

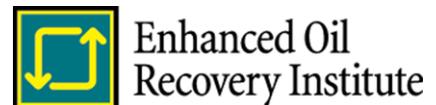
REQUEST FOR PROPOSALS (RFP)
for
Rocks & Reservoirs Phase 2

Issued by:
Enhanced Oil Recovery Institute

A collaboration between:
Center of Innovation for Flow through Porous Media
Enhanced Oil Recovery Institute
School of Energy Resources
Wyoming Energy Authority

Issue Date: November 19, 2020

Proposal Due Date: Open, rolling due date



REQUEST FOR PROPOSALS
Rocks & Reservoirs Phase 2

1. INTRODUCTION

Wyoming is a leading producer of energy. A continued drive toward innovation will help the state maintain its exporting energy role. In that vein, several Wyoming entities, including the Center of Innovation for Flow through Porous Media, the Enhanced Oil Recovery Institute and the University of Wyoming School of Energy Resources have teamed up use innovation to drive increased production for Wyoming producers.

Center of Innovation for Flow through Porous Media

The Center of Innovation for Flow through Porous Media (COIFPM) is located at UW's High Bay Research Facility (<https://coifpm.com>). It was inaugurated in August 2017. The High Bay Research Facility (HBRF) contains approximately 90,000 square feet of high-bay and highly customized laboratory space, and affiliated office and meeting areas. The laboratories established within COIFPM enable research that improve understanding of how to maximize recovery from both conventional and unconventional oil and gas reservoirs. The Center is, to the best of our knowledge, the world's largest experimental research facility of its kind focused on flow through porous media problems with applications primarily in oil and gas recovery and carbon utilization and storage. It is developed using more than \$100 million investment from the State of Wyoming and corporate sponsors. The facility provides imaging and flow capabilities at atomic, nano, micro, and macro scales. Furthermore, it establishes a massive capacity for scientists to conduct numerous studies in parallel. COIFPM is a world-class research entity with a distinguished track record in scholarly activity, application-oriented research, technology development, and commercialization.

Significant new oil and gas reserves within Wyoming are projected to be discovered, and any new insights/technologies that can enable incremental improvements to new and existing production from both conventional and unconventional reservoirs represent major new revenue streams to the state. This has direct implications for the future of the state and its citizens.

Enhanced Oil Recovery Institute

The Institute was created by the Wyoming Legislature with the intent to backfill the vacuum left during the oil market depression in the 1970's and 1980's. The expectation is that the Institute will provide the oil and gas engineering, geology, and economics research that used to be provided by the major oil companies who at the time had staffs located in Wyoming. With the downturn of the industry and the retraction of the majors to locations like Denver, Oklahoma City, Houston, and Bakersfield, there was a lack of technical expertise in the state of Wyoming to support the much relied upon hydrocarbon extraction industry.

EORI provides these services in cooperation with the School of Energy Resources (SER) at the University of Wyoming. In order to be closer to the oil and gas producers as well as the service

industry that supports the oil and gas producers, the Institute is centered in Casper. This allows for the continued collaboration with researchers and assets on campus in Laramie while at the same time engaging with the producers and their support industry in Casper and across Wyoming at the wellhead. The Institute has made several significant changes over the last couple of years including centralizing operations in Casper and pivoting to more data analytics in pursuit of the Institute's mission and legislative mandate.

The mission of the Institute is to facilitate a meaningful and measurable increase in recoverable reserves and production of oil and natural gas in Wyoming that may otherwise not be realized. Key to this is the effective and efficient transfer of relevant technology, information and knowledge to Wyoming producers. EORI believes that its mission is being met when producers consider EORI as a vital source of relevant technology, information, expertise and knowledge for Wyoming fields. The mission is accomplished through a variety of interactions, engagements, and projects with Wyoming operators and Stakeholders throughout the life cycle of oil and gas production, focusing on the Improved Oil Recovery aspect of hydrocarbon production, and specifically this Rocks and Reservoir Phase 2 RFP.

