

CFDA No.	81.089	Cooperative Agreement No.	DE-FE0031838
CFDA Program Title	Fossil Energy Research and Development		

SUBAWARD

Effective October 1, 2020

Between

The University of North Dakota Energy & Environmental Research Center

and

University of Alaska Fairbanks

MODIFICATION NUMBER 002

In accordance with the U.S. Department of Energy's ("DOE's") award of additional funding to the "Project" (as defined in the SUBAWARD) on September 30, 2021, and DOE's approval for the University of North Dakota Energy & Environmental Research Center ("EERC") to proceed with Budget Period 2 of the Project, the purpose of this Modification is to:

- 1.) Extend the period of performance from March 31, 2022, to September 30, 2024;
- 2.) Incorporate a revised Scope of Work;
- 3.) Incorporate an additional Budget documenting the increased costs in the SUBAWARD's Scope of Work;
- 4.) Increase the overall amount of the SUBAWARD by \$624,877, from \$1,250,200 to \$1,875,077;
- 5.) Increase the costs to be paid to SUBRECIPIENT by \$499,901, from \$999,727 to \$1,499,628; and
- 6.) Increase the in-kind cost share to be provided by the SUBRECIPIENT by \$124,976, from \$250,473 to \$375,449; and
- 7.) As Budget Period 2 of the Project has been awarded by DOE, approving and fully funding the SUBAWARD.

ACCORDINGLY, the undersigned parties to the above-referenced SUBAWARD hereby agree to:

1. Replace the first paragraph of **ARTICLE 4** entitled “**CONSIDERATION AND PAYMENT**” in its entirety with the following:

“The estimated cost of the Scope of Work cited in APPENDIX A is anticipated to be US\$1,875,077. As consideration and compensation for the Scope of Work cited in APPENDIX A, the EERC agrees to pay SUBRECIPIENT total estimated costs in the amount not to exceed US\$1,449,628; the remaining amount of US\$375,449, will be provided by SUBRECIPIENT as in-kind cost share (costs incurred by SUBRECIPIENT in performance of the Scope of Work, but not reimbursed by the EERC). Whereas, of the total amount to be paid to SUBRECIPIENT, funds in the amount not to exceed US\$1,499,628 are hereby allocated for work through September 30, 2024. If, at any time, SUBRECIPIENT anticipates the total costs shall exceed said funding allocation, SUBRECIPIENT shall, within the next succeeding ten (10) days, notify the EERC in writing. Said notification shall indicate the estimated costs to complete any and all work.”

2. Replace APPENDIX A in its entirety, and incorporate the attached Scope of Work (*Revision A-Two, March 23, 2022*) as APPENDIX A.

3. Incorporate the attached Budget addition (*Second Budget Supplement, May 10, 2021*) within APPENDIX B.

4. All other terms and conditions remain unchanged.

The Parties hereto have executed this modification by their duly authorized representative on the dates set forth below.

UNIVERSITY OF ALASKA FAIRBANKS	UNIVERSITY OF NORTH DAKOTA ENERGY & ENVIRONMENTAL RESEARCH CENTER
By _____	By _____
Name <u>Tapiana Wray</u>	Name <u>Sheryl A. Eicholtz-Landis</u>
Title <u>Acting Executive Director</u>	Title <u>Director of Contracts and Intellectual Property</u>
Date <u>04/21/2022</u>	Date _____

SCOPE OF WORK

(Revision A-Two, March 23, 2022)

UAF will support the EERC and the Principal Investigator/Task Leads across the following PCOR Partnership Initiative tasks. Note, task and subtask numbers and titles in the scope of work below correspond to those in the U.S. Department of Energy (DOE) Statement of Project Objectives (SOPO) for the PCOR Partnership Initiative (DOE Contract No. DE-FE0031838).

Task 4 – Regional Infrastructure

UAF will contribute to Task 4 by performing a study and providing expertise on technical issues related to scale-up of CO₂ transportation in Alaska. These efforts will focus on assessing the performance of certain corrosion inhibitors in the presence of various concentrations of CO₂ in Arctic operating environments common to the North Slope of Alaska’s Prudhoe Bay Unit (PBU). To support this task, UAF will perform the following activities:

Activity 1: UAF will conduct a literature survey specific to the oil and gas industry that assembles a general body of knowledge regarding the effects of corrosion inhibitors in the presence of CO₂. Similar data specific to the PBU provided by subject matter experts will be analyzed. The results will be compared in a manner appropriate for public release. Knowledge gaps identified in the literature will be highlighted.

