 billion DKK	10% = 1.6 billion DKK	First round in 2022	CCS on flue gas from industry and waste incineration, electricity and district heating (including biomass)
The Danish government's negative emissions pool	2.5 billion DKK	20% = 500 million DKK	2024	CO_2-capture through biogas-upgrade, pyrolysis and DAC

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Private investors/venture capital		250 million DKK		An expected increased demand for private funding for research and innovation

For low-TRL activities, we propose establishing an open CCUS platform for research, innovation, and development. The CCUS partnerships will coordinate closely with ongoing and new research centres that form on the initiative of universities and private foundations.

Capacity building

The Partnership achieves the objectives within the capacity building workstream by forming a Ph.D. training network and a Master training network as coordination points. Each training network will establish training and educational activities in collaboration with the individual universities. The Partnership amplifies the initiatives down to the enrolment of bachelor students at the respective universities through:

- Supporting recruitment nationally through building a new joint national campaign initiative, e.g. called " CCUS the Future" inspired by "Engineering the Future", focusing on the CU, CCUS Technology and Nature-based-Solutions educations to distinguish them from the plethora of SDG based educations outside the Science and Technology disciplines.

- International recruitment by making the INNO-CCUS internationally renowned and establishing partnerships with universities willing to supply and/or exchange students at Masters' level.

- Initiating a Horizon Europe Marie Curie CO-FUND project that funds the Danish CCUS ecosystem's internationalisation by attracting international post-doc to Denmark and secondments of Danish post-docs to internationally renowned institutions.

- Offering scholarships and student jobs for talented students with their ideas. The Partnership plans aim at convincing companies to support such initiatives (for example, through Energy Cluster Denmark or CLEAN).

- Supporting master student research training by involving students as resources in research projects. Thereby, students will participate in problem-based learning related to IM1 research projects.

- Improving gender and cultural diversity by cross-institutional onboarding and retention activities based on best practice as well as providing equal opportunities by addressing gender language and topic biases when organising educational activities in the INNO-CCUS.
- Initiate industrial Ph.D. projects in corporation with universities and industries/consultant enabling the results to be close to market.

All of these initiatives require university capacity building, and a large portion of the universities' cofounding will be devoted to such national and international recruitment and educational activities.

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Partnership activities

The Partnership has a plan outlined for a range of activities, which will define and shape the Partnership, engage stakeholders and pave the road for the fulfilment of the Roadmap. The detailed plan for executing these activities, including defining responsibilities, will be determined during the first six months of the Partnership, in collaboration between the Partnership Leader and the Steering Committee.

Table 13 Suggested partnership activities

Area	Activity	Content	Objective
Research environments	- Publications in peer reviewed international journals - Project collaboration with other research organisations - Participation in international conferences	Published results from projects funded by IFD and other external sources Horizon Europe projects and other international projects International conferences, workshops, and presentations	Disseminate results from Innomission projects to a wide range of international peers Secure wider collaboration and knowledge-sharing in public and private research environments Educate next generation researchers and professionals
Industry	- Set up cooperation with national industry associations by using existing channels to members of industry associations - Workshops and hackathons targeted towards start-ups - Arrange events and set up information channels for SME's	Disseminate knowledge about Innomission results and public events together with industry associations Provide physical environments, support functions and events for entrepreneurs across DK	Reach a wide national industrial audience e.g. sub-suppliers and other sectors Create an entrepreneurial environment using existing platforms e.g. incubators at universities Engage the SME environment
Government institutions & EU Commission/DG's	- Arrange and participate in meetings and workshops for relevant government agencies - Deliver policy reports/briefs/white papers	Establish a platform for communication with relevant government agencies and other political institutions	Contribute with research-based decision support and industrial know how to regulatory frameworks for CCUS in DK

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Municipalities	- Arrange meetings and workshops with municipalities in DK - Include municipalities in projects/demonstrations of technologies/methods/business	Establish a platform for communication with municipalities	Identify municipalities that may be interested in/or have the capacity to host capture/storage facilities Contribute with decision support, citizen science and at citizen debate
Other Innomission partnerships	- Identify overlapping industry driven challenges - Coordinate project cooperation on technology development	Define the mutual and/or overlapping gaps in the value chain IFD external event will be incorporated as part of the activities	Secure alignment with IM2, 3 and 4 to boost knowledge sharing and/or develop solutions in common
Investors	- Provide pitching and Business-to-Business dating events with investors/investment funds/ venture capital/business angels - Go-to-market strategies for high TRL projects	Activate existing platforms such as industry clusters, incubators and industry associations	Facilitate access to investments for commercialising new technologies/products and support start-ups
IFD annual external event	- Participate in preparation and execution of annual event	The Partnership BoD is responsible for activities and engage relevant partners across missions and the secretary coordinates	Use external event to present results and attract new partners

Strategic capabilities

The Partnership takes due consideration to the variety and complexity of CCUS by working with five designated workstreams divided further into specialised themes. Projects will develop new solutions under each theme, and over time the innovation model will result in projects based on needs or ideas identified by the partners. Thus, the workstream leads and Partnership BoD will have an overview and secure that we constantly commit to our common goal and vision for INNO-CCUS. From collaboration in the actual projects and ideas arising from dialogues within the united ecosystem, radical innovation ideas will emerge and transfer into the Partnership.

To achieve the greatest possible effect, the Partnership will be part of ensuring the necessities to transform the investment in research, including CCUS, into value for society and businesses. Based

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on the long tradition for collaborative projects and partnerships, the Partnership develops innovative technologies, applications and services based on the latest research and technology. It is thus necessary that the innovation infrastructure support society and the business sector to efficiently create value.
To support value creation (short-term, e.g. business value and long-term, e.g. societal value) and the commercialisation of the research carried out in INNO-CCUS), a workstream focused on innovation and entrepreneurship is established within the Partnership. This workstream brings results from research to market and supports start-up initiatives. Further, the workstream will be cross-cutting and support both the core thematical workstreams as well as workstreams within education and capacity building.
Activities will include:

- Industry need-driven innovation and entrepreneurship
- Master training network
- Ph.D. training network
- Knowledge and tech transfer between research and industry such as in-residence activities, tech-challenges and recruitment fairs between universities and industry.
- Lifelong learning courses for companies

Barriers

Developing a new sector in an international competitive setting involves a broad number of risks. They range from technologies with low TRLs, low SRL-levels for storage, uncertainties related to investment-intensive complicated multi-actor value-chains, the absence of viable business models and uncertainties regarding political regulation. Risk reduction activities should be planned. Such actions will vary and involve small-scale experiments, large-scale testing, continuous systems-analysis and modelling, and stakeholder involvement. Risk management must be coordinated in the Partnership, and specific risk analysis results align with overall mitigation and adjustment expectations. With a gradually increased dependency on green CCUS, the risks decrease. The expectations to reduce the risks and barriers while building a CCUS-sector happen in the context of a multi-source, multi-technology, and multi-actor scenario, which allows for a diversified pipeline of innovation. The main risks associated with CCUS are illustrated in the figure below.

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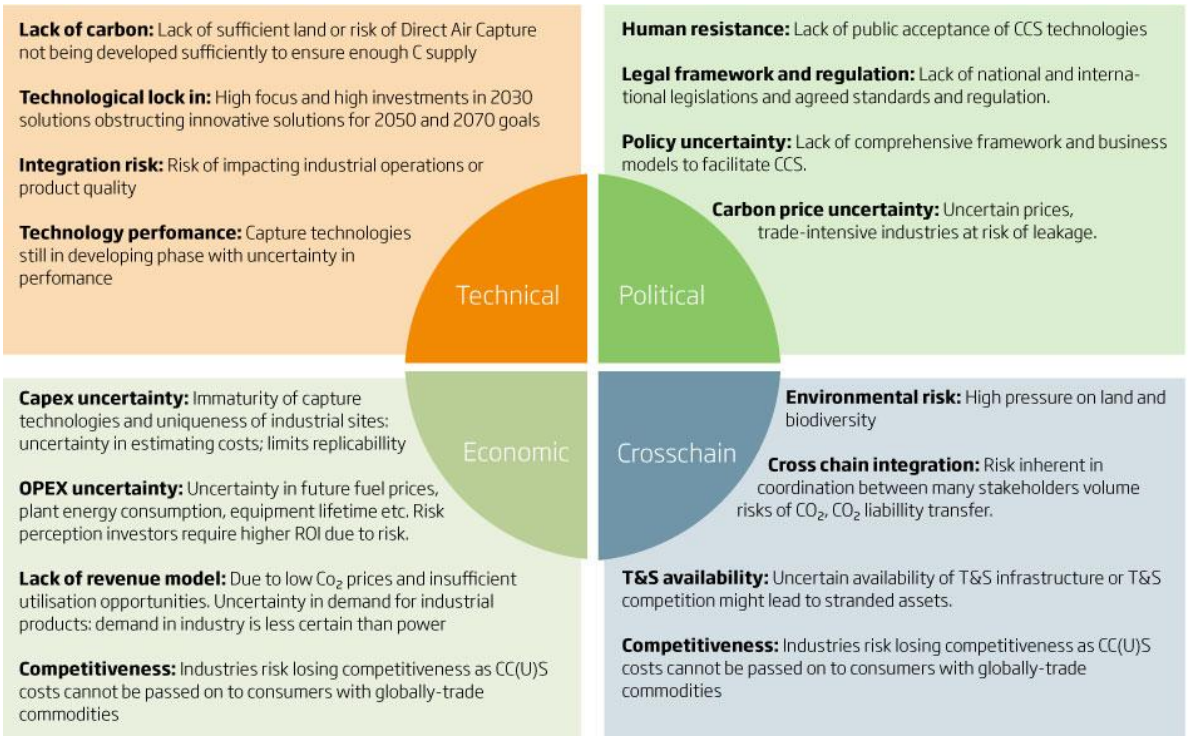

Table 14 Identified barriers and obstacles within technical, economical, political and cross chain contexts

Strategy for overcoming barriers - Key inflection points

There are three key inflection points for the development of the CCUS sector, and they will be of crucial importance for the development of the sector. As a part of the risk assessment and management, these inflection points are in focus, but they cannot be solved by the Partnership alone.

Regulation
Establishing a common and cross-sectorial value/price and/or tax/credit of carbon, providing incentives for removing/replacing fossil CO_2, storing CO_2, and delivering green CO_2 for utilisation is a fundamental requirement. Regulation must be international and agreed upon at the latest in 2025 for gradual implementation. This agreement is a fundamental requirement for the realisation of a fossil-free future.

Inflection points:

- When the price of CO_2 emission exceeds the cost of capture, transport, and storage, this point marks the shift from subsidised to the full commercial market.
- When subsidies of storage are no longer needed. This point marks the transition to a full commercial international storage market. Large storage sites should be developed for this to happen, and transport infrastructure must be in place for the economy of scale to work. This should happen in good time before 2030.

Capture technologies
Development, optimisation, and upscaling of capture technologies are profound necessities to reach the CO_2 reduction targets nationally and globally. All kinds of capture have to be taken into account for that purpose.

Inflection points:

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- When CO_2 capture technologies are no longer based on thermally driven processes but are purely driven by electricity or biology.
- When CO_2 capture is not only from high concentration point source emitters but also from low concentration gas sources like shopping malls, office buildings, and schools. This is expected to happen around 2040 but well before 2050.

When direct air capture (DAC) matures, it will be vital to reaching the net-negative CO_2 emission goal and a carbon source in the non-fossil future. Currently, the development of the DAC technology is at a low TRL with critical challenges to be solved. If DAC fails to scale up, the lack of CO_2 sources may become an obstacle to reaching the net-negative CO_2 emission goal, as the potential for BECCS is limited by the amount of biomass available.

Utilisation
For the development and implementation of non-fuel CO_2 utilisation, food production, and chemical products, the economic incentive should become stronger to reach a sufficiently large scale.

Inflection points:

- When the price of utilisation of CO_2 no longer exceeds the cost of storage. This marks the time when CO_2 becomes a commercial resource. This inflection point is likely reached after 2030 but well before 2050.

Citizen involvement & social acceptability

Citizen's involvement and societal acceptance are connected to the local value creation regarding business and employment, understanding potential (local) environmental effects and transparency and communication of the technology, economy and risks and opportunities. More considerable potential for CCUS and a faster deployment can be achieved with local involvement of citizens and stakeholders, with workshops and transparent communication strategies and innovative business models and public regulation with a local element. New models of public acceptance are needed for technologies that have not been used at this scale before. The active involvement of citizens, municipalities and Non-Governmental Organisations (NGOs) can increase the level of societal readiness, and this work must start immediately. Public acceptance is fundamental to the future deployment of a CCUS value chain. Experiences in energy planning and the case of wind power are valuable inputs when developing the CCUS-sector.
Communication and dissemination of knowledge about the different CCUS options to all levels of society and a transparent approach to actively promote public acceptance will be essential to increase the understanding of CCUS. Such involvement can be supported significantly with public regulation that also ensures local value creation. Local participation in developing solutions to make carbon capture an essential tool to lower the greenhouse gas effect is critical. A prerequisite for this involvement is efficient communication to the local societies. The local environments help define the solution through their participation, ensuring broad support.
An ongoing dialogue with relevant stakeholders and partners is crucial to ensure acceptance and dissemination of results. Formal partnerships with selected stakeholders are considered.
Stakeholders must engage in a public dialogue with affected communities to address fears and reservations towards the different parts of the CCUS value chain and highlight the benefits of the projects (e.g. environmental and regarding local jobs). Given the importance of societal acceptance, the present roadmap targets TRL and the Societal Readiness Levels (SRL) according to the SRL concept of IFD. Right now, the societal readiness level of CCUS is relatively low (SRL 1-3). The

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proposed Roadmap will include research and test cases regarding regulation, cost models and public acceptance. These activities should lead to pilot testing in relevant environments as a first step. Further, the proposed solutions should be validated locally in cooperation with stakeholders (SRL 4-6) to build the basis for refining solutions and implementing and disseminating results (SRL 7-9). In essence, economic research and regulatory research could be the basis for a positive implementation of CCUS in society.

The Partnership has prioritised a separate workstream for Society and Systems Analysis, where three projects focus on CCUS systems integration, public acceptance of CCUS and the development of cross-sectorial business set-ups and pathways. Together, these projects contribute significantly to the inclusion of SSH-research.