School of Energy Resources

The School of Energy Resources (SER) at the University of Wyoming (UW) was created in 2006 to enhance the university's energy-related education, research and outreach. SER directs and integrates cutting edge energy research and academic programs at UW and bridges academics and industry through targeted outreach programs. SER collaborates with stakeholders at the state, national, and international levels to advance energy technologies and policies to grow and support Wyoming's robust energy sector. SER's focus is energy-driven economic development for the state of Wyoming.

These three entities – COIFPM, EORI, and SER – specifically designed to collaborate with Wyoming oil and gas stakeholders, are collaborating within to provide more services, analysis, and outreach collectively to Wyoming than each out singularly.

Wyoming Energy Authority

Created in 2020 by the Wyoming Legislature, The Wyoming Energy Authority combines the existing scopes of the Wyoming Infrastructure Authority, Wyoming Pipeline Authority and the State Energy Office, effectively consolidating Wyoming's energy program into one entity that works to advance the state's energy strategy by supporting Wyoming's full energy portfolio. The Wyoming Energy Authority coordinates with the entire energy spectrum, empowering collaboration, innovation and growth.

2. PROGRAM OBJECTIVES

This program is designed to acquire real world Wyoming reservoir characterization and operating data in partnership with Wyoming operators. This data will be used by the "Consortium" of COIFPM/EOR/SER/WEA to further research, engineering and geologic analysis of Wyoming reservoirs and to suggest improved, economic methods for recovering more

stranded oil and gas to improve the commercial viability of Wyoming operations, which is at the heart of the Consortium's mission.

All members of the Consortium receive some form of public funding and therefore the results (analysis) of this program are subject to the public domain and therefore available to all Wyoming oil and gas operators and stakeholders. Direct operating data may be protected via a Memorandum of Understanding (MOU) but results of analysis will be published.

The program contemplates some form of cost share in the form of "in-kind" access to reservoirs/well bores or exiting data.

3. APPLICANT ELIGIBILITY AND QUALIFICATIONS

This program is open to all Wyoming oil and gas operators doing business in the State of Wyoming producing oil and gas from reservoirs in the state.

4. DATA OF INTEREST

The first round of this effort was very successful, and projects were awarded in the following areas:

- Scale removal in the phosphoria formation with Relevant Technologies at Sunshine Valley Petroleum
- Improved Oil Recovery (IOR) in the teapot formation with Greenzyme Technologies at Sunshine Valley Petroleum
- Paraffin removal in the tekla formation Relevant Technologies at Sunshine Valley Petroleum
- Paraffin removal in the muddy formation with Relevant Technologies at Sunshine Valley Petroleum
- Improved Oil Recovery (IOR) in the muddy formation with Viper Technologies at Bear Tooth Oil
- Scale removal in the minnelusa formation with Relevant Technologies at Sunshine Valley Petroleum
- Seismic data reinterpretation in the minnelusa with Red Leaf Technologies at Osborn Heirs
- Emulsion study in the Shannon formation with Relevant Technologies at Sunshine Valley Petroleum
- Paraffin removal in the turner formation with Relevant Technologies at Sunshine Valley Petroleum
- Improved Oil Recovery (IOR) in the tensleep with Production Optimization Technologies at XRO Energy

Wyoming has a rich and varied geology and therefore a rich and varied collection of geological traps and structures that produce oil and gas. The objective of this program is to gather a diverse set of real-world operating data looking at various approaches to increased oil and gas production in these varied production scenarios. With an eye to maintain appropriate formation diversity, the Consortium wishes to expand the use, capacity, and expertise housed in the consortium. Specifically, there is interest in identifying projects that fall into these types, though proposals not aligned with these areas will also be considered:

A. Characterization of Reservoir Rock and Fluid Properties (Conventional and Unconventional Systems)

1. X-ray macro-CT imaging of reservoir core samples – Mapping of heterogeneity, bedding planes, and induced/natural fractures