Activity 2: For each field of interest, the efficacy of the corrosion inhibitors at various CO₂ concentrations using commercially available corrosion modeling software will be evaluated, and the implications for CO₂ enhanced oil recovery (EOR) development will be examined. If field data are made available by the Working Interest Owners, then modeling results will be compared to actual corrosion inhibitor performance, and the model will be adjusted to more closely match the history. These efforts will be presented in two topical reports, one with initial results (D1), followed by an update that incorporates data and knowledge gained throughout the project (D4).

Activity 3: UAF will contribute to Subtask 4.4 by assisting the EERC with outreach activities as directed. It is anticipated UAF will contribute to the PCOR Partnership Atlas, which will be updated by the EERC throughout the project, as well as representing the PCOR Partnership to Alaska regulatory bodies or industry stakeholders. UAF will support the Atlas development by providing data, text, and images as agreed upon by UAF and EERC.

Activity 4: Investigate the phase behavior of heavy oil when contacted by CO₂-enriched miscible injectant (CO₂-enriched MI). Mixing CO₂-enriched MI with reservoir fluids will induce complex and uncommon phase behavior and viscosity change over the ranges of pressure and temperature encountered. Poor understanding of reservoir oil’s PVT (pressure, volume, and temperature) properties may lead to an inadequate EOR process. The findings of this activity will be presented in D6 (Table 1).

Task 5 – Technology Transfer

UAF will assist and advise the EERC on Task 5 efforts by performing the following activities:

Activity 5: UAF will develop a technical analysis and high-level business case scenario to evaluate the feasibility of implementing CO₂ EOR on the Alaska North Slope. Commercially available modeling tools will be used to investigate CO₂ plume development, subsurface pressure response, and potential fluid pathways to develop estimates of incremental oil production resulting from CO₂ injection in the field(s) of

interest. Simulation scenarios including well spacing, perforation, CO₂ concentration versus other constituents of the injected fluid, as well as injection and production rates will be used to understand potential recovery factors, utilization rates, associated CO₂ storage, and CO₂ concentration at the producing wells that may be realized at the evaluated fields. These efforts will be presented in two topical reports, one with initial results (D2), followed by an update that incorporates data and knowledge gained throughout the project (D3).

In addition to the above activity, UAF will support technology transfer by participating in PCOR Partnership meetings and attending and presenting at technical conferences as appropriate to inform and educate stakeholders about carbon capture, utilization, and storage (CCUS) technologies.

Activity 6: UAF will identify key policy issues that must be addressed to bring clarity to Alaska’s oil and gas industry with respect to CCUS. This effort will require engaging Alaska’s oil and gas industry, State agencies (esp. AOGCC, DNR, ADEC, the Administration, and possibly legislators), Native Corporations and other NGOs, and federal agencies such as BOEM in the case of offshore fields outside of Alaska state waters. In addition to addressing regulatory aspects, techno-economic elements required for the oil and gas industry to create a business model that includes tax policy, incentive programs, and addresses long-term liability issues will be identified. The findings of this activity will be presented in a topical report (D5), which will serve as a “pathway” for deploying commercial CCUS in Alaska.

Deliverables

UAF will complete the following deliverables, which may serve as sections or chapters to the EERC’s deliverables presented in the PCOR Partnership Initiative’s DOE SOPO.

Table 1. UAF Deliverables

DOE Task/Subtask No.	Deliverable Title	Due Date
4.1/4.2	D1 – Topical Report: Efficacy of corrosion inhibitors at various CO ₂ Concentrations and Implications for CO ₂ EOR Development on the North Slope	10/31/2022
5.3	D2 – Topical Report: Regional Business Case Assessment for CCUS on the North Slope	10/31/2021
5.3	D3 – Topical Report: Updated Regional Business Case Assessment for CCUS on the North Slope	10/31/2023
5.4	D5 – Topical report: A roadmap for deploying commercial CCUS in Alaska	06/30/2023
4.1/4.2	D6 – History matched reservoir simulation model for CO ₂ -enriched miscible injectant flood of a heavy oil reservoir, optimized injection strategy, and data files	06/30/2023
4.1/4.2	D4 – Topical Report: Updated Efficacy of corrosion inhibitors at various CO ₂ Concentrations and Implications for CO ₂ EOR Development on the North Slope	05/31/2024

In addition to the above deliverables, UAF may also be required to contribute content or provide review for EERC’s required quarterly reports to DOE. This support will be requested as needed by EERC.

APPENDIX B

BUDGET

(Second *Budget Supplement*, March 10, 2021)