Partnership structure (activities and workstreams)

The partnership activities are structured in eight workstreams for the first period. Five workstreams contain research and innovation activities, and each scientific lead is responsible for the overall development within their respective workstream. The remaining three workstreams include activities supporting comprehensive partnership building, cross-cutting activities and management. The Partnership Leader has the overall responsibility for these workstreams.
The tables in *AD Exhibit 2 - project tables*, contain an overview of the 20 research and innovation projects in pool 1, workstreams 1-5, and the milestones and tasks in workstreams 6-8. Information on the content, milestones, results, Roadmap alignment and contribution to workstream/KPI is included for each project.

Work package overview – key milestones

In “Ad Exhibit 2_project charter”, a full list of projects in pool 1 is provided. The project list is supported by a Gantt-like overview of the first 48 months of the Innomission, showing the major milestones during the first 48 months of the Partnership.
The Partnership will collect specific and measurable deliverables for all projects before project initiation. IFD will receive the total project overview at Month 4.
Here, the TRL progression for each project is shown in Figure 4.

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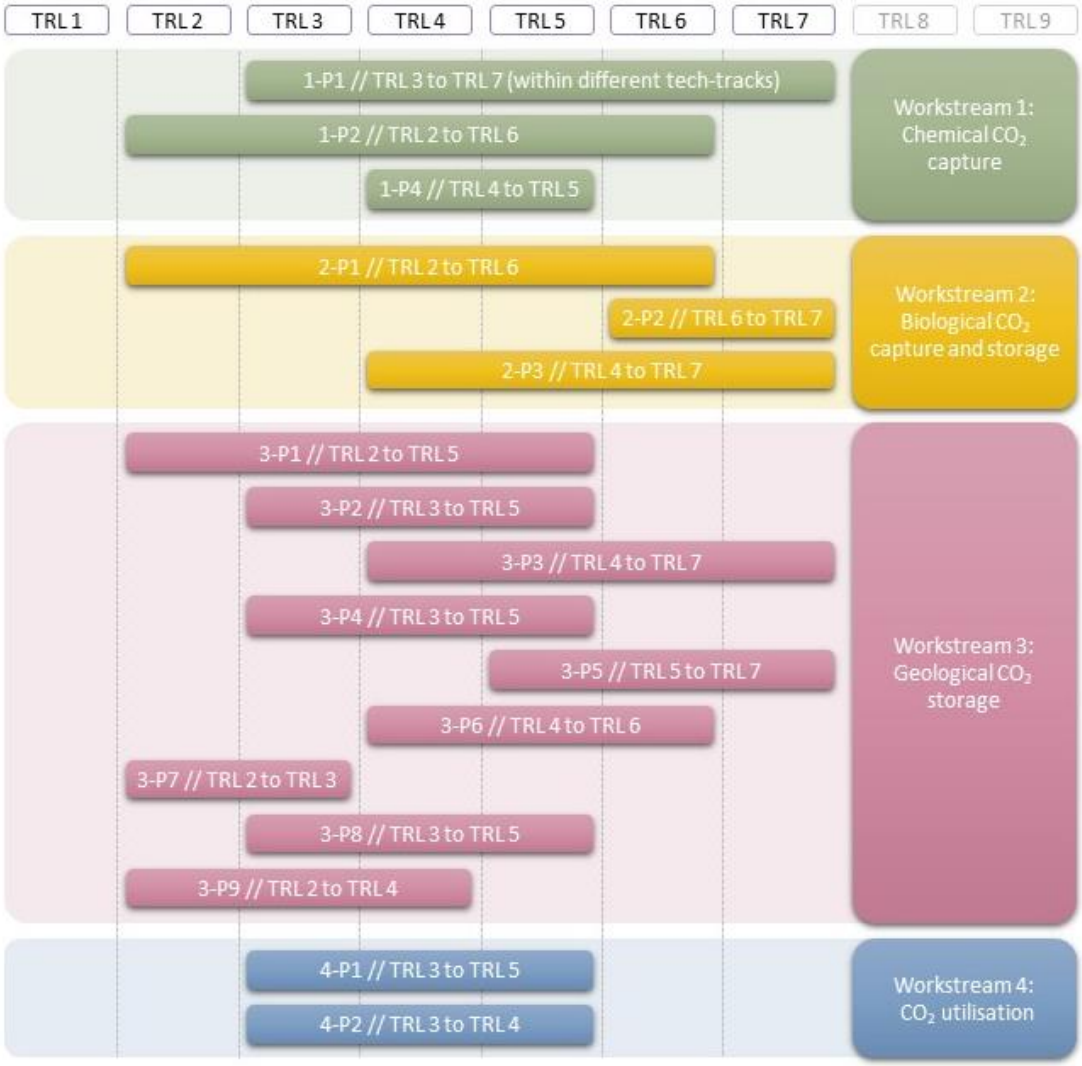

Figure 4 shows an overview of the 20 projects in pool 1, and their progression on the TRL scale from start to end of project. The lowest starting TRL is 2, and the highest final TRL is 7.

Partnership placement (leading the Roadmap)

Partnership placement and information flow

The Partnership considers communication and information flow essential to building a CCUS-sector. By placing the Secretariat of the Partnership in a university environment at DTU, the access to a broad knowledge and information network is secured.

The Partnerships' access to critical knowledge is secured through a strong collaboration in the management group; the combined experience, work relations and network of the Board of Directors, Scientific workstream leads and the Partnership Leader, will build the foundation for a significant and relevant inflow of critical information. It is the responsibility of the Partnership Leader to distribute relevant information to relevant stakeholders.

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Additionally, the Partnership management group will engage with the project participants and build a culture where information flow is a natural part of the strong collaboration.
Having three government agencies, one municipality, and a broad network of industrial and scientific partners, the Partnership aim at becoming the Danish central platform for CCUS. Once the Partnership is inaugurated, the Partnership Leader, in close collaboration with the Steering Committee, will reach out to identified project partners and stakeholders and discuss the models for information flow within the Partnership. To ensure a good collaboration, the Partnership prioritises identifying important stakeholders in the CCUS-area who are not a partner in the Partnership.

The partnership will stay connected to other relevant CCS activities both nationally and regionally. The most prominent activities in Denmark is currently the EUDP industry driven Greensands and Bifrost projects, as well as the newly established Novo Nordisk CO_2 Research centre placed at AU. On a regional scale relations will be built to other CCS projects (Northern Lights, Northern Endurance and Aramis/Porthos) and in addition the partnership will be active in EU research community.

With The CCUS Partnership in (INNO-CCUS) a new structure is being developed in Denmark for a long term collaboration between universities, research and technology organisations, large companies and SMEs. The structure deals with how innovation and development of new business areas can occur naturally and how we can create a structure that supports issues and problems being addressed on an ongoing basis. This requires an institutionalised and coordinated effort from a diverse set of partners (companies, clusters, industry associations, universities, and authorities) working to support and reduce barriers to collaboration to support each other in creating new opportunities mutually.

It will be relevant for the CCUS Partnership to join CCUS- related European partnerships, such a European Partnership on Clean Hydrogen, People-centric sustainable built environment (Built4People), European Partnership for a Circular bio-based Europe, Processes4Planet – Transforming the European Process Industry for a sustainable society, and EIC Accelerator Challenge – Green Deal innovations for the Economic Recovery.

The CCUS partnership must collaborate internationally based on our knowledge and innovation support efforts, thus creating access to globally leading knowledge and technology. Public research must be utilised better and based on research competencies in close interaction with the companies' competencies. We must focus on education, entrepreneurship, and knowledge of new forms of innovation to create the basis for future business successes and valuable jobs. Danish companies have been at the forefront of energy, water and wastewater treatment resulting in a large export volume, and CCUS can be the start of a similar business.

Research-based education within the wide range of topics and technologies relevant for the blooming CCUS industry are considerably dependent on strong research groups in the CCUS field and close collaboration with the sector. Only by investing in CCUS research at the highest international level Denmark will be at the forefront of the ongoing CCUS revolution. Strong research groups are needed to cope with the demand for high quality education and collaboration with industry and the public sector.

International collaboration

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Most of the stakeholders in CCS are already operating in an international context. Many industry partners have been involved in the international energy industry in the past, and there is a significant pool of international knowledge and experience that they are willing to share in this Partnership.

The Partnership has an established network of organisations such as the IEA and international universities. At different stages of the project, a wide range of stakeholders will be involved:

- Biobased CHP plant owners/operators (CO_2-source)
- Waste-to-energy plant owners/operators (CO_2-source)
- Large process industry companies (CO_2-source)
- Turnkey CCU and Power-to-X solution providers (technology development)
- Sub-suppliers to Power-to-X plants (technology development)
- Plastic industry, fuel industry and chemical companies (carbon users)
- SME incl. new start-ups in all the above fields, especially within novel electrolysis processes.

The Partnership will use their presence in the media and participation in activities aimed at specialists (conference, workshops, and guidelines), to ensure the knowledge transfer both within the scientific community but also industrial community, with the specific output of papers to be published in peer-reviewed scientific journals and presentations given at scientific conferences, either during or immediately following the project.
The Partnership will coordinate with other national and international initiatives, e.g. with The Novo Nordisk Foundation CO_2 Research Center. This centre will focus on developing knowledge and technology within both chemical and biological technologies for CO_2 utilisation.

It is pivotal to see CCUS from an international perspective. Both concerning the value chain and valuation of carbon in the market design and volumes and in relation to legislation, technical standards and legal framework. The international perspective may secure a lower perceived risk for investors in offshore storage, while this may be less important in biological or chemical carbon storage. A detailed understanding of the context is important, as tailored solutions may be needed for different CCUS pathways. For Denmark, a specific focus on the Northern Europe may be beneficial in the possibility of having joint solutions, more investors, and in relation to creating a larger regional volume in storage or utilisation. The global market for CCUS may in time be very competitive. An understanding of the international competition is thus essential to reduce the risk for investors.

Society & Systems analysis

To promote and sustain the acceptance, stakeholders must engage in a public dialogue with affected communities to address fears and reservations towards the different parts of the CCUS value chain and highlight the benefits of the projects. Given the importance of societal acceptance, development must target TRL and the SRL according to the SRL concept of IFD. Right now, the societal readiness level of CCUS is relatively low (SRL 1-3). These activities should lead to pilot testing in relevant environments as a first step. Further, the proposed solutions should be validated locally in cooperation with stakeholders (SRL 4-6) to build the basis for refining solutions and implementing and disseminating results (SRL 7-9).
To identify technological symbioses and optimise operations, an energy system analysis will be performed in project 5-P2. An energy system analysis contains all affected components of the energy system, including production, consumption and balancing units, and analyses the design and operation of CCUS as part of a coherent and dynamic energy system in order to maximise efficiency.

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With a dedicated project, 5-P1, the Partnership's priority is to investigate the factors deciding public acceptance and legitimacy in the placement of far-shore, near-shore and on-shore CCUS and related infrastructure. This will result in a solid understanding of the measures and processes that must be adopted to secure acceptance of carbon storage initiatives.

Plan for communication

Communication to the general public will be an important task for the Partnership. A fundamental change in how we view, value, and use carbon resources is needed. As a first step, implementing CO_2 capture at large point sources and in biomass and geological and biological storage will depend on local perception and acceptance from citizens. It will be the responsibility of the Secretariat to develop a communication plan within the first year of the project period, to set up communication channels in the form of a webpage, social media platforms and a common digital and graphic profile. Some of the SSH research-based activities will evolve around the public perception and acceptance of CCUS, and the Partnership will include knowledge and results from these activities in the outreach to the general public. Further, partners in INNO-CCUS are encouraged to participate in the public debate on CCUS, and it is the task of the Secretariat to support and contribute to this.

The Partnership Leader and the Board of Directors will develop a communication plan within 6 months of the partnership inauguration. This plan will consider communication at several levels:
Within the Partnership – communication between IFD, Board of Directors, Scientific workstream leads, Partnership Leader, and PI’s of the projects.
To stakeholders outside the Partnership, such as members of Energy Cluster Denmark, other CCS-partnerships CCS alliance large CCS-projects such as Greensand and Bifrost, EUDP and relevant EUDP-projects, international research, industry and partnerships.
With a dynamic Partnership, it is essential to consider the information flow continually. The Partnership Leader is responsible for updating the communication plan every year to maintain an overview of relevant stakeholders and types of information to distribute.

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Exhibit 3 - Organisation and Management

INNO-CCUS

This exhibit contains the following sections:

- Management and organization
- Governance model
- Management roles
- Portfolio management
- Governance for investment in Pool 2

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Management and organization

Governance model
The partnership will be structured as a consortium. Governance of the partnership in the consortium (see Figure 5) entails a General Assembly, a Partnership Board of Directors, and a project management group including five workstream leaders and all project leaders, and the project management group are aided by a secretariat. GA and the BoD will get inspiration from an international advisory board and a national stakeholder sounding board.
The General Assembly (GA) is the supreme authority of the Partnership. Exhibit 4, *Rules of Procedure for the Partnership Board of Directors*, describes the detailed process for choosing members for the BoD.

The BoD on mandate from the GA develops strategies, monitors performance of the organisation, strategically identifies and manages risk, initiates, and oversees dissemination and communication activities, manages the uptake of new partners.

- *The international advisory board* consists of a panel of acknowledged, international experts from both academia and industry with expert knowledge on various parts of the CCUS value chain. CCUS networks and centres will also be invited to join.

- *The stakeholder sounding board* consists of national stakeholders from NGO's, municipalities with interest in CCUS, authorities, think tanks, and other relevant associations.