2. X-ray micro-CT imaging of reservoir rock samples – Characterization of pore space topology, porosity, pore size distribution, etc.
 3. Quantitative Evaluation of Minerals using Scanning Electron Microscopy – Characterization of reservoir rock mineralogy
 4. Two- and three-dimensional Focused Ion Beam-Scanning Electron Microscopy (FIB-SEM) – Characterization of pore structure, salt crystals in the pore space, organic matter, organic porosity, etc. at ultra-high resolutions (e.g., 5-10 nm)
 5. Sub-nanometer resolution imaging of the reservoir rock specimens using Environmental Transmission Electron Microscopy (ETEM)
 6. Porosity and gas permeability measurements
 7. Fluid density and viscosity measurements under reservoir conditions
 8. Dynamic interfacial tension (IFT) measurements using reservoir fluids (including live fluids)
 9. Characterization of in-situ wettability within the reservoir rock pore space (measurements of in-situ contact angles on the reservoir pore walls) using HPHT miniature core-flooding and high-resolution x-ray micro-CT imaging technologies (Conventional reservoirs)
- B. Advanced Core Analysis (RCAL and SCAL – Conventional and Unconventional Systems)
1. Original fluid content and saturation measurements
 2. Steady-state liquid and gas absolute permeability measurements
 3. Core cleaning/conditioning and restoration of wettability through dynamic aging
 4. Steady-state measurements of two- and three-phase relative permeabilities on conventional and unconventional reservoir rock samples using live fluids
 5. Steady-state measurements of two- and three-phase relative permeabilities on propped or unpropped fractured core samples using live fluids
 6. Characterization of in-situ wettability of proppants
 7. Micro- and macro-scale characterization of proppant pack deformation under varying stress conditions and its impact on effective oil or gas permeabilities
 8. Measurements of capillary pressure-saturation curve for different fluid pairs (oil/brine, oil/gas, and gas/brine) using centrifugation technique
 9. Characterization of production during primary depletion using live reservoir fluids
 10. Experimental measurements of critical gas saturation as well as oil and gas relative permeabilities during solution gas drive process with reservoir core samples and live fluids
 11. Experimental measurements of critical condensate saturation as well as gas and condensate relative permeabilities during liquid dropout (retrograde condensation) process with reservoir core samples and live fluids
 12. Permeability degradation studies under single and multiphase flow conditions
 13. Characterization of multiphase flow properties in fractures under varying confining pressure conditions
 14. Characterization of single and multiphase flow properties in reservoir rock samples under varying hydrostatic stress conditions

C. Enhanced and Improved Oil Recovery (EOR and IOR)

1. Waterflooding – Conventional reservoirs
2. Smart waterflooding (e.g., low-salinity and engineered brine) – Conventional reservoirs
3. Chemical-based waterflooding (e.g., surfactants, polymers, nanoparticles, alkaline, etc.) – Conventional reservoirs
4. Spontaneous imbibition (surfactants, nanofluids, wettability reversal agents, etc.) – Fractured conventional reservoirs
5. Spontaneous imbibition (surfactants, wettability reversal agents, etc.) – Additives for hydraulic fracturing fluids - Unconventional reservoirs
6. Gas injection (e.g., Huff & Puff, cyclic, miscible, and immiscible – Hydrocarbon gas, scCO₂, N₂, etc.) – Conventional and unconventional reservoirs
7. CO₂ or hydrocarbon gas foam injection for conformance control in tight fractured systems – Conventional and unconventional reservoirs
8. Evaluation of precipitation, scaling, and chemical retention in the reservoir rock pore space

Note: IOR/EOR/SCAL flow experiments can be conducted on whole reservoir core samples (or core plugs with various diameters and lengths) using live fluids at pressure and temperature conditions up to 9,000 psi and 220 °F. Under certain pressure conditions, COIFPM also provides the option of conducting flow experiments while using x-ray imaging to obtain in-situ fluid saturations.

D. Oil Recovery Enhancement through Introduction of Chemicals into Hydraulic Fracturing Fluid (Unconventional Reservoirs)

Development of a comprehensive and systematic screening workflow to select optimum chemical formulations and concentrations for a given geosystem using a multiscale approach that includes the following:

1. Cloud point measurements and evaluation of chemical stability at reservoir pressure and temperature conditions
2. Dynamic IFT and static contact angle measurements – Identify chemicals with the ability to reverse wettability and reduce IFT
3. Critical micelle concentration (CMC) measurements
4. Evaluation of chemical adsorption on reservoir rock minerals
5. Evaluation of oil recovery by spontaneous imbibition at high temperature conditions

5. AWARD AMOUNTS AND PROJECT PERIOD

This round of potential awards does not have predetermined limits for project awards. There is no maximum nor a minimum. The funding levels may change as the Consortium responds to current market conditions, but at this time, the funding level for projects is **\$500,000**. What is relative and will be the main discriminator in evaluating the proposals is the ability of the proposer's project to take advantage of the services and expertise of the COIFPM and the

proposals ability to identify and apply Wyoming reservoir issues to the broadest extend possible. There is no specified individual project limit, although those projects that can provide cost-share may and/or greater impact to Wyoming production will be considered more favorably. Proposers are required to provide demonstrable matching in the form of in-kind access to assets or hard dollar matching funds with a minimum 1:1 cost-share, recognizing in-kind cost-share. This round of proposal will remain open and available until June 30, 2022. The availability of this round is based on the availability of funds, and this program may be expanded or extended beyond the current amount and timing.

6. PROPOSAL FORMAT

The required proposal format is provided in Attachment 1: Form of Proposal. The proposal requires a statement of the problem to be addressed. The proposal is required to describe how solving the stated problem would be beneficial to other Wyoming operators, in identified Wyoming fields/basins/reservoirs, and to estimate enhanced recovery, increased production and/or cost reduction as accurately as possible. The proposal requires the discussion of the methodology used to collect the data; the number, type, and amount of data to be acquired along with project timeline. Specific details of the proposal format are included in the following attachments:

- Attachment 1: Form of Proposal
- Attachment 2: EORI MOU/CNDA
- Attachment 3: Proposal Evaluation form

7. REVIEW PROCESS AND EVALUATION CRITERIA

A. Review Process

Project proposals will be reviewed and evaluated as they are received. The evaluation team will be comprised of the COIFPM Director, Dr. Piri, SER Executive Director, Dr. Krutka, SER Director of Research, WEA Executive Director, Dr. Glen Murrell, and EORI Director, Dr. Steven Carpenter. Negotiations of scope may be necessary based on availability of funds, previously approved proposals (e.g., existing projects in the same reservoir), or the need for further information.

B. Evaluation criteria

Proposals will reviewed for compliance with the requirements of this program and the proposal format. Proposals found to be non-compliant may be disqualified, or the Consortium may seek additional information. The criteria by which the proposals will be evaluated is provided in Attachment 3: Evaluation Criteria.

8. AWARD NOTIFICATION

Awards will occur on a rolling basis as evaluations are completed. Successful applicants will be notified, and the award process initiated. Awards will continue until the program fund is expended and/or not later than June 30, 2022.

9. RESEARCH CONTRACT REQUIREMENTS

The projects will be conducted using the Consortium MOU/CNDA (Attachment 2) and the data and analysis of these projects will be the source of published research by the Consortium.

10. INTELLECTUAL PROPERTY

The Consortium will make no claims for intellectual property.

11. SUBMITTAL INFORMATION

Proposers are required to submit an electronic copy of the required proposal to EORI's Director, Dr. Steven Carpenter at steven.carpenter@uwyo.edu for consideration.