- *The Project Management Group* consists of the five scientific workstream leads (from workstreams 1-5) and one project lead from each of the ongoing projects. The scientific workstream leads' role is described under *Portfolio Management*, in this Exhibit. The Project Management Group refers to the Partnership Leader. The Partnership Leader is responsible for ensuring coordination within the Project Management Group. The Partnership Leader, supported by the relevant scientific lead, monitors the overall progress of the projects, based on input from the project leader. The Partnership Leader provides status reporting and communication to the Partnership BoD on projects and project management.
- *The secretariat,* managed by the Partnership Leader (PL), answers to and supports the BoD. The PL is responsible for the day-to-day management of the partnership. The PL has a permanent position in the BoD with observation status only. The secretariat is responsible for legal, finance, communication, reporting, day-to-day administrative operations, etc. of the entire programme, CCUS ecosystem, educational initiatives and support to applications. Moreover, they are responsible for:
- IFDs yearly InnoMission meeting, and to invite IFD to relevant meetings*:* 4 times a year; 2 of them "within" the 5 workstreams and 2 for the whole committee, working as planning meetings for BoD meetings
- BoD meetings 4 times a year
- GA meetings once a year on behalf of the BoD

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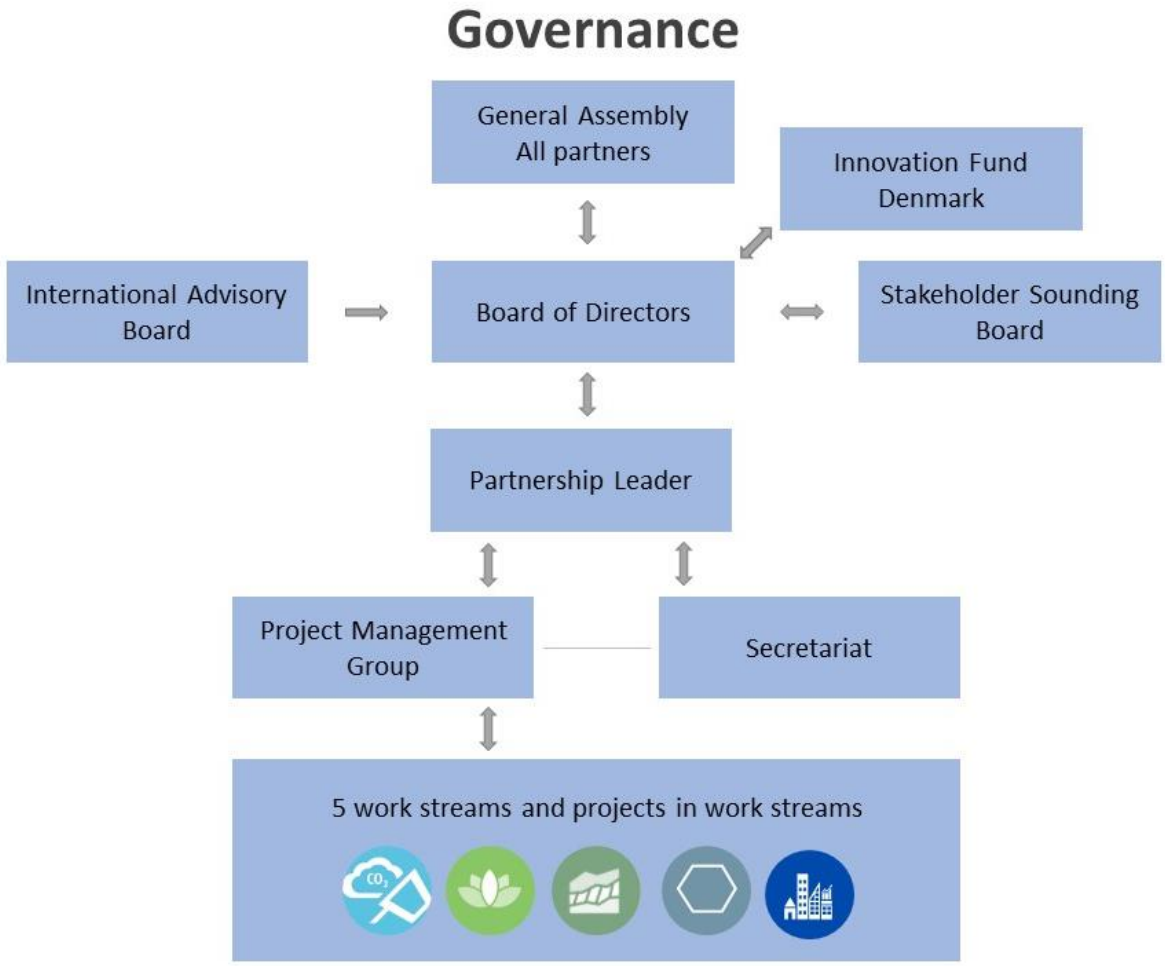

Figure 5 Governance in INNO-CCUS

Management roles

Interim Partnership Leader
Karina Marie Søgaard

Workstreams and workstream leaders:

Table 15 Workstream leaders in INNO-CCUS

Workstream	Workstream leader	Affiliation	Email address
1: Chemical CO_2 Capture	Philip Fosbøl	DTU	plf@kt.dtu.dk
2: Biological CO_2 capture and storage	Claus Beier	KU	cbe@ign.ku.dk

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3: Geological CO_2 storage	Marie Keiding	GEUS	mke@geus.dk
4: CO_2 utilization	Kim Daasbjerg	AU	kdaa@chem.au.dk
5: Society and Systems Analysis	Tooraj Jamasb	CBS	tj.eco@cbs.dk
6: Crosscutting Actions and Capacity Building	Karina Marie Søgaard	INNO-CCUS secretariat	kamam@dtu.dk
7: Communication, Dissemination and Outreach	Karina Marie Søgaard	INNO-CCUS secretariat	kamam@dtu.dk
8: Mission Management	Karina Marie Søgaard	INNO-CCUS secretariat	kamam@dtu.dk

Interim Partnership Board of Directors

Table 16 INNO-CCUS Partnership Board of Directors

Role	Name	Job title	Affiliation	Email address
Chairman	Morten Gjetting Stage	Head of CCS and Technical Services	TotalEnergies	morten.stage@totalenergies.com
Vice-chairman	Erling Halfdan Stenby	Head of Department, Chemistry	DTU	ehst@kemi.dtu.dk
Member	Bogi Bech Jensen	Director, Technology, EPC & Operations	Ørsted	BOGJE@orsted.com
Member	Bjørn Kofod	Product Manager CO_2	Pentair	Kofod@Pentair.com
Member	Maj Wendorff	Head of Reservoir Department, Energy Production and Storage	GEUS	mw@geus.dk
Member	Lasse Rosendahl	Head of Department, AAU Energy	AAU	lar@energy.aau.dk
Member	Sune Dowler Nygaard	Executive Vice President Environmental Technology	DTI	snd@teknologisk.dk
Member	Andreas de Neergaard	Dean of Technology and Health Sciences, Department of People and Technology	RUC	neergaard@ruc.dk

Administrator

Financial administration is handled at DTU

Advisory board members (names)

The advisory board will be filled after the Partnership inauguration, see Table 11.

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Stakeholder Sounding Board

The Sounding Board will be established after the Partnership inauguration and depends on the Stakeholder mapping activity described in Table 11.

Portfolio management

The internal portfolio management is handled in a collaboration between the Scientific workstream leads, the Partnership Leader, and the Partnership Board of Directors. While the Partnership Leader has the administrative and process-related responsibility, the Scientific workstream leads' role is defined here:

Table 17 The role of the scientific workstream leads in INNO-CCUS

The role of the scientific workstream leads in the INNO-CCUS partnership

The five scientific workstream leads in the INNO-CCUS partnership are appointed to represent one of the five scientific workstreams in INNO-CCUS:

1: Chemical CO_2 Capture
2: Biological CO_2 capture and storage
3: Geological CO_2 storage
4: CO_2 utilization
5: Society and systems analysis

In recognition of an aspiration for a common professional, strategic awareness of the development of the CCUS area, the scientific workstream leads have a range of tasks, divided into three main areas of responsibility:

1: INNO-CCUS roadmap and new calls

- Contribution to updating the roadmap on an annual basis.
  - This contribution is based on the scientific workstream leads' overview of workstream project progress and external activities of significant importance to the roadmap. The scientific workstream leads are expected to have a broad orientation within research and innovation in their respective field, and this knowledge is implemented in the Partnership in terms of roadmap update, informing the Partnership Board of Directors, new thematic calls and a general knowledge development with the project leaders.
- New calls in the partnership
  - Based on the roadmap and the scientific workstream leads' knowledge of ongoing project contributions and external activities, the scientific workstream leads will provide input to the Partnership BoD for writing new calls for pool 2 and future pools thereafter.

2: Communication

- The scientific workstream leads will contribute to the annual INNO-CCUS conference with relevant scientific content. This could be as a scientific presentation, a contribution to a workshop, or another suitable format.
- The scientific workstream leads may contribute to up to 2-3 relevant meetings with their relevant knowledge.
- If the press addresses the partnership for scientific content, the scientific workstream leads are available for statements/interviews within reason.

3: Coordination and monitoring

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- The scientific workstream leads have the responsibility to monitor the scientific progress and, in collaboration with the Partnership Leader, contribute to coordination on three levels:
  - 1: Between the project leaders within their workstream
  - 2: Between each other, representing the workstreams
  - 3: Between the Innomissions to ensure synergy and avoid overlap between projects.

To support the work, the scientific workstream leads will receive compensation for 130 h pr. year, this is covered in Work Package 6.
As scientific workstream lead, it is not possible to represent one's organisation in the Partnership Board of Directors.

External portfolio management, including collaboration and relations within funding, research, innovation, and industry within a portfolio of activities is fundamental to the development of the Partnership.
The Partnership has identified key collaboration and knowledge sharing points within the four categories; Funding, Research and Innovation, Industry, and Key Projects. With more than 50 partners across the Danish CCUS development landscape, the Partnership has secured a broad representation in the identified interest areas. With this, we can ensure good communication with the stakeholders. This is already initiated for key initiatives such as the Novo Nordisk Foundation CO_2 Research Center and the EUDP-projects Bifrost and Greensand.
Figure 6 below gives an overview of the Partnerships orientation within the different fields. As the Partnership and the CCUS innovation landscape progress, the overview will be updated.



Figure 6 Schematic overview of the INNO-CCUS' orientation within the CCUS ecosystem in Denmark and Europe

The financial plan will be developed within the first 6 months of the Partnership, and after this, there can be updates to the Funding area. Research and Innovation is a constantly evolving area, and the activities listed are key identified areas to collaborate with, but the list is not exhaustive. The industry

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representation within the INNO-CCUS partnership covers around 30 different companies, and their activities within CCUS are broad. The Partnership will work with the industry partners to secure a strong knowledge sharing platform with technological development. Table 18 shows how the Partnership will support the ecosystem development with the highlighted activities and areas of interest.

Funding	Research and Innovation	Industry	Key projects
Innovation Fund Denmark The Partnership is funded by IFD; a strong collaboration in developing the Partnership and securing the future. **EUDP-MUDP** The Partnership will follow relevant EUDP- and MUPD-projects, and initiate a dialogue for future funding for high-TRL advancements within CCUS **Horizon Europe Pillar II** The Partnership will identify relevant CCUS calls within Horizon Europe Pillar II, and encourage research to apply within a Partnership setting *The financial plan will be developed within the first 6 months of the Partnership, and after this, there are updates to the Funding area.*	**Novo Nordisk Foundation CO2 Research Center** The Partnership has initiated a dialogue with the center, and will secure synergies between research activities – the center can likely foster projects with potential for future funding in an INNO-CCUS setting **MissionGreenFuels** The Partnership has a strong relationship with the **Technology Centre Mongstad** The Partnership will reach out for a discussion on a collaboration and knowledge-sharing platform for mutual benefit **CERE, DTU** Direct collaboration via the involvement in Net Zero Carbon Capture at ARC **TNO, Netherlands** TNO has identified CCUS as a focus area. A collaboration can be mutually beneficial	**CCS-alliance** The Partnership will reach out to the CCS-alliance and discuss a mutual collaboration, where our shared intests are well covered. Several companies are represented in both organisations, and there is a good basis for a collaboration. **Northern Jutland Lighthouse project – CCUS** The consortium behind the project is well represented inINNO-CCUS, and communication to collaborate will be established early in the Partnership Period The Partnership will establish a collaboration across the industrial CCUS stakeholder landscape, including: **CO2 Capture demonstration at ARC** **+C4 collaboration** **GreenLab Skive** **DK Export**	The Partnership will build an overview of ongoing large projects within CCUS, and establish collaborations and knowledge sharing where relevant. Several of the ongoing projects are deeply connected to the activities in INNO-CCUS, and this is reflected by overlapping organizational representation. The projects include: **EUDP: Greensand** **EUDP: Bifrost** **Stenlille – maturation of storage potential in Denmark** **GEUS: Finance Act allocation of 210 mDKK in 2022-23** **Northern Lights, Norway** **3D-CCUS H2020 project** **The Acorn Project UK**

Table 18 shows how the Partnership will support the ecosystem development with the highlighted activities and areas of interest.

Governance for investment in Pool 2

In budget for Mission-driven Green Partnerships a minimum of 40 % of the total investment is reserved for new investments within a defined field(s) of the roadmap(s) connected to the specific Mission, and within the partnership period. This part of the budget is referred to as pool 2.
In the Investment Agreement the purpose of pool 2 investment is described in detail. This description will be defining for the development of calls under pool 2. With the approval of the Investment Agreement by IFD board of directors the budget for pool 2 is allocated to the Mission-partnership.
The Mission-partnership is responsible for process of application, evaluation and decision-making regarding investment of pool 2 budget. IFD can provide assistance with the frame and develop basic templates for call text, application format, criteria, evaluation process and investment decision by the Mission-partnership.
IFD Board of Directors must approve process and investment decision.

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Exhibit 4 - Rules of procedure for the Partnership Board of Directors

INNO-CCUS

This exhibit contains the following sections:

- 1 - The Partnership Board of Directors' composition and competence
- 2 - Innovation Fund Denmark's participation in the Partnership Board of Directors
- 3 - The tasks of the Partnership Board of Directors
- 4 - The conduct of Partnership Board of Directors meetings
- 5 - Minutes etc.
- 6 - The conduct of Investment Reviews
- 7 - Other provisions

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Rules of procedure for the Partnership Board of Directors for INNO-CCUS

1 - The Partnership Board of Directors' composition and competence

1.1 The Partnership Board of Directors consists of 10 members; 5 members from knowledge institutions, and 5 members from industry. The members are appointed according to the model described in 1.3. The IFD shall approve the composition of the Partnership Board of Directors.

1.2 At the Partnership Board of Directors' inaugural meeting a Chairman and a Vice-Chairman are appointed by the Partnership Board of Directors. The appointments shall be approved by the IFD. It is recommended that the positions are distributed evenly among the partnership partners. The Chairman and Vice-Chairman must be members of the Partnership Board of Directors. The appointments are made through simple majority of votes. In the absence of the Chairman the Vice-chairman acts on his/her behalf. If the Chairman or Vice-Chairman resigns the Partnership Board of Directors appoints a new Chairman or Vice-Chairman amongst the members of the Partnership Board of Directors

1.3 The Partnership Board of Directors' 10 members are appointed via a hybrid-model, where five seats for knowledge institutions are appointed via a rotation scheme, and the remaining five seats for industry are appointed through a majority of votes. The two processes are described in 1.3.1 and 1.3.2.

1.3.1 Four members from knowledge institutions are appointed according to an annual rotation schedule between DTU, AAU, AU, SDU, RUC, CBS, GEUS, and KU. The fifth member is a GTS-representative, and the GTS-institutes Teknological Institute, Force Technology and DHI rotates for this seat. The rotation plan for the knowledge institutions and GTS institutions, which can be adapted by the Partnership Board of Directors, is enclosed here:

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Table 19 Rotation plan for knowledge institutions and GTS institutions in Partnership BoD

	2022	2023	2024	2025	2026	2027
DTU	1	1		1	1	
AAU		1	1			1
AU			1	1	1	
SDU			1	1		1
RUC	1				1	
CBS				1		1
GEUS	1	1	1			1
KU	1	1			1	
Teknological Institute	1	1				
Force Technology			1	1		
DHI					1	1
Total	5	5	5	5	5	5

1.3.2 Five members from the industry are appointed through a majority of votes between the industry Partnership Partners. Four of the five industry members must represent each of the scientific workstreams 1-4. The fifth industry member is an SME, appointed by Energy Cluster Denmark. An industry Partnership Partner must assign themselves to its primary workstream (1-4), see Partnership Agreement Exhibit 1. An industry Partnership Partner can vote for the Partnership Board of Directors position representing their primary workstream.
If a member resigns before time, the successor will be appointed by the Partnership Participant, whom the member represents in the Partnership.

1.3.3 Scientific workstream leads are not eligible for the Partnership Board of Directors.

1.4 A member is personally appointed and cannot be represented by another person by power of attorney. The member may, however, if prevented from being present vote by proxy through the Chairman.

1.5 The Partnership Board of Directors forms a quorum when at least half the members and the chairman, and in his/her absence the Vice-chairman, are present.

1.6 All decisions in the Partnership Board of Directors are made by simple majority of votes. In case of a tied vote the Chairman’s vote, or in his/her absence the Vice-chairman’s vote, will be decisive.

1.7 Veto rights
1.7.1 Every member of the Partnership Board of Directors with a right to vote may veto any decision made by the Partnership Board of Directors. No member can, however, veto discussions or decisions about infringement of the Investment agreement and the Collaboration Agreement from the Partnership Partner, which the member represents. Nor can any member oppose a decision that will not have consequences for or relates to the member’s own work and/or budget.

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1.7.2.1 Partnership Participants which are not represented in the Board of Directors may, if it can show that its own work, time for performance, costs, liabilities, intellectual property rights or other legitimate interests would be severely affected by a decision of the Board of Directors, exercise a veto with respect to the corresponding decision or relevant part of the decision.

1.7.2.2 Notwithstanding 1.7.2.1, a Party may neither veto decisions relating to its identification to be in breach of its obligations nor to its identification as a Defaulting Party. The Defaulting Party may not veto decisions relating to its participation and termination in the consortium or the consequences of them.
Furthermore, the veto rights granted to Partnership Participants according to 1.7.2.1 cannot be exercised with respect to decisions regarding accession of new Partnership Participants and/or suggestions of projects to be funded.

1.8 The Partnership Leader has the right to attend and speak in the Partnership Board of Directors.

2 - Innovation Fund Denmark’s participation in the Partnership Board of Directors

2.1 Innovation Fund Denmark appoints 1-2 Innovation Officers to follow the work of the Partnership Board of Directors. The Innovation Officers appointed by Innovation Fund Denmark are not members of the Partnership Board of Directors but are solely observers and have no right to vote at the Partnership Board of Directors meetings. The appointed Innovation Officers do have the right to attend and speak at all Partnership Board of Directors meetings. Innovation Fund Denmark or any Innovation Officer may convene a Partnership Board of Directors meeting and put separate items on the agenda of a Partnership Board of Directors meeting.

3 - The tasks of the Partnership Board of Directors

3.1 The tasks and responsibilities of the Partnership Board of Directors are described in the Investment Agreement.

3.2 The Partnership Board of Directors has the overall responsibility for setting the direction for the Partnership and ensuring optimal impact on goals defined in mission-roadmap. With approval by Innovation Fund Denmark, the Partnership Board of Directors will appoint a Partnership Leader who will have the daily responsibility for the Partnership. Operations which are of unusual type in relation to the content of the Partnership, or which will be of great importance to the Partnership, may only be undertaken with special authorisation from the Partnership Board of Directors

3.3 The Partnership Board of Directors will monitor the development and progress of the Partnership and make decisions to ensure that the interaction between the Partnership Participants and the Partnership's organisation, management and resource allocation enables the achievement of the Milestones and in accordance with the mission-roadmap. The Partnership Board of Directors must amongst other things ensure that the Partnership Participants collaborate towards common goals defined in the mission-roadmap throughout the Investment Period, and if appropriate make the necessary adjustment of the Partnership Plan/Roadmap and/or the Partnership's organisation.

3.4 The Partnership Board of Directors will monitor impact of the Partnership on Roadmap. Governance model for pool 2 investments is described in exhibit 3, where the process for securing alignment between investments and roadmap is outlined, and how IFD ensures that all guidelines and regulations are kept. In the yearly review process, it is the responsibility of the Partnership Board of Directors to monitor and support the Partnership leadership and engage in the review process, cf. 6.

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3.5 The Partnership Board of Directors must ensure that account is taken of the Partnership's management and administration throughout the entire Investment period. The Partnership Board of Directors can decide to replace the Partnership Leader and/or the Administrator, cf. conditions in the Investment Agreement.

3.6 The Partnership Board of Directors must undertake the Partnership's financial management and at the Partnership Board of Directors meetings approve the Partnership Leader's annual scientific and financial reports (Annual Report), final report and other reports Innovation Fund Denmark may require.

3.7 Any member of the Partnership Board of Directors is entitled to raise matters concerning the Partnership's scientific content, results, business relevance, etc., for the Partnership Board of Directors to evaluate.

3.8 The Chairman and Vice-Chairman of the Partnership Board of Directors together with the Partnership Leader represent the Partnership vis-à-vis the outside world.

4 - The conduct of Partnership Board of Directors meetings

4.1 The Partnership Board of Directors must meet a least twice a year (once every six months), or whenever the Chairman, and in his/her absence the Vice-chairman, finds it necessary, or upon written request from at least one member of the Partnership Board of Directors. The Partnership Board of Directors must in that case at the request of the Chairman, and in his/her absence the Vice-chairman, convene within three weeks of receiving the request.

4.2 Meetings are called by the Chairman, and in his/her absence the Vice-chairman, with at least two weeks' notice if possible. An agenda for the meeting is sent out with the call for the meeting. Any supplementary documents must be sent out at least a week before the meeting if possible. Every member may request an item to be put on the agenda.

4.3 At the start of the meeting the proposed agenda is approved. The Chairman, and in his/her absence the Vice-chairman, chairs the meeting

5 - Minutes etc.

5.1 The Chairman, and in his/her absence the Vice-chairman, is responsible for minutes to be taken of the Partnership Board of Directors' negotiations and decisions. If members of the Partnership Board of Directors does not agree with a Partnership Board of Directors decision, they have the right to have their opinion reported in the minutes. The minutes must contain clear definitions of actions and clearly state who are responsible for the actions.

5.2 The draft minutes must be sent out no later than one week after the Partnership Board of Directors meeting with notice of a deadline for comments. The minutes must be approved by email no later than two weeks after the Partnership Board of Directors meeting by the Partnership Board of Directors members.

5.3 Unless objections have been raised to the minutes within the given notice, cf. 5.2, the Partnership Board of Directors' decisions may be executed after the expiry of the notice

6 - The conduct of Investment Reviews

6.1 The investment Review is to be held once a year.

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6.2 Investment reviews are called by the Chairman of the Partnership Board of Directors, and in his/her absence the Vice-chairman. An agenda for the review is coordinated with IFD Investment Officer and sent out with the call for the review. Supplementary documents must be sent out at least two weeks before the review if possible. Every member and IFD may request an item to be put on the agenda.

6.3 At the start of the Investment Review the proposed agenda is approved. IFD representative chairs the review.

6.4 Participants from IFD – Investment Officers, members of board of directors and members of Mission Advisory Board (MIAB).

6.4 Minutes follow the same process as for Partnership Board of Directors meeting, cf. 5.

7 - Other provisions

7.1 The present Rules of procedure have been agreed on by the Parties in the Partnership by signing the Investment Agreement between the Partnership Parties and Innovation Fund Denmark and are enclosed as an exhibit to this Agreement.

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Exhibit 5 – Budget

INNO-CCUS

The budget is provided in a separate file

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Addendums

INNO-CCUS

There are no addendums for Exhibit 1

The following addendums for Exhibit 2 are supplied:

- Projects descriptions for pool 1
- Gantt-like overview

There are no addendums for Exhibit 3, 4 and 5.

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Project descriptions – pool 1

Workstreams

1: Chemical CO_2 Capture	3 projects
2: Biological CO_2 capture and Storage	3 projects
3: Geological CO_2 Storage	9 projects
4: CO_2 utilisation	2 projects
5: Society and Systems Analysis	3 projects

Table 20 List of project numbers and titles, related to workstream

Project number	Workstream	Project title
1-P1	Chemical CO_2 capture	Carbon capture Open tests and Review of Technologies
1-P2		CO_2 capture by oxyfuel combustion at cement plants
1-P4		Large scale integration of DAC in Energy Systems
2-P1	Biological CO_2 capture and Storage	Blue Carbon - a mission to maximise C storage in Danish marine ecosystems
2-P2		Biochars for soil carbon storage and sustainable agriculture
2-P3		Innovative forests for curbing climate change while integrating biodiversity, nutrient retention, and recreation
3-P1	Geological Storage	Compositional Simulation of Reactive Transport in CO_2 Storage
3-P2		Experimental study and modelling of CO_2 propagation in geological storage
3-P3		Monitoring Fugitive emissions
3-P4		Risk assessment of the CO_2injection well damage due to thermal stresses
3-P5		BOrehole Monitoring Solutions for CO_2storage wells
3-P6		The adaption of existing infrastructure for CO_2 storage in reservoirs
3-P7		Corrosion protection for CO_2 storage facilities using nanofilament coatings
3-P8		Evaluation of residual hydrocarbons effect on CO_2 injectivity in depleted chalk reservoirs
3-P9		Chalk– CO_2reactions at reservoir conditions
4-P1	CO_2 utilisation	Research and development platform for flexible BECCU/S
4-P2		Biotechnology for converting CO_2 to platform chemicals
5-P1	Society and Systems Analysis	Public acceptance of CCUS
5-P2		Large Scale Integration of Carbon Capture in Energy Systems
5-P3		Local value creation in carbon capture, storage and use: the development of cross-sectorial business set-ups and pathways

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	1-P1 CORT
Project title	Carbon capture Open tests and Review of Technologies
Partners	DTU, Aalborg Portland, Pentair, Ørsted, AAU, FORCE
Project leader	Philip Fosbøl, DTU
Total budget	19,289,908 DKK
IFD-investment	14,505,292 DKK
Project period	36 months
Content	Demonstration of solvents and process technologies for carbon capture. Cases: Aalborg Portland and Ørsted
Milestones	M1: Design of the reconfigured container finalised - Month 6 M2: Reconfigured container commissioned - Month 18 M3: Demonstration finalised at AP - Month 24 M4: Demonstration finalised at Ørsted - Month 32
TRL progression	3 to 7
Expected results	An optimised solvent and process integration is required to lower the price for large scale CC systems. Chemical CC carbon capture is expected to result in 0.5 million ton CO_2 captured per year at ARC alone. The solvent optimisation in this project could have a direct impact on the energy consumption at ARC, Ørsted and Aalborg Portland. The optimised CC process developed in this project may also result in more CC installations in Denmark.
Integration to Roadmap	The project is closely aligned with Roadmap for CCUS. Chemical CC carbon capture is expected to result in 0.5 million ton CO_2 captured per year at ARC alone. There is a need to develop this knowhow, using strategic inflection points, allowing for development, which will sustain a competitive potential also in the future.
Impact	This project will have a positive impact on the climate before 2030. Chemical CC is the only CC technology which can be up-scaled and implemented widely before 2030. An optimized solvent and process integration is required to lower the price for large scale CC systems. Chemical CC carbon capture is expected to result in 0.5 million ton CO_2 captured per year at ARC alone.
Workstream	1: Chemical CO_2 Capture

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	1-P2 | NEWCEMENT
Project title	CO_2 capture by oxyfuel combustion at cement plants
Partners	DTU, DTI, FLSmidth, Faxe Kalk
Project leader	Jens Christiansen, DTI
Total budget	11,363,590 DKK
IFD-investment	7,694,234 DKK
Project period	39 months
Content	To investigate a new route for carbon capture from cement production and make concrete a CO_2 negative product.
Milestones	M1: Show continuous calcination in pure oxygen - Month 15 M2: Develop digitalization technologies (simulation, control and optimization) for CO_2 emission free cement production - Month 24 M3: Oxyfuel pilot developed based on process simulations and combustion studies - Month 32 M4: Validate potentials of the technologies - Month 39
TRL progression	2 to 6
Expected results	We expect the oxyfuel based CO_2 produced to be less costly than end-of-pipe carbon capture. It is expected to obtain a fully integrated pilot plant, process knowledge, new design tools and a technical layout, including techno-economic documentation. This information will pave the way for the first large-scale industrial unit and accelerate the decarbonisation of cement sector.
Integration to Roadmap	The project is closely aligned with Roadmap for CCUS, as cement production is listed as one of the 'Large CO_2 point sources. The cement production has a CC potential of 1.1 CO_2e/year in 2030 and a CC potential of 0.8 CO_2e/year in 2050.
Impact	Cement is a significant global industry with about 8 % of current global CO_2 emissions. FLSmidth is a major player in construction of cement plants and equipment for that. By developing the oxyfuel cement technology FLSmidth can offer a product with large international potential, which can contribute too large global CO_2 reductions.
Workstream	1: Chemical CO_2 Capture

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	1-P4 | eDAC
Project title	Large scale integration of DAC in Energy Systems
Partners	AAU, EuroWind, COWI, Port of Aalborg
Project leader	Thomas Helmer Pedersen, AAU
Total budget	5,544,000 DKK
IFD-investment	4,344,600 DKK
Project period	36 months
Content	Guidelines for stakeholders across the entire value chain, covering both technology and SSH aspects
Milestones	M1: Thermodynamic models completed. Month 24. M2: DAC-PtX concepts selected. Month 36. M3: DAC implemented in EnergyPlan. Month 18.
TRL progression	4 to 5
Expected results	The project will develop a first-of-its-kind modelling framework to evaluate capture technology deployment into existing and future energy systems. The project provides concrete guidelines on how different DAC technologies can efficiently be deployed in the system systems with various characteristics.
Integration to Roadmap	According to the Roadmap, DAC is a key to reaching the net-negative CO_2 emission goal, and as a carbon source in the non-fossil future. Development of the DAC technology is at a low TRL with critical challenges to be solved. It is critical for the implementation of the Roadmap to develop multi-scale integrated modelling capacities for exposing efficient deployment pathways and predicting their effects on CCSU (p. 18).
Impact	DAC is regarded as an inflection point, and the deployment of DAC is a necessity to reach capture rates in the order of Gt CO_2/year, needed to deflect global CO_2 emissions. DAC can provide storage capacity and thereby increase the utilized capacity of existing and future intermittent power production. The impact on emission reduction in Denmark is long-term as DAC is not mature, but it is highly important to ramp up activities now in order to harvest its enormous potential in due time.
Workstream	1: Chemical CO_2 Capture

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	2-P1 | BlueOFS
Project title	Blue Carbon - a mission to maximise C storage in Danish marine ecosystems
Partners	SDU, DHI GRAS A/S, DHI A/S
Project leader	Mogens Flindt, SDU
Total budget	4,508,467 DKK
IFD-investment	3,232,120 DKK
Project period	36 months
Content	Upscaling of blue Carbon Capture: To create a spatial planning decision support tool for optimising carbon storage and carbon capture- identify the total carbon capture/storage capacity in Odense fjord's catchment area as a pilot study for national upscaling
Milestones	M1: Partnership & Stakeholder engagement (Lead OFS (Odense Fjord partnership secretariat) – Month 1-36 M2: Combining machine learning techniques on satellite / aerial images with topographical data – Month 14 M3: Quantifying the direct and indirect effects of the existing carbon hotspots – Month 12 M4: Simulating potential upscaling scenarios – Month 26 M5: Providing a schematic plan on how to apply and/or scale up blue carbon capture – Month 36
TRL progression	2 to 6
Expected results	In our project we will identify the total carbon capture/storage capacity in Odense fjord's catchment area as a pilot study for national upscaling, as well as to run diverse possible scenarios in which we optimise the use of the mentioned NbS to increase carbon capture/storage capacity in catchment areas.
Integration to Roadmap	As outlined in the roadmap1, Carbon storage in the marine environment (blue carbon) requires identification of suitable restoration habitats, and restoration and conservation actions must be upscaled to national and global level. Further, there is a strong need to accurately monitor, model and forecast C sequestration, storage opportunities in ecosystems of up to 250 Mt CO_2e by 2050.
Impact	Restoring these blue carbon ecosystems could remove 0.5% of current emissions, with co-benefits for local ecosystems and livelihoods. These include improved water quality; increased marine and terrestrial biodiversity; preservation of livelihoods, cultural practices, and values of local and traditional communities; and the protection of shorelines and their resilience in the face of climate change. Coastal ecosystem restoration and conservation storing blue carbon has a huge potential (234 Tg C per year globally) which scaled to Denmark accounts for carbon sequestration of potentially 250 Mt CO_2e by 2050.
Workstream	2: Biological CO_2 capture and storage

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	2-P2 | BioStore
Project title	BioStore - Biochars for soil carbon storage and sustainable agriculture
Partners	KU, DTU, RUC, AAU, GEUS, Stiesdal, Aquagreen, MASH Energy ApS, SEGES
Project leader	Dorette Müller-Stöver, KU
Total budget	8,759,040 DKK
IFD-investment	6,563,136 DKK
Project period	4 years
Content	The project's aim is to investigate carbon stability and agroecosystem and groundwater quality effects of soil amendment with high doses of a range of biochars produced by Danish companies.
Milestones	M1: Different Danish biochars produced and characterized. Month 24 M2: Stability of the different biochars determined in different soils. Month 48 M3: Effects of selected biochars on soil hydraulic properties, crop growth, leaching, soil contaminants and groundwater quality determined. Month 48 M4: Recommendation for a market organization designed. Month 48 M5: DK national climate impact determined. Month 45
TRL progression	6 to 7
Expected results	This project will help to pave the way for large scale implementation of PyCCS in Denmark based on production and use of biochar from relevant Danish biomasses by central Danish technology providers. The project will contribute directly to the development of the regulatory frameworks around near-future implementation of large-scale PyCCS in Denmark. The project findings and results will be discussed continuously with central stakeholders from business organisations and the relevant ministries and authorities in Denmark. The results from the project will be used by the involved industrial parties to assess and pursue export of Danish green-tech solutions.
Integration to Roadmap	The proposed project is in direct alignment with the Green CCUS Roadmap, where CO_2-sequestration using biogenic sources is a key driver. The Roadmap emphasises the need to find solutions that are feasible for the CO_2-neutral future beyond 2050 and not just applicable in the short term (up to 2030). With a future with limited fossil carbon sources, carbon capture through biochar is one of the very few and fast ways to generate the needed negative CO_2emissions. Furthermore, it is potentially the track which has the lowest cost of implementation per t CO_2-eq saved, hence it has a huge strategic relevance for the overall CCUS roadmap. In section 4.1.5 of the Roadmap, the impact and the role of PyCCS is explained, and the main challenges are listed. The challenges are related to maturing the biochar product value-network, which the proposed project addresses.
Impact	In a recent political agreement on climate change mitigation efforts in Danish Agriculture, it was decided that production and use of biochar should contribute with a reduction of 2 million tons CO_2-eqin 2030. Today it contributes with none. It is potentially the track which has the lowest cost of implementation per t CO_2-eq saved A recent desktop-study on the potential climate change impact of production and use of straw-based biochar in Denmark suggests a mitigation potential of around 2.5 million tons CO_2-eq if all the straw that is currently amended directly back to soil was used for biochar production instead. This corresponds to 35% of the 7.1 million tons CO_2-eq the Danish agricultural sector targets to save until 2030, Based on previous first-iteration calculations by DTU and RUC, the aggregated climate effect of Danish production and use of biochar may be more than 5 million tons CO_2-eq per year.
Workstream	2: Biological CO_2 capture and storage

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	2-P3 | INNO4EST
Project title	Innovative forests for curbing climate change while integrating biodiversity, nutrient retention, and recreation
Partners	DHI GRAS A/S, KU, AU, HedeDanmark, MUSHOLM, Gubra, Naturstyrelsen, Miljøstyrelsen, Samsø Kommune, Foresting Tomorrow, KW Plan APS, NaturIT, Styrelsen for Dataforsyning og Effektivisering
Project leader	Vivian Kvist Johannsen
Total budget	12,191,703 DKK
IFD-investment	8,428,332 DKK
Project period	48 months
Content	Provide and demonstrate sustainable afforestation and provide transparent and reliable methods for documentation of effects for the 4 ecosystem services in new and existing forests.
Milestones	M2: Report – documentation – methods and application in practice. Month 30 M3: Dissemination to stakeholders through seminars (annual seminar). Month 12, 24, 36, 48.
TRL progression	4 to 7
Expected results	The project will in general increase the transparency and hence the willingness to invest in afforestation, for companies and individuals. The implementation of INNO4EST is expected to influence the afforestation projects taking place during the project period and in many years to come in both Denmark and internationally. The results will provide transparent, credible and reportable indicators on the 4 ecosystem services and hence provide a basis for assigning accountable values to these services and thereby also to provide economic incentives to design and make afforestation providing a suite of ecosystem services.
Integration to Roadmap	There are eminent needs for transparency and impact assessments on the results of afforestation, with the 4 ecosystem services addressed by INNO4EST, being essential. The impacts of informed decisions, in terms of clear expectations on trade-offs and synergies dependent on the design of the new forests, INNO4EST provides insight and tools for a strategic important measure, the afforestation, to support the green transition, the CCUS.
Impact	The INNO4EST project will primarily generate value in the below mentioned ways: - Afforestation based on clear goals for provisioning of the four ecosystem services (up to 50,000 ha before 2030 in Denmark, an investment of approx. 2.5 bi. DKK). - An afforestation of 100,000 ha in Denmark alone, will capture 1 mi. t CO_2-eq per year. With a price of 1,000-2,000 DKK/t CO_2-eq, it would generate annual values of 1-2 bi. DKK. Global perspectives are significant. - Documentation of CO_2 sequestration will be pivotal for evaluation of the climate mitigation effects. - Improved valuation for carbon, biodiversity, nutrient retention, and recreational access.
Workstream	2: Biological CO_2 capture and storage

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	3-P1 | CompReact
Project title	Compositional Simulation of Reactive Transport in CO_2 Storage
Partners	DTU, Total Energies, Noreco, Stanford University
Project leader	Wei Yan, DTU
Total budget	9,953,600 DKK
IFD-investment	6,888,240 DKK
Project period	48 months
Content	(1) Develop a compositional simulator with multiphase geochemical reactions that is more robust and efficient than the existing CO_2 storage simulators; (2) Couple the simulator with the post-injection simulator GEOSX in collaboration with Stanford University so that compositional and geochemical effects are accounted for in the post-injection analysis; and (3) Improve the technical expected results during injection and the long-term safety evaluation by using more accurate reactive transport description.
Milestones	M1: The multiphase geochemical module will be integrated into an in- house compositional simulator - Month 24 M2: Analysis of injection and storage problems at relatively short time- scales - Month 42 M3: The reaction module developed in WP1 will be integrated into GEOSX - Month 27 M4: The new GEOSX simulator will be applied to long time-scale post-injection simulations with coupled geomechanics - Month 48
TRL progression	2 to 5
Expected results	The project will further improve the state-of-the-art compositional and geochemical algorithms, and integrate them into the open source GEOSX simulator. This will further enrich the physics in the GEOSX simulator with a highly-efficient treatment of complex equilibria and reactions. The CO_2 storage simulation analysis will therefore be equipped with improved reliability and efficiency, suitable for risk evaluation of a larger variety of storage sites.
Integration to Roadmap	The Roadmap points out four different potential storage options, each with its own maturation timeframe and advantages. De-risking is emphasised especially for those high TRL storage options. For offshore depleted oil and gas reservoirs, complex interactions due to CO_2 injection are also identified as a major concern. CO_2 storage simulation provides a comprehensive tool to integrate information for de-risking injection and storage. Our project emphases particularly the compositional and geochemical reactions to address the complex interactions. In terms of innovation, the Roadmap points out that simulations, reaction models, and injectivity of CO_2 in reservoir and seal are critical R&D activities to reduce storage cost, with which this project is in perfect alignment.
Impact	According to the Danish government's 2020 Klima Program, around 4 to 9 Mt/yr. CO_2 should be utilized or stored by 2030. It is expected that most of these will be achieved by geological storage, which is challenging in both scale and urgency.
Workstream	3: Geological CO_2 storage

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	3-P2 | CO_2 flow
Project title	Experimental study and modelling of CO_2 propagation in geological storage
Partners	DTU, GEUS, TotalEnergies, Gas storage Denmark
Project leader	Samira Mohammadkhani, GEUS
Total budget	4,220,640 DKK
IFD-investment	3,150,576 DKK
Project period	39 months
Content	1. Conduct the CO_2-brine core flooding experiments both using X-ray CT monitoring (DTU) and an acoustic two-phase separator (GEUS) for saturation logging on reservoir samples from the Stenlille gas storage site. 2. Aided by core-scale numerical simulations, obtain the relative permeability and capillary pressure functions from both saturation logging methods. 3. Establish the laboratory procedures for the two-phase miscible flows and identify the domain of applicability of both approaches. 4. Develop analytical and semi-analytical models for CO_2 plume migration using the obtained laboratory measurements.
Milestones	M1: Fluids, rock samples and experimental setups are prepared, fluid miscibility studied, first un-steady state CO_2 flooding with saturation logging, experiments under X-ray CT performed – Month 15 M2: Effects analysed, the model for core-scale CO_2-brine flows established, Flooding experiments at GEUS performed and analysed with the new model; relative permeabilities extracted – Month 27 M3: Reservoir-scale model has been established – Month 30 M4: Data transferred on selected Stenlille wells, report completed, articles from output of the research has been written - Month 39
TRL progression	3 to 5
Expected results	The main innovation within the project is related to developing a procedure at GEUS with the knowledge and current setup, which is tailored towards experiments with supercritical CO_2 to be able to measure the flow functions (relative permeability parameters). Defining laboratory protocol which will allow for direct comparison of the experimental results from both laboratories related to steady-state vs unsteady state experiments, auxiliary measurements of CO_2-brine solubility, and cross- validation of the results. Numerical modelling of the two-phase miscible core-flooding experiments (forward and inverse problems), and numerical modelling at the sector and reservoir scales for the conditions of the Stenlille gas storage site.
Integration to Roadmap	Carbon capture, utilisation and storage of CO_2 (CCUS) is seen as a critical element to achieve Danish government target of 70 % reduction in greenhouse gas emissions by 2030. The project is of importance for existing onshore gas storage sites, as Stenlille which has been used as natural gas storage for decades. According to the roadmap ´Mission CCUS-a roadmap for carbon capture, utilisation and storage´, the questions on de-risking the reservoir will be answered to a great extend after completing this study.
Impact	The results of this project will thus contribute to better estimates of the efforts needed to meet CO_2 emissions reductions targets, both for Denmark and globally. Linking the results of the project to a specific industrially operated geological site (Stenlille) will provide the data needed for estimating the commercial viability of CO_2 storage and the estimates for the workforce needed to run such operations.
Workstream	3: Geological CO_2 storage

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	3-P3 | Monitoring Fugitive emissions
Project title	Monitoring Fugitive emissions
Partners	DTI, Aarhus Universitet, Gas Storage Denmark, Dansk Gasteknisk Center, Explicit
Project leader	Jacob Ask Hansen, DTI
Total budget	6,702,978 DKK
IFD-investment	4,014,497 DKK
Project period	30 months
Content	The aim of this project is to provide an efficient monitoring system that can detect and quantify fugitive CO_2 emissions from surface infrastructure as well as subsurface geological storage sites.
Milestones	M1.1: Review of inversion tools for satellite measurements – Month 18 M1.2: Delivery of inversion tools for the CO_2M mission – Month 30 M2.1: Payload construction - Month 9 M2.2: Flight validation – Month 24 M3.1: Instrument validation – Month 12 M3.2: Model developed – Month 20 M4.1: Release campaigns completed – Month 18
TRL progression	4 to 7
Expected results	The aim of this project will be achieved by combining drone monitoring, on-site monitoring, and satellite-based measurements: - Stationary monitoring systems (fence post-based monitoring) provide precise, continuous measurements in the local areas of up to a few hundred meters. - Drone based monitoring systems can be deployed over larger areas (kilometres) at regular intervals but will not provide continuous monitoring. - Satellite systems can provide a continuous monitoring of CO_2 concentrations over very large areas and act as a sentinel for fugitive CO_2 emissions. - Inverse modelling of the measured atmospheric concentrations may allow localisation and quantification of fugitive CO_2 emissions. Combining these systems will provide a very strong base for detecting possible leaks via satellite imaging and subsequently pinpointing these using drones. For the fixed limited size installation sites with high risk, gas monitor technologies would provide a very effective continuous monitoring system.
Integration to Roadmap	In both roadmaps for CCUS, it is pointed out one of the main challenges related to geological storage in the lack of an efficient monitoring system ensuring the environmentally safe storage and handling og CO_2. Furthermore, an efficient monitoring system providing knowledge of the safety of the individual sites will be kay for the public acceptance of the new facilities, thus mitigating “not-in-my-backyard”.
Impact	The aim of this project is to provide an efficient monitoring system that can detect and quantify fugitive CO_2 emissions from surface infrastructure as well as subsurface geological storage sites. The expected impact is a reduced leakage from estimated 5% to below 1%, to ensure sufficiently high impact on climate and environment of CCUS.
Workstream	3: Geological CO_2 storage

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	3-P4 | THERMO CO_2WELL
Project title	Expected results of the CO_2injection well damage due to thermal stresses
Partners	DTU, GEUS, Gas storage Denmark
Project leader	Nikolai Adrianov, GEUS
Total budget	3,021,940 DKK
IFD-investment	2,266,456 DKK
Project period	21 months
Content	In the present proposal, we aim to tailor a numerical simulation model which will consider single-and multiphase mixtures of CO_2 and CO_2-rich mixtures in realistic well configurations, including friction and heat transfer. In order to account for the induced thermal stresses in the cement and in the reservoir, the wellbore flow model will be coupled to geomechanical simulators. This will allow exploring the operational conditions that minimise the risks (e.g., leakage and wellbore stability) associated with the induced thermal stresses.
Milestones	M1: Collect all relevant data for Stenlille reservoir – Month 3 M2: The developed wellbore flow simulator will be loosely coupled with a geomechanical simulator – Month 9 M3: A standalone routine for thermodynamic flash calculation for the CO_2-rich injected fluid – Month 12 M4: An approximate model for the near-wellbore stresses distribution will be developed and coupled to the wellbore flow model – Month 18 M5: A technical meeting/workshop with stakeholders – Month 21
TRL progression	3 to 5
Expected results	The main deliverable of the project is a standalone software tool allowing for forecasts of the anticipated pressure and temperature profiles along the well, and the associated thermal stresses in the near-wellbore area.
Integration to Roadmap	The proposed project is addressing one of the key challenges of the Mission CCUS Roadmap, namely the maturation and de-risking of large potential storage sites. The focus on Stenlille as a potential CO_2pilot is motivated by the relatively high TRL and SRL for this site which are linked to the ongoing successful natural gas storage experience.
Impact	Choosing the right design of a well is key to mitigate some of the risks concerning well integrity. In order to be able to do this, it is necessary in detail to know the environment in which the well is operated. The results of this project are therefore crucial in the preparation for a CO_2-pilot in Stenlille, which has the potential of accelerating the implementation of full-scale CCS in Denmark by several years. The potential impact on climate is therefore enormous. The methods and tools developed in this project can be generalized to usage for other storage sites such as new onshore wells, and therefore, this project therefore has the potential of significantly improving the economic and societal benefits from storage.
Workstream	3: Geological CO_2 storage

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	3-P5 BOMS
Project title	BOrehole Monitoring Solutions for CO_2-storage wells
Partners	DTU, GEUS, Noreco Oil Denmark, Gas storage Denmark, Technion, Welltec
Project leader	Martin Patrong Haspang, Gas storage Denmark
Total budget	3,582,604 DKK
IFD-investment	2,671,743 DKK
Project period	21 months
Content	Defining criteria for safe and environmentally sound well operation. Defining operational needs for borehole monitoring, in particular defining operational needs for monitoring well integrity based on identified risks. Establishing an overview of existing methods in use in a global perspective. Establishing an overview of existing and developing monitoring technology- Investigating how technology can be chosen and developed for CO_2-monitoring in onshore wells. Investigating how well monitoring data can be used to improve various reservoir and rock mechanical models. Finding suitable solutions for existing well designs Testing technology at a CO_2 test site
Milestones	M1: Establishment of an overview of the existing technology for borehole monitoring and finding the most important gaps between the capabilities of existing technology and operational needs. Month 6 M2: Assessment of well completion design in order find options for integrating monitoring systems in existing and new wells. Month 12 M3: Development of a reservoir simulation model and laboratory scale prototype(s) and test solution(s) in reservoir conditions. Month 21 M4: Assessment of results in comparison with standard solutions and development of solution catalogue. Month 27
TRL progression	5 to 7
Expected results	Solutions for downhole monitoring in CCS-wells.
Integration to Roadmap	The IM1 roadmap shows several parallel tracks to CCS in Denmark. Two of these tracks are concerning near/onshore CO_2-storage and usage of existing gas storage site, respectively. In order to develop near/onshore storage, the Roadmap points out the necessity of a pilot, which could be favoured by the existing gas storage site in Stenlille. In order to initiate a pilot, cutting edge borehole monitoring is key to ensure safe storage, and well integrity in particular, and therefore the outcome of this project is a necessary step in the Roadmap.
Impact	Developing a good monitoring programme and suitable technologies is necessary for operating a CO_2storage reservoir. This project is a key part of preparing for a CO_2-pilot in Stenlille, which has the potential of accelerating the implementation of full-scale CCS in Denmark by several years. The potential impact on climate is therefore significant.
Workstream	3: Geological CO_2 storage

DocuSign Envelope ID: 9B240BF6-B41D-485C-B7DA-61CFD9D01654

	3-P6 | The adaption of existing infrastructure for CO_2 storage in reservoirs
Project title	The adaption of existing infrastructure for CO_2 storage in reservoirs
Partners	Aalborg University, Welltec, Gas Storage Denmark, Force Technology, Rambøll
Project leader	Simon Pedersen, AAU
Total budget	12,309,594 DKK
IFD-investment	7,501,146 DKK
Project period	40 months
Content	The central aim of this project is to measure the corrosion effect of a liquid or supercritical CO_2 in the presence of the impurities and provide a mathematical model to predict this corrosion on existing and new infrastructure. Moreover, the best available technology to measure impurities in a CO_2 liquid environment will be investigated.
Milestones	MS1: Validation of measurements in lab-scale – Month 15 MS2: Full-scale monitoring operational – Month 21 MS3: Completion of complete material qualification – Month 40 MS4: Establishment of a corrosion model with different CO_2 impurities and flow rates – Month 40 MS5: Gap analysis completed – Month 40
TRL progression	4 to 6
Expected results	- Measurements of corrosion in liquid/supercritical carbon dioxide in the presence of impurities for different process conditions and materials - Identification of the best available technology for measuring the impurities in liquid or supercritical carbon dioxide - Develop a mathematical model to predict corrosion in liquid and supercritical carbon dioxide
Integration to Roadmap	This project is supporting the Innomission Roadmap IM1. Since transportation and injection of captured CO_2 is an essential part of any CCUS strategy the impact of the project is significant, as improper material use and corrosion prediction can lead to uncontrolled releases of CO_2 during transportation or during storage when the wells fill with brine forming a highly corrosive environment. Proper material selection and qualification will lead to less material lost due to corrosion meaning fewer resources spent in workovers on wells and pipelines which provides and indirect environmental benefit. Thus, the project does not directly impact but can be regarded as an enabler of the CCUS strategy and the green transition. Also, the flow-loop is opening a new business area to Welltec which is not only a Danish market but internationally with the increased focus on CCUS across the world.
Impact	Since transportation and injection of captured CO_2 is an essential part of any CCUS strategy, the project's impact is significant, as improper material use and corrosion prediction can lead to uncontrolled releases of CO_2, as well as of toxic impurities contained in it, during transportation or when storing CO_2 filled with brine forming a highly corrosive environment. Proper material selection and surveillance will lead to less material loss due to corrosion. Thus, it will have a positive economic impact on CCUS infrastructure. If corrosion in the carbon storage system is left unchecked, the entire strategy of injecting CO_2 into the offshore reservoirs will result in excessive OPEX to such a degree that it may never be financially feasible.
Workstream	3: Geological CO_2 storage

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	3-P7 | Corrosion protection for CO_2 storage facilities using nanofilament coatings
Project title	Corrosion protection for CO_2 storage facilities using nanofilament coatings
Partners	DTU, AU, DUC
Project leader	Tobias Weidner, AU
Total budget	1,917,762 DKK
IFD-investment	1,442,410 DKK
Project period	12 months
Content	The aim of the project will be to test whether newly developed silica nanofilaments (SNF) can protect well pipes and reservoir sediments from corrosion by highly acidic liquid CO_2 solutions.
Milestones	M1: Silicon nanofilament coating mechanical and chemical stability tested, Month 6 M2: Coating function as long term-corrosion inhibitor assessed, month 11.
TRL progression	2 to 3
Expected results	The liquid repelling properties of SNF surfaces inhibit direct contact of the storage medium with the pipe surfaces. This mechanism is expected to reduce corrosion. Besides the inside of tubes and pipes, SNF surfaces could also have applications to protect the intricate hydromechanics within pumps, the inside of tanks and pipes. When developing coatings for assets exposed to the storage medium, we will focus on materials actually used in Danish facilities, which could be of interest as storage facility. The aim is to be able to 'spray' the coating inside the tubing in the existing wells.
Integration to Roadmap	This project is supporting the Innomission Roadmap in the area for 'Offshore storage – depleted O&G sandstone fields' and 'Offshore storage – depleted O&G chalk fields' where is will help de-risk and reduce uncertainties with respect to re-use of existing infrastructures for CO_2 storage.
Impact	The present project will have an economic impact as it might facilitate the use of existing wells for CO_2 injection. If 60 rigdays can be saved per new storage well drilled and if it can be assumed that drilling a well cost 2.0 mmdkk/day the saving is appx. 120 mmdkk per storage well. The CO_2 emissions for the drilling operation is proportional to the cost of the well (estimate around 0.5 kg CO_2/USD) which means that if a well does not have to be drilled appx 10.000 ton of CO_2 emissions will be avoided.
Workstream	3: Geological CO_2 storage

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	3-P8 CO_2RESHC8
Project title	Evaluation of residual hydrocarbons effect on CO_2 injectivity in depleted chalk reservoirs
Partners	GEUS, AU, TotalEnergies
Project leader	Henrik I. Petersen, GEUS
Total budget	4,288,689 DKK
IFD-investment	3,211,820 DKK
Project period	24 months
Content	The main purpose of this study is to examine the effect of residual hydrocarbons in non-flooded and water-flooded chalk reservoirs on CO_2 injectivity. This will be achieved through a thorough characterisation of the residual hydrocarbons in core samples from chalk fields with different production histories prior and after CO_2 flooding. Further the variation in residual hydrocarbon composition along a horizontal well will be investigated.
Milestones	M1: Completion of CO_2 flooding experiments (month 16) M2: Geochemical analysis of residual HCs in pre- and post-flooding samples (month 19) M3: Microscopic analysis of residual HCs in pre- and post-flooding samples (month 19) M4: Data interpretation and reporting (month 24)
TRL progression	3 to 5
Expected results	The core flooding experiments will provide injectivity/permeability data for chalk samples and furthermore simulate the effect of interaction between supercritical CO_2 and residual oil in the reservoir rock samples. The pyrolysis ESH® method will measure accurately the volume fractions of hydrocarbons in the CO_2 flooded reservoir rocks on as-received basis and after CO_2 flooding. By comparing the results of hydrocarbon fractions from non-flooded and flooded rock samples, we can evaluate and measure the volume of hydrocarbon residue that can be potentially solubilised and mobilised by CO_2. Using this data, we can calibrate the ESH® method to predict CO_2 solubility and movability of hydrocarbon residue in the rock samples. This calibration is crucial as we can use the ESH® method, a relatively low cost and fast method, to predict and assess the CO_2 interactions with hydrocarbon residue in the as-received chalk reservoir rocks for highlighting potential injection and storage issues related to residual hydrocarbons mobilisation and pore throat clogging. These data can be used for core-scale and reservoir-scale modelling studies as well.
Integration to Roadmap	The project has strategic relevance for Denmark's global climate action strategy that includes a decision to reduce greenhouse gas emissions with 70% by 2030. A mean to accomplish this is to store CO_2 in the subsurface, including depleted oil and gas chalk reservoirs. This is aligned with the option of offshore storage of CO_2 in hydrocarbon depleted chalk fields as outlined in "The Green CCUS Roadmap – Towards a fossil free future" (Mission CCUS – a roadmap for Carbon Capture, Utilisation and Storage).
Impact	The results on specific risks for residual hydrocarbons movability/clogging will translate directly into the decision-making process of the applicability of a depleted chalk reservoir as storage site. It will further address issues related to potential leakage due to CO_2-induced hydrocarbon movability. The project will help de-risk depleted oil field CO_2 storage sites and may thus have a substantial impact on emission reduction and thus on reaching the goal of atmospheric CO_2 reduction in Denmark.
Workstream	3: Geological CO_2 storage

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	3-P9 | Chalk CO_2RE
Project title	Chalk– CO_2reactions at reservoir conditions
Partners	DTU, KU, GEUS, TotalEnergies, Noreco Oil Denmark
Project leader	Kresten Anderskouv, KU
Total budget	8,292,347 DKK
IFD-investment	6,167,904 DKK
Project period	39 months
Content	Provide fundamental data on dissolution/precipitation in chalk during and after CO_2 injection. Investigate the effect of dissolution/precipitation induced by CO_2 injection on the chalk and its reservoir properties. Establish a sector-model which can be applied to chalk fields to predict dissolution/precipitation.
Milestones	M1: Completion of fundamental data acquisition regarding reactions and reservoir properties. M2: Summary of dissolution/precipitation effects on lithology and reservoir properties. M3: Conditions inducing dissolution/precipitation determined M4: Conceptual sector-scale established M5: Completion and reporting.
TRL progression	2 to 4
Expected results	The most important outcome of the project is to provide the fundamental knowledge necessary to decide to further progress the TRL of CO_2 storage in depleted chalk reservoirs. At the completion of the project, the concept will be validated in the lab and through simulations. The outcome will be implemented by allowing industry and other investigators to evaluate the effect of dissolution/precipitation on specific fields as a first step towards piloting after 2025 (as specified in “Mission CCUS”)
Integration to roadmap	“Mission CCUS – a roadmap for Carbon Capture, Utilisation and Storage” identifies CO_2 storage in chalk as a low-TRL, but high-potential opportunity. Progression of storage in depleted hydrocarbon fields to TRL 4 by 2025 (which is the aim of this project) is listed as a milestone in the process towards a storage capacity of 20–50 Mtpa by 2050. In addition, the extensive experience with chalk reservoirs in Denmark provides an opportunity to taking the lead on developing CO_2 storage in chalk reservoirs.
Impact	The project represents the first step towards CO_2 storage in retiring chalk oil fields, which are estimated to represent a total storage capacity of approximately 900–1300 Mt (GEUS). Provided the implementation of an efficient CO_2 tax model, the project increases the potential for CO_2 injection as an integral part of abandonment strategies for operators in the North Sea and increases the potential for CO_2 import as a business model. In addition, the knowhow created can be exported to other countries with hydrocarbon fields in chalk or other tight carbonates.
Workstream	3: Geological CO_2 storage

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	4-P1 | RD-BECCUS
Project title	Research and development platform for flexible BECCU/S
Partners	DTU, DTI, Alexandra, Verdo Production, Hafnium Labs, CO_2techn, Ammongas
Project leader	Morten Gottlieb, Danish Technological Institute
Total budget	7,471,650 DKK
IFD-investment	5,098,860 DKK
Project period	19 months
Content	The project consortium will investigate, design, and plan a research, development, and test platform for Flexible BECCU/S (bioenergy carbon capture and utilisation/sequestration).
Milestones	M1: Data Collected from CHP plant. Month 6 M2: Operation cycles of the CO_2 source is developed. Month 9 M3: Flexible BECCU/S digital twin is setup and ready for simulation. Month 12
TRL progression	3 to 5
Expected results	Designing and planning of a 50-kW research platform complete with biomass combustion and carbon capture, the partial commissioning of the plant, the creation of digital models for flexible BECCU/S, as well as the upscaling of a co-electrolysis process for chemicals (and possibly fuels as by-product) from captured CO_2. Data from a combined heat and power plant at Verdo and electricity grid data will be used to digitally
Integration to Roadmap	Access to renewable electricity at low prices is essential for the success of CCU/S. Equally important is access to capital. The successful expansion of wind power in the Nordic market secures both access to electricity and serves as a template for the financing structure of upcoming PtX projects. The focus on utilisation in this project avoids the potential barriers in CCS, such as a current lack of regulatory framework or a possible lack of societal acceptance of underground carbon storage. While CCU is currently more costly than CCS or emission certificates per unit carbon, this challenge will be tackled here by process improvements and preparatory work to leverage economy of scale. The research platform for flexible BECCU/S will be an important step in developing next-generation CCU technologies that integrate well with fluctuating energy and CO_2 availability. Current CCU technologies are not economically attractive for medium-sized, combined heat and power plants that are operated following heat demand (seasonal variation) or participate in grid balancing (daily variation). CO_2 from these plants is thus not usable as energy carrier or material in PtX-concepts. To the knowledge of the project consortium, no technology has so far explicitly been designed and developed with flexibility in mind. The proposed project aims to close this gap.
Impact	The project represents the first step towards CO_2 storage in retiring chalk oil fields, which are estimated to represent a total storage capacity of approximately 900–1300 Mt (GEUS). Provided the implementation of an efficient CO_2 tax model, the project increases the potential for CO_2 injection as an integral part of abandonment strategies for operators in the North Sea and increases the potential for CO_2 import as a business model. In addition, the knowhow created can be exported to other countries with hydrocarbon fields in chalk or other tight carbonates.
Workstream	4: CO_2 utilisation

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	4-P2 | BioTechCCU
Project title	Biotechnology for converting CO_2 to platform chemicals
Partners	SDU, AU, Dansk Gasteknisk Center, Nature Energy
Project leader	Muhammad Tahir Ashraf, SDU
Total budget	5,378,000 DKK
IFD-investment	4,000,200 DKK
Project period	36 months
Content	The partners SDU, AU, and NE] have demonstrated biomethanation as a robust technology for biogas upgrading through their R&D. This project aims to build on the biomethanation platform as CO_2 capture and integrate it with the utilisation pathways by developing biological technologies to produce platform and value-added chemicals. The project has 3 specific objectives for this integration: (i) develop biomethanation using power-to-x (PtX) for diverse CO_2 point sources and demonstrate at TRL4 (ii) integrated acetic acid production at TRL4 (iii) develop integrated fermentation of biomethane for bioplastics at TRL4.
Milestones	M1: Demonstration of biomethanation for diverse CO_2 sources at TRL5 M2: Lab scale demo of acetic acid production for further upscale and optimisation M3: Lab-scale demonstration at TRL4 of biomethane fermentation to bioplastics
TRL progression	3 to 4
Expected results	This project aims to develop an innovative platform for the utilisation of biogas and diverse CO_2 point sources for bioplastics and precursors for sustainable plastics. The innovative method is to integrate the promising biomethanation technology with biochemical utilisation technologies. Two partners from academia (SDU and AU) and two industrial partners (NE and DGC) have joined forces for this research and development (R&D). R&D goals are to optimise existing biomethanation technology for diverse CO_2 point sources and develop a novel integrated process for value-added chemical production. The project will focus on biological processes as they are carried out at close to ambient conditions and are suitable for existing diverse CO_2 sources and small-scale applications with off-grid renewable power.
Integration to Roadmap	As outlined in the Roadmap, biogas production is expected to double from now 25 PJ to ca. 51 PJ by 2030, and methanation of biogas-derived CO_2 with hydrogen has the potential to increase output further by up to 40%. Considering this biomethanation is a promising platform in the future. This would enable CO_2 and biomethane-derived sources of carbon for chemical production, given that the technological and implementation challenges for CO_2 utilisation are met. Currently, the cost of utilisation exceeds the price of emission. This project aims to develop an innovative platform for the utilisation of diverse CO_2 point sources for bioplastics and precursors for sustainable plastics.
Impact	It is expected that renewable feedstock availability for fuels, chemical processes, and materials will become a limiting factor for the green transition. Capturing diverse CO_2 point sources and utilizing them to produce value chemicals can provide a sustainable alternative. The maturation of biomethanation technology is, therefore, a crucial technology that can enable the production of value-added chemicals in the future. For NE, operating a major part of Danish biogas production (165 million m3/y, approx. 3.9 PJ), the biomethanation technology constitutes a great opportunity to increase biomethane production and associated business. Therefore, NE plans to invest significantly in becoming a player in this field over the coming years. Developing biomethanation for diverse CO_2 point sources and using PtX will be crucial to this area to open new opportunities and supply CO_2-

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	neutral carbon and energy sources. Further, insight into upcoming utilization technologies will help prepare for potential future higher value applications and offtakes, like bioplastics and platform chemicals (acetic acid). DGC and its owner EVIDA (owner of the natural gas distribution system), with their focus on the green transition of the gas grid, insight into upcoming technologies is important to be able to provide infrastructure and services. The project results will provide input for the infrastructure development strategy and further help prepare DGC's service offerings in terms of analytical and consultancy services.
Workstream	4: CO_2 utilisation

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	5-P1 | Public acceptance of CCUS
Project title	Consumers' willingness to pay and acceptance of carbon capture, utilisation and storage technologies
Partners	AAU/CBS
Project leader	Tooraj Jasamb, CBS
Total budget	5,119,999 DKK
IFD-Investment	4,608,000 DKK
Project period	01.01.2023-31.12.2025
Content	The aim of the project is to investigate the factors deciding public acceptance and legitimacy in the placement of far-shore, near-shore and on-shore CCUS and related infrastructure. This will result in solid understanding of the type of measures and processes that must be adopted, in order to secure acceptance of carbon storage initiatives.
Milestones	M1: Obtain CCUS and preference data from ongoing surveys (M1-3) M2: Obtain insights into how consumers perceive different CCUS technologies and how the technologies can be implemented in the best possible way. (M6-12) M3: Estimate acceptance and preference relations for the use of CCUS technologies. (M9-24)
Expected results	The project aims at estimating acceptance and preference relations for different types of CCUS technologies among Danish consumers. The project will focus on the relative preferences and acceptance of onshore, nearshore and offshore C02 storage, how different levels of information will influence the relations. The study also aims at obtaining knowledge of how consumers see CCUS as a way to ensure a more stable (green) energy production and the use of CCUS technologies in the transport (shipping)sector.
Integration to Roadmap	Implementation of carbon capture, storage and utilisation technologies rest on both acceptance and demand for the technologies and their associated products. Detailed information of consumers' willingness to accept and pay for CCUS technologies and products will help to gear the green energy transition. The information will furthermore help potential pitfalls concerning CCUS and help harvesting the lowest hanging fruits.
Impact	The project will contribute with a better understanding of how to secure public acceptance of carbon storage, both in terms of choosing the right location, communicating effectively about risks and benefits of carbon storage and by outlining optimal processes for citizen involvement to ensure legitimacy. As public acceptance is a prerequisite for successful carbon storage projects in Denmark, the impact of this project is of immense importance in order to realize CO_2 emission reductions of CS.
Workstream	5: Society and systems analysis

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	5-P2 | LSICC
Project title	Large Scale Integration of Carbon Capture in Energy Systems
Partners	AAU, EN2Save, Greenport North
Project leader	Jakob Zinck Thellufsen, AAU
Total budget	3,524,040 DKK
IFD-investment	2,901,636 DKK
Project period	48 months
Content	The aim of the project is to investigate the role of point source carbon capture and direct air carbon capture in the energy system. With an overall transition of society and the energy system to a more sustainable future there is a requirement to implement large amounts of renewable energy into the system and remove CO_2 to lower the climate impact of the energy and production sector. This will enable a strategic plan for carbon capture in Denmark, combining the knowledge of demand for carbon with the knowledge of resource location.
Milestones	M1: preliminary maps of the resources - Month 28 M2: Energy system analyses showing the potential consequence of different carbon capture technologies - Month 28
Expected results	The overall main outcome of the LSICC project is a strategic plan for carbon capture in Denmark, including strategy for both direct air capture and point source capture. This will include three main outcomes, based on three analyses: 1) A geographical assessment of Carbon Capture. This is done through GIS analyses, highlighting concrete suggestions for placement of carbon capture in Denmark. The locations are based on CO_2 resource mapping and mapping of district heating and electricity grid, necessary to assess both location of direct air capture and point source capture. 2) Energy system analyses of carbon capture. Here we calculate the consequences of different technologies for the energy system. This includes the advantages of carbon capture, but also how it will impact other parts of the energy systems, in terms of increased energy demands, potential use of waste heat. The goal is to see it in the relation of Denmark's climate goals in 2030 and 2050. 3) Economic assessments of costs. These will be based on the GIS analyses and energy system analyses enabling a total assessment of both costs for carbon capture, but also the associated costs and savings in the other parts of the energy system.
Integration to Roadmap	LSICC integration into the strategic plan, is to provide the overall framework for national, regional and municipal strategies and planning of carbon capture. Thus they are able to assess impacts for the total energy system towards the green transition targets both in 2030 and 2050. These assessments allows us to both integrate with the rest of the roadmap in terms of technical potentials and development, potentially allowing us to use numbers and figures from other projects in Innomission 1. Furthermore, LSICC can be used by the other projects, to see their projects in an overall roadmap for carbon capture in a country.
Impact	The project will result in a roadmap for e carbon capture, to highlight the potential for the technology in terms of CO_2 but also in relation to carbon capture and storage and carbon capture and utilisation. The roadmap includes GIS analyses and energy system analysis as well as an assessment of the case of Aalborg Portland.
Workstream	5: Society and systems analysis

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	5-P3 | VALCCAP
Project title	Local value creation in carbon capture, storage and use: the development of cross-sectorial business set-ups and pathways
Partners	AAU, Thy-Mors Energi, KU, Thisted Kommune
Project leader	Karl Sperling, AAU
Total budget	3,140,800 DKK
IFD-investment	2,449,870 DKK
Project period	48 months
Content	The main objective of the project is to support the development of cross-sectorial business set-ups for integrating carbon capture, storage and use (CCUS) technologies into the existing energy system.
Milestones	M1: 2-4 concrete scenarios for CCUS development in Thy-Mors. Month 24. M2: The final selection of CCUS business set-ups. Month 40. M3: Will be showing the local development effects of the different CCUS scenarios. Month 36.
Expected results	The aim is to co-create business set-ups and pathways with a high degree of local support and involvement. By developing these value creating, cross-sectorial solutions, we aim to develop generalizable knowledge on the integration of CCUS value chains into pre-existing energy systems with a focus on local development potentials that can bring some clarity to the needed changes in the national regulatory frameworks.
Integration to Roadmap	As outlined in the CCUS roadmap, CCUS is a case of installing a new infrastructure system, which may require an inter-sectorial, long-term model for cooperation between public and private stakeholders. There is a need for clarifying the need for new regulatory frameworks, as well as for reducing the uncertainty around viable business models. The roadmap also highlights that public acceptance is absolutely fundamental to the development of the CCUS value chain. The VALCCAP projects feeds into these areas with its focus on developing locally integrated and acceptable CCUS business models, and actively engaging stakeholders and communities in a workshop-based dialogue. The focus on strengthening the local value chain is expected to contribute positively to the social acceptability of the developed business models and scenarios. Finally, suggestions for updating regulatory frameworks to support the above will be developed throughout the project.
Impact	The underlying motivation for this project is to accelerate the Danish development of CCU/CCS in a locally and socially acceptable way, supporting a just transition of the energy system. The project will ensure that local actors can benefit from this new technological avenue, which will, at the same time speed up and support the value creation for the companies working with these technologies. Finally, the project will provide solutions for how to integrate the new technologies locally in such a way that fuel pathways are optimized and energy costs (at consumer level) are reduced.
Workstream	5: Society and systems analysis

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Innovation Fund Denmark

Project month

Description		Lead	Month 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
WP1	**Chemical CO2 Capture**	**Philip Fosbøl**	
1-P1	**CORT - Carbon capture Open tests and Review of Technologies** M1: Design of the reconfigured container finalised - Month 6 M2: Reconfigured container commissioned - Month 18 M3: Demonstration finalised at AP - Month 24 M4: Demonstration finalised at Ørsted - Month 32	Philip Fosbøl, DTU	TRL 3-6 · M1 · M2 · M3 · M4 · TRL 6-7
1-P2	**NEWCEMENT - CO2 capture by oxyfuel combustion at cement plants** M1: Show continuous calcination in pure oxygen - Month 15 M2: Develop digitalization technologies (simulation, control and optimization) for CO2 emission free cement production - Month 24 M3: Oxyfuel pilot developed based on process simulations and combustion stud-ies - Month 32 M4: Validate potentials of the technologies - Month 39	Jens Christiansen, DTI	TRL 2 · M1 · M2 · M3 · M4 - TRL 6
1-P4	**eDAC - Large scale integration of DAC in Energy Systems** M1: Thermodynamic models completed. Month 24. M2: DAC-PIX concepts selected. Month 36. M3: DAC implemented in EnergyPlan. Month 18.	Thomas Helmer Pedersen, AAU	TRL 4 · M1 · M2 · M3 - TRL 5
WP2	**Biological CO2 capture and storage**	**Claus Beier, KU**	
2-P1	**BlueOFS - Blue Carbon - a mission to maximise C storage in Danish marine ecosystems** M1: Partnership & Stakeholder engagement (Lead OFS (Odense Fjord partnership secretariate) – Month 1-36 M2: Combining machine learning techniques on satellite / aerial images with topo-graphical data – Month 14 M3: Quantifying the direct and indirect effects of the existing carbon hotspots – Month 12 M4: Simulating potential upscaling scenarios – Month 26 M5: Providing a road map on how to apply and/or scale up blue carbon capture – Month 36	Mogens Flindt, SDU	TRL 2 · M3 · M2 · M4 · M5 - TRL 6
2-P2	**BioStore - Biochars for soil carbon storage and sustainable agriculture** M1: Different Danish biochars produced and characterized - Month 24 M2: Stability of the different biochars determined in different soils - Month 48 M3: Effects of selected biochars on soil hydraulic properties, crop growth, leach-ing, soil contaminants and groundwater quality determined - Month 48 M4: Recommendation for a market organization designed - Month 48 M5: DK national climate impact determined - Month 45	Dorette Müller-Stöver, KU	TRL 6 · M1 · M5 · M2-3-4 - TRL 7
2-P3	**INNOHEST - Innovative forests for curbing climate change while integrating biodiversity, nutrient retention, and recreation** M1: Report - 4 ecosystem services and indicators, basis and selection - Month 24 M2: Report – documentation – methods and application in practice - Month 30 M3: Dissemination to stakeholders through seminars (annual seminar) - Month 12, 24, 36, 48.	Vivian Kvist Johannsen, KU	TRL 4 · M3 · M1, M3 · M2, M3 · M3 · M3 - TRL 7
WP3	**Geological CO2 storage**	**Marie Keiding, GEUS**	
3-P1	**CompReact - Compositional Simulation of Reactive Transport in CO2 Storage** M1: The multiphase geochemical module will be integrated into an in-house compositional simulator - Month 24 M2: Analysis of injection and storage problems at relatively short time-scales - Month 42 M3: The reaction module developed in WP1 will be integrated into GEOSX - Month 27 M4: The new GEOSX simulator will be applied to long time-scale post-injection simulations with coupled geomechanics - Month 48	Wei Yan, DTU	TRL 2 · M1 · M3 · M2 · M4 - TRL 5
3-P2	**CO2 flow - Experimental study and modelling of CO2 propagation in geological storage** M1: Fluids, rock samples and experimental setups are prepared, fluid miscibility studied, first un-steady state CO2 flooding with saturation logging, experiments under X-ray CT performed – Month 15 M2: Effects analysed, the model for core-scale CO2-brine flows established, Flooding experiments at GEUS performed and analysed with the new model; relative permeabilities extracted – Month 27 M3: Reservoir-scale model has been established – Month 30 M4: Data transferred on selected Stenlille wells, report completed, articles from output of the research has been written - Month 39	Samira Mohammadkhani, GEUS	TRL 3 · M1 · M2 · M3 · M4 - TRL 5
3-P3	**Monitoring Fugitive emissions** M1.1: Review of inversion tools for satellite measurements – Month 18 M1.2: Delivery of inversion tools for the CO2M mission – Month 30 M2.1: Payload contruction - Month 9 M2.2: Flight validation – Month 24 M3.1: Instrument validation – Month 12 M3.2: Model developmed – Month 20 M4.1: Release campaigns completed – Month 18	Jacob Ask Hansen, DTI	TRL 4 · M2. 1 · M3. 1 · M1. 1, M4. 1 · M3. 2 · M2. 2 · M1. 2 - TRL 7
3-P4	**THERMOCO2WELL - Expected results of the CO2injection well damage due to thermal stresses** M1: Collect all relevant data for Stenlille reservoir – Month 3 M2: The developed wellbore flow simulator will be loosely coupled with a geomechanical simulator – Month 9 M3: A standalone routine for thermodynamic flash calculation for the CO2-rich injected fluid – Month 12 M4: An approximate model for the near-wellbore stresses distribution will be developed and coupled to the wellbore flow model – Month 18 M5: A technical meeting/workshop with stakeholders – Month 21	Nikolai Adrianov, GEUS	TRL 3 · M1 · M2 · M3 · M4 · M5 - TRL 5
3-P5	**BOMS - BOrehole Monitoring Solutions for CO2storage wells** M1: Establishment of an overview of the existing technology for borehole monitoring and finding the most important gaps between the capabilities of existing technology and operational needs. Month 6 M2: Assessment of well completion design in order find options for integrating monitoring systems in existing and new wells. Month 12 M3: Development of a reservoir simulation model and laboratory scale prototype(s) and test solution(s) in reservoir conditions. Month 21 M4: Assessment of results in comparison with standard solutions and development of solution catalogue. Month 27	Martin Patrong Haspang, Gasstorage Denmark	TRL 5 · M1 · M2 · M3 · M4 - TRL 7
3-P6	**The adaption of existing infrastructure for CO2 storage in reservoirs** M1: Validation of measurements in lab-scale – Month 15 M2: Full-scale monitoring operational – Month 21 M3: Completion of complete material qualification – Month 40 M4: Establishment of a corrosion model with different CO2 impurities and flow rates – Month 40 M5: Gap analysis completed – Month 40	Simon Pedersen, AAU	TRL 4 · M1 · M2 · M3-4-5 TRL 6
3-P7	**Corrosion protection for CO2 storage facilities using nanofilament coatings** M1: Silicon nanofilament coating mechanical and chemical stability tested, Month 6 M2: Coating function as long term-corrosion inhibitor assessed, month 11.	Tobias Weidner, AU	TRL · M1 · M2 · TRL 3
3-P8	**CO2RESHC - Evaluation of residual hydrocarbons effect on CO2 injectivity in depleted chalk reservoirs** M1: Completion of CO2 flooding experiments - Month 16 M2: Geochemical analysis of residual HCs in pre- and post-flooding samples - Month 19 M3: Microscopic analysis of residual HCs in pre- and post-flooding samples - Month 19 M4: Data interpretation and reporting - Month 24	Henrik Ingermann Petersen, GEUS	TRL 3-6 · M1 · M2, M3 · M4 - TRL 5
3-P9	**ChalkCO2RE - Chalk–CO2reactions at reservoir conditions** M1: Completion of fundamental data acquisition regarding reactions and reservoir properties - Month 21 M2: Summary of dissolution/precipitation effects on lithology and reservoir properties - Month 24 M3: Conditions inducing dissolution/precipitation determined - Month 27 M4: Conceptual sector-scale established - Month 33 M5: Completion and reporting - Month 36	Kresten Anderskouv, KU	TRL 2 · M1 · M2 · M3 · M4 · M5 · TRL 4
WP4	**CO2 utilisation**	**Kim Daasbjerg, AU**	
4-P1	**RD-BECCUS - Research and development platform for flexible BECCU/S** M1: Data Collected from CHP plant - Month 6 M2: Operation cycles of the CO2 source is developed - Month 9 M3: Flexible BECCU/S digital twin is setup and ready for simulation - Month 12	Morten Gottlieb Warming-Jespersen, DTI	TRL 3 · M1 · M2 · M3 · TRL 5
4-P2	**BioTechCCU, - Biotechnology for converting CO2 to platform chemicals** M1: Demonstration of biomethanation for diverse CO2 sources at TRL5—Month 24 M2: Labs cale demo of acetid acid production from CO2.—Month 30 M3: Lab-scale demonstration of biomethane fermentation to bioplastics—Month 30	Muhammad Tahir Ashraf, SDU	TRL 3 · M1 · M2, M3 · TRL 4
WP5	**Society and systems analysis**	**Brian Vad Mathiesen, AAU**	
5-P1	**Public acceptance of CCUS** M1: Obtain CCUS and preference data from ongoing surveys - Month 3 M2: Obtain insights into how consumers perceive different CCUS technologies and how the technologies can be implemented in the best possible way - Month 12 M3: Estimate acceptance and preference relations for the use of CCUS technologies - Month 24	Jacob Ladenburg, DTU	M1 · M2 · M3
5-P2	**LSICC - Large Scale Integration of Carbon Capture in Energy Systems** M1: preliminary maps of the resources - Month 28 M2: Energy system analyses showing the potential consequence of dif-ferent carbon capture technologies - Month 28	Jakob Zinck Thellufsen, AAU	M1, M2
5-P3	**VALCCAP - Local value creation in carbon capture, storage and use: the development of cross-sectorial business set-ups and pathways** M1 will contain 2-4 concrete scenarios for CCUS development in Thy-Mors. Month 24. Milestone M2 consists of the final selection of CCUS business set-ups. Month 40. Milestone M3 will be showing the local development effects of the different CCUS scenarios. Month 36.	Karl Sperling, AAU	M1 · M3 · M2
WP6	**Cross-cutting Actions and Capacity Building**	**INNO-CCUS secretariat supported by Energy Cluster Denmark**	
	Cross-cutting Actions and Capacity Building M1: Connection to SME- and startup environments - Month 24 M2: Knowledge and tech transfer between research and industry such as in-residence activities, tech-challenges and recruitment fairs between universities and industry - Month 36 M3: Life long learning courses for companies established - Month 48 M4: Establish PhD and Master training networks before 2025 - Month 48		M1 · M2 · M3, M4
WP7	**Communication, Dissemination and Outreach**	**INNO-CCUS secretariat supported by Energy Cluster Denmark**	
	Communication, Dissemination and Outreach M1: Dissemination plan will be developed in detail within the first six months of the Partnership, and updated and revised annually - Month 6, 18, 30, 42 M2: Communication plan within 6 months, includes: i. Plan for communication channels (website, SoMe, graphics), ii. Stakeholder mapping and need for information level, iii. Internal communication chain and plan, iv. Plan for integration of SMV and startup-environments interests - Month 6 M3: Organise and conduct annual INNO-CCUS conference – Month 18, 30, 42 M4: At least two annual hackathons to generate new ideas for INNO-CCUS projects, focusing on additional research and innovation funding. The participants will be current and potential partners including academia, RTOs, industry, SMEs, and start-ups - Month 9, 15, 21, 27, 33, 39, 45. M5: ECD will organise two network activities within the 5 workstreams that create links to neighbouring sectors, other innomissions, and complementary clusters - Month 24. M6: Establish an open CCUS platform as a network for research, innovation, and development - Month 18		M1, M2 · M4 · M4 · M1, M3, M6 · M4 · M5 · M4 · M1, M3 · M4 · M4 · M1, M3 · M4
WP8	**Mission Management**	**INNO-CCUS secretariat**	
	Mission Management Selected management tasks: *The first year:* T1: Prepare a communication plan in collaboration with the BoD. T2: Set up communication platforms: Website, social media, newsletter, digital and graphic profile T3: Plan and conduct a kick-off meeting T4: Plan and conduct the first General Assembly T5: Upstart meetings with all project teams during the first 3 months T6: Prepare the process for pool 2 T7: Prepare an overview of the annual cycle for the Partnership – adapted every year. T8: Update Partnership Plan during the first six months, according to detailed planning. *Recurring:* T9: IFD reporting - annually T10: Steering Committee meetings - organisation T11:Budget overview and management – in collaboration with the Administrator T12: Project progress and reporting – in collaboration with PIs T13: BoD reporting – meeting agenda and meeting minutes T14: Information distribution according to the communication plan T15: Roadmap update – collaboration with scientific leads.		