Attachment 1: Form of Proposal

Proposers are required to submit a proposal that contain the following required elements:

- 1. Project Title:
- 2. Problem Statement/Issue Being Addressed/Project Objective:
- 3. Project Formation/Field/Basin:
- 4. Key Project Personnel/Contact information:
- 5. Detailed project description:
 - a. Describe how solving the stated problem would be beneficial to other Wyoming operators, in identified Wyoming fields/basins/reservoirs
 - b. Estimated enhanced recovery/production, if possible
 - c. Methodology used to collect the data
 - d. Number, type, and amount of data to be acquired
 - e. Project timeline/schedule

6. Budget: It is assumed that proposers will contact COIFPM Director Dr. Mohammad Piri directly and discuss the scope and cost of services needed for this application at mpiri@uwyo.edu, <https://coifpm.com/>, or 307-766-3954. Dr. Piri will provide a cost estimate from Piri Technologies, at cost (no mark-up) for the Consortium. Please provide Piri Technologies proposal with your application.

- a. Cost of work performed by Piri Tech at COIFPM: \$ _____ +
- b. Cost to acquire core: \$ _____ =
- c. **Total Project Budget:** \$ _____
- d. In-kind/access by Proposer \$ _____ +
- e. Amount requested from Consortium (from Dr. Piri): \$ _____ =
- f. **Total Project Budget:** \$ _____

Attachment 2: Consortium MOU/CNDA

COIFPM/SER/EORI/WEA Consortium Memorandum of Understanding & Non-Disclosure Agreement

This Agreement entered into this ____ day of _____, 2020, memorializes the understanding and intent of the Parties hereto, the Consortium of COIFPM/SER/EORI/WEA (CONSORTIUM) and _____ (Operator). Parties enter into this Memorandum of Understanding (MOU) to define and clarify the related tasks, activities, and data disclosure that may be undertaken as part of the project (hereinafter referred to as the PROJECT).

The CONSORTIUM was created to facilitate research programs intended to increase reserves and production of oil and natural gas in Wyoming through transfer of relevant technology, information and knowledge to operators producing Wyoming reserves, and to promote research and technology transfer in conventional and unconventional oil and gas reservoirs.

The Parties agree that the PROJECT to be undertaken by CONSORTIUM and Operator is defined by the following:

1. Project Description:
 - a) <<text>>
2. Operator will provide certain data that will be used by CONSORTIUM to complete the Project, including:
 - a) <<text>>
3. Operator shall designate information and data that it deems CONFIDENTIAL, ("Confidential Data" or "Meta Data"). For this project, Operator has provided _____ which has been identified as Confidential Data.
4. Consortium shall prepare a report that documents the findings of the Project. The report shall be prepared for and provided to Operator, which may, at the Operators discretion, include the Confidential Data.
5. Consortium shall retain the Meta Data, which shall remain confidential and which may be used to inform future modeling and analysis.
6. The Parties agree that in accordance with the statutory purposes of the Consortium, the analysis and findings of the Project will be released to the public as part of the Consortium technology transfer responsibilities. In consultation with the Operator, Consortium will remove Confidential Data or Meta Data related to the Project from the public release.
7. The term of this agreement is valid through June 30, 2022.

Non-Disclosure Requirements

8. Non-Disclosure of Confidential Information. Consortium agrees to treat any Confidential Data provided for the Project by or on behalf of the Operator, whether furnished before or after the date of this letter, including analyses, compilations, studies or other documents prepared by Operator or any of

COIFPM/SER/EORI/WEA Consortium Memorandum of Understanding & Non-Disclosure Agreement

its directors, officers, employees, agents or advisers (including, without limitation, attorneys, accountants, consultants, bankers, financial advisers and any representatives of its advisers) that contain or otherwise reflect Confidential Data, in accordance with the provisions of this Agreement. The term Confidential Data does not include information that (a) was or becomes generally available to the public other than as a result of a disclosure by Consortium or its Representatives in violation of this Agreement or (b) was or becomes available to Consortium on a non-confidential basis from a source other than Operator or its advisers, provided that such source was not known by Consortium to be bound by any agreement with Operator to keep such information confidential, or otherwise prohibited from transmitting the information to Consortium by a contractual, legal or fiduciary obligation.

9. Notice Proceeding Compelled Disclosure. In the event that Consortium is requested or required by law, regulation, supervisory authority or other applicable judicial or governmental order to disclose any Confidential Data, Consortium will provide Operator with prompt written notice of such request or requirement so that Operator may seek an appropriate protective order. If, failing the entry of a protective order, Consortium is, in the opinion of its counsel, compelled to disclose Confidential Data, CONSORTIUM shall disclose that portion of the Confidential Data that it is compelled to disclose and will exercise reasonable efforts to obtain assurance that disclosed Confidential Data will remain confidential. In any event, CONSORTIUM will not oppose action by Operator to obtain an appropriate protective order or other reliable assurance that confidential treatment will be accorded the Confidential Data. Notwithstanding the foregoing, CONSORTIUM is not required to give notice of disclosure of Confidential Data in connection with regulatory examination by governmental authorities that regulate CONSORTIUM.
10. Governing Law. This Agreement is governed by the laws of the State of Wyoming without regard to conflict of laws principles. Any action brought in connection with this agreement shall be brought in the federal or state courts located in the State of Wyoming, and the parties hereto hereby irrevocably consent to the jurisdiction of such courts.
11. Sovereign Immunity/Governmental Claims. CONSORTIUM does not waive its sovereign immunity or its governmental immunity by entering into this Agreement and fully retains all immunities and defenses provided by law with regard to any action based on this Agreement. Any actions or claims against CONSORTIUM under this Agreement must be in accordance with and are controlled by the Wyoming Governmental Claims Act, W.S. 1-39-101 et seq. (1977) as amended.
12. Interpretation. The Parties hereto agree that (i) the laws of Wyoming shall govern this Agreement; (ii) any questions arising hereunder shall be construed according to such laws; and (iii) this Agreement has been

COIFPM/SER/EORI/WEA Consortium Memorandum of Understanding & Non-Disclosure Agreement

negotiated and executed in the State of Wyoming and is enforceable in the courts of Wyoming.

13. Amendment; Waiver; Counterparts. This Agreement may not be amended except in writing signed by all parties hereto. No failure or delay by CONSORTIUM exercising any right hereunder or any partial exercise thereof shall operate as a waiver thereof or preclude any other or further exercise of any right hereunder. The invalidity or unenforceability of any provision of this Agreement shall not affect the validity or enforceability of any other provisions of this agreement, which shall remain in full force and effect. This Agreement may be executed in counterparts.

14. IN WITNESS WHEREOF, the Parties acknowledge their agreement to the foregoing as of the date first set forth above by execution of the Agreement by their respective authorized representatives.

*Enhanced Oil Recovery Institute
2435 King Blvd., Suite 140
Casper, WY 82604*

Operator

Signature: _____

Signature: _____

Name: Steven M. Carpenter

Name: _____

Title: Director

Title: _____

Date: _____

Date: _____

Attachment 3: Proposal Evaluation Criteria/Form

Project Title:

Problem Statement/Issue Being Addressed/Project Objective:

Project Formation/Field/Basin:

Proposal Completeness:

Criteria	Yes	No
Does the proposal contain all the elements required in the RFP?		
Is the budget reasonable and adequate for the work proposed?		

Relevance, Importance, Feasibility, & Merit:

Criteria	Poor	-	Average	-	Excellent	Rating
	1	2	3	4	5	
Degree to which the Problem Statement/Issue Being Addressed/Project Objective addresses a Wyoming production issue						
Degree to which the Formation/Field/Basin proposed addresses Wyoming need						
Degree to which this project has the potential to enhance or improve Wyoming oil & gas production						
Degree to which the project utilizes the Consortium expertise and tests new ideas for enhanced and improved oil & gas production in Wyoming						
Degree to which the methodologies, data, and data collection techniques are adequately and completely described						
Degree to which the project can be initiated and completed within the required timeframe of the WRPTDAP program						
Total Score:						

Compelling reasons this project should be funded:

Concerns or weakness with this proposal: