Development of Formulations for the Removal of Scale from Oil and Gas Wells in the Williston Basin

North Dakota Oil and Gas Research Council Meeting

Bismarck, ND

Dr. Ali Alshami

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Outline

- ❑ Researchers Credentials
- ❑ Project Objectives & Significance
- ❑ Innovation & Approach
- ❑ Outcomes & Impacts
- ❑ Response to Reviewers’ Comments

Researchers Credentials

Ali Alshami, PI

- Associate Professor of Chemical Engineering at the University of North Dakota.
- Over 10 years in the private sector working on R&D engineering projects at global chemical manufacturing and processing corporations.
- Specializations include material interfacial phenomena, polymer science and separations, and biochemical product development.
- Currently Managing projects with the City of Grand Forks and AE2S Corp., to study the scaling of the membranes and associated piping in the city's newly constructed regional RO water treatment plant.

Vamegh Rasouli (co-PI)

- Petroleum Engineering Department Chair, UND Continental Resources Distinguished Prof.
- Over 17 years of consulting work with Schlumberger globally.
- will bring a strong industry support to this project.
- His expertise in drilling fluid lab testing and analysis will be of core support to this project

Minou Rabiei (co-PI)

- Associate Professor, Petroleum Engineering Department, UND.
- Has strong analytical and intelligent computer modelling experiences with emphasize in MLA and Data Mining applications in the oil and gas industry.
- Her contribution to this project will be in the computational studies, data analysis and some of the lab work.

Aims and Objectives

Principal Aim: to advance the development of a novel oilfield antiscalants specifically tailored the predominant scalants found in the Williston Basin Formation.

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Enabling Objectives:

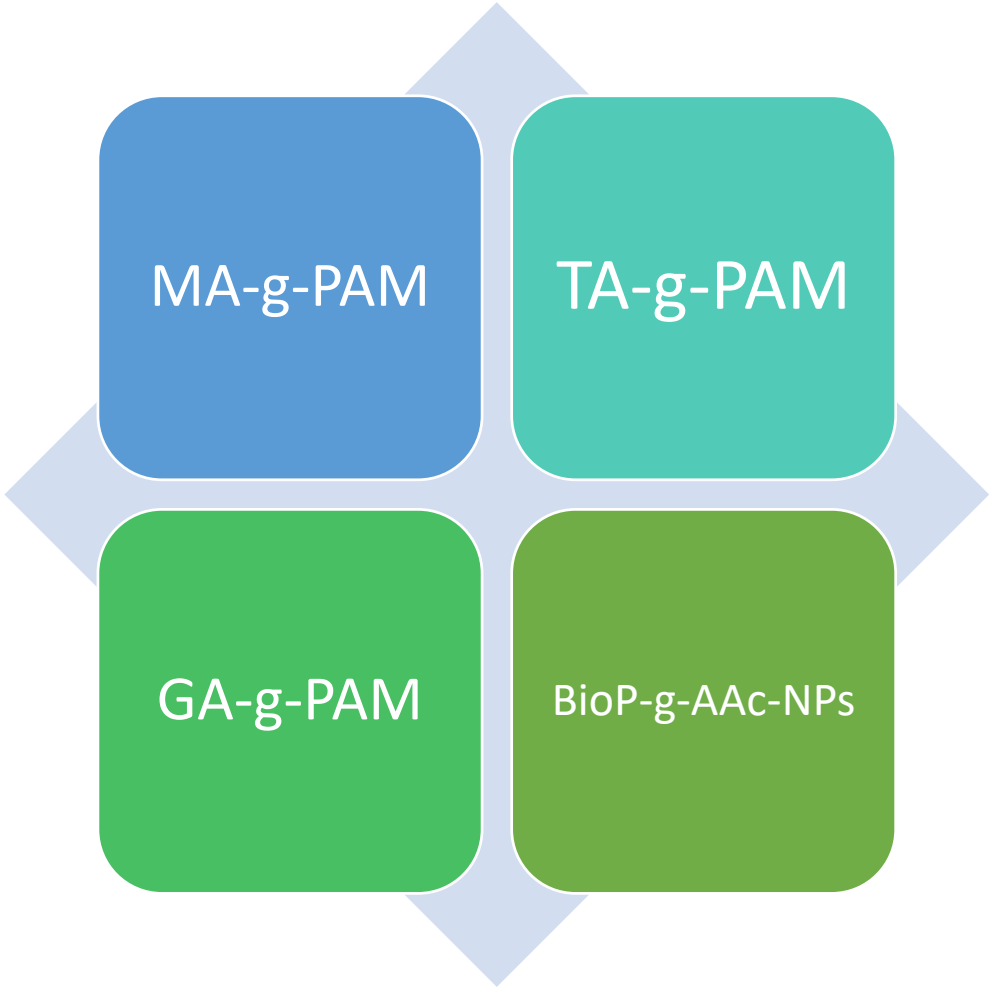
- Chemical synthesis via polymer-grafting of inhibiting compounds
- Synthesis and formulation of chelating compounds
- Synthesis and formulation of converting compounds

Why the project is needed?

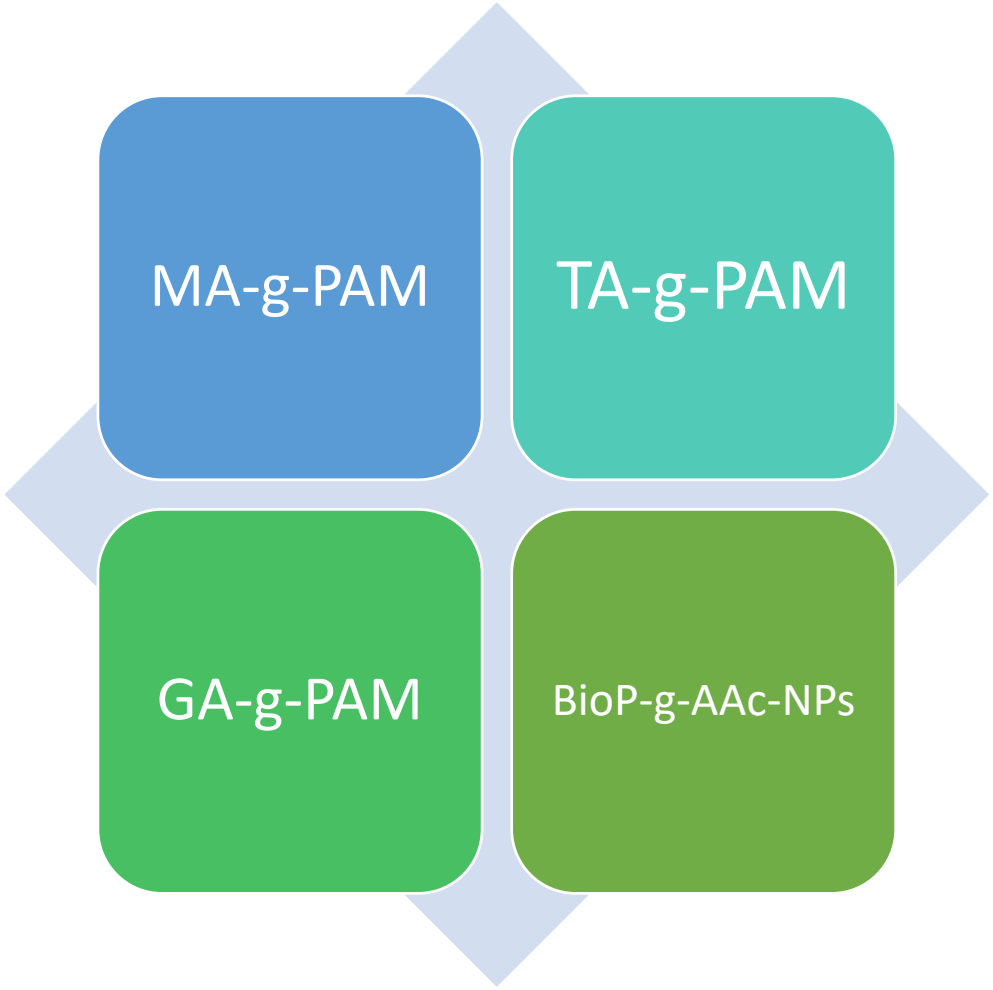
1. US impressive growth in unconventional oil &gas over the past 20 years must be sustained and leveraged
2. Scale formation has been one of the ongoing **top production problems** for operators in the Williston Basin Formation
3. For one North Dakota operator with 150 Bakken producing wells, **22 of the wells** have experienced **at least one event of severe** calcium carbonate scaling in the pump and production tubing, leading to **well failure** (Dennis Denney, JPT MARCH 2012)
4. Each of these events has a direct scale removal cost of approximately **$2.5 M per operator, from just one well**
5. These costs surge to approximately **$9 billion across the US**, in addition to the significant indirect operating costs.

Scale deposition (left to right): in the pipeline, on a separator surface, on a clean separator surface, in downhole tubing, and in the riser pipe of a heating furnace.

Innovation

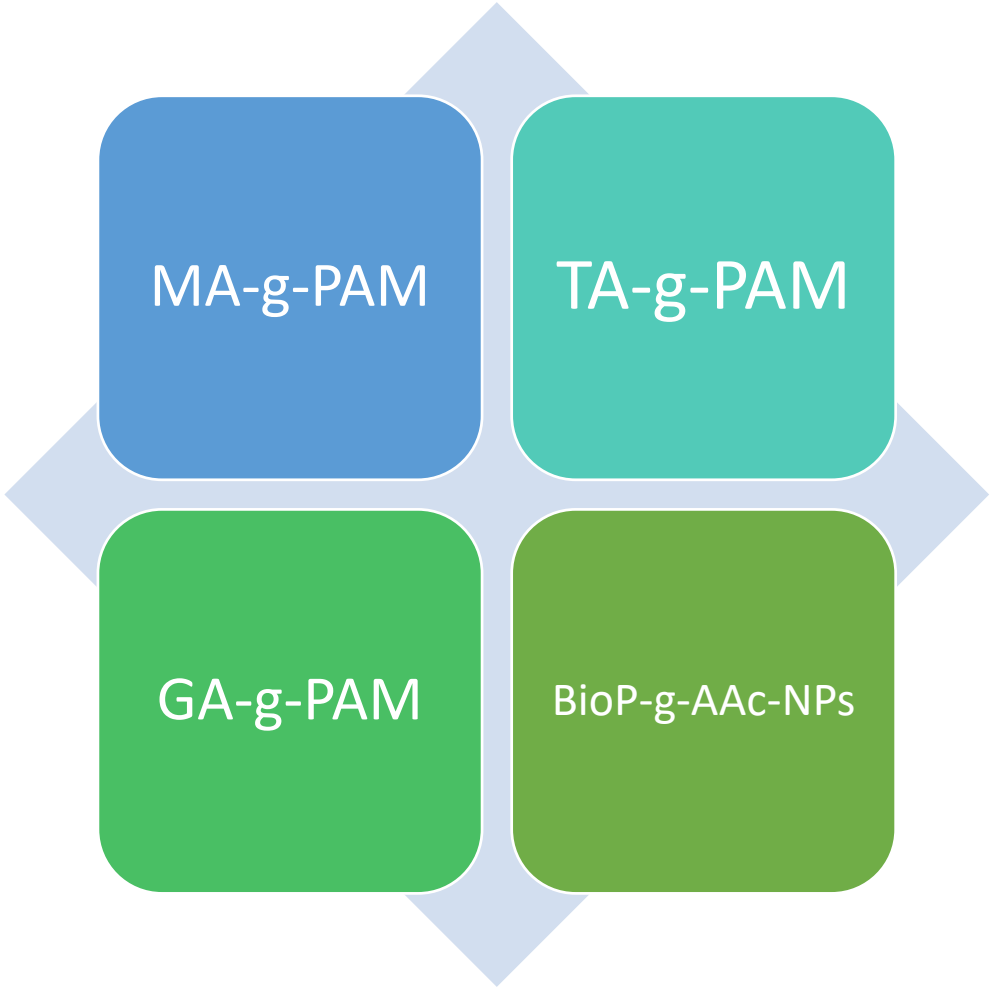


Innovation



Product	Description	Efficiency
1	Commercial 1	47.0%
2	Commercial 2	68.6%
3	Commercial 3	66.1%
4	Commercial 4	1.1%
5	**UND (locally synthesized and developed)**	**95.0%**

Innovation



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Biodegradability results: UND formulations range between 21 to 25 days for up to 23% biodegradability, compared to the commercial products biodegradability ranging from 28 to 35 days for only 17% biodegradability.

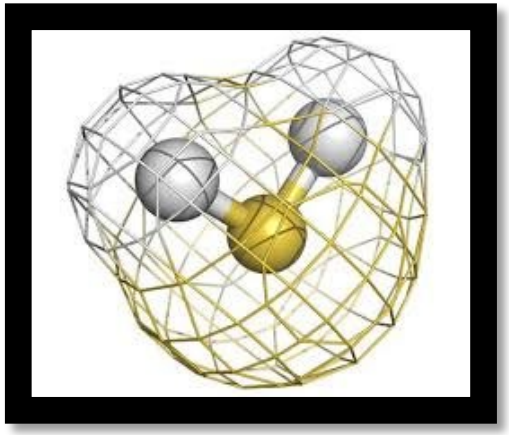
Targeted Scales

Calcite

Halite

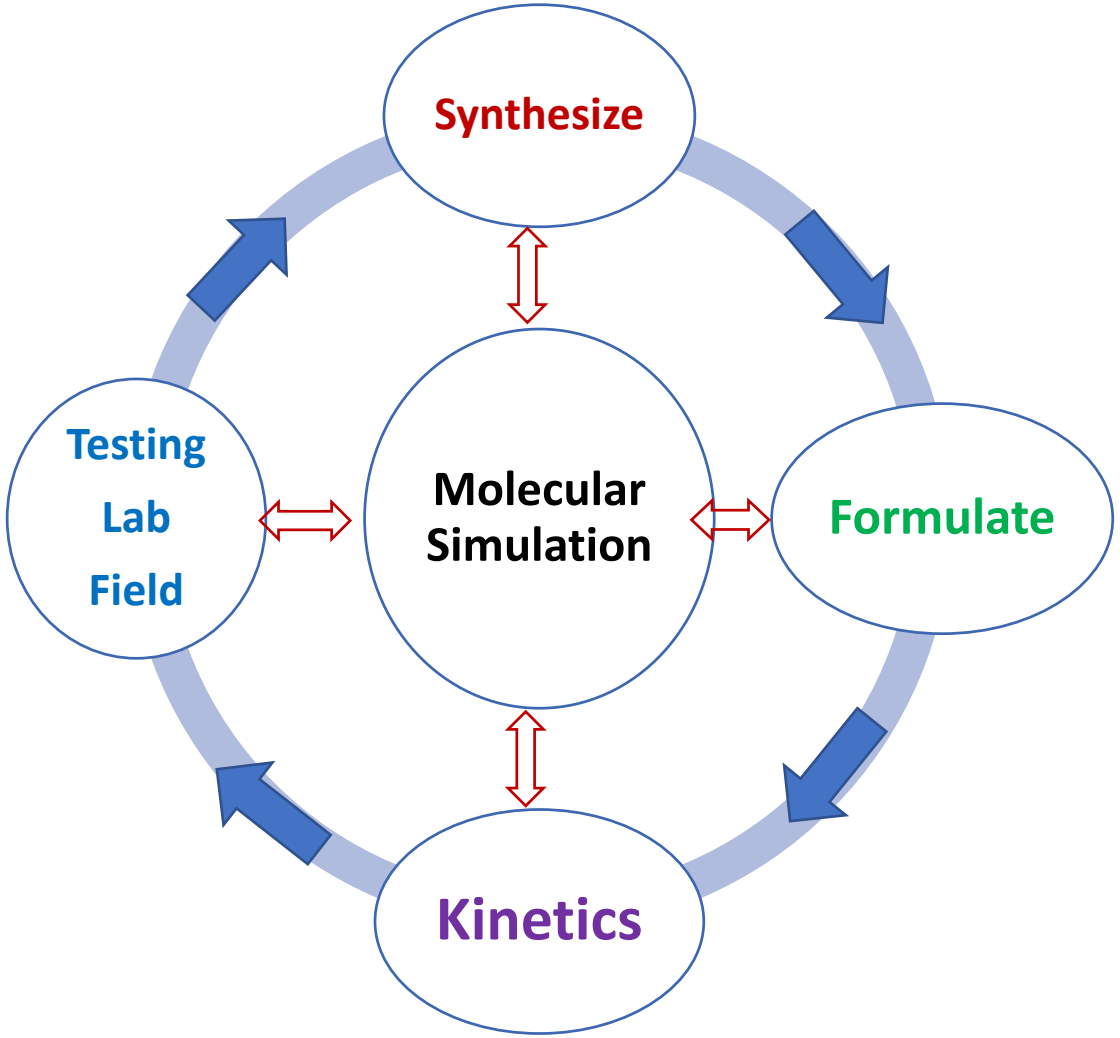
Pyrite

H2S Scavengers



Corrosion Inhibitors

Approach and Methodology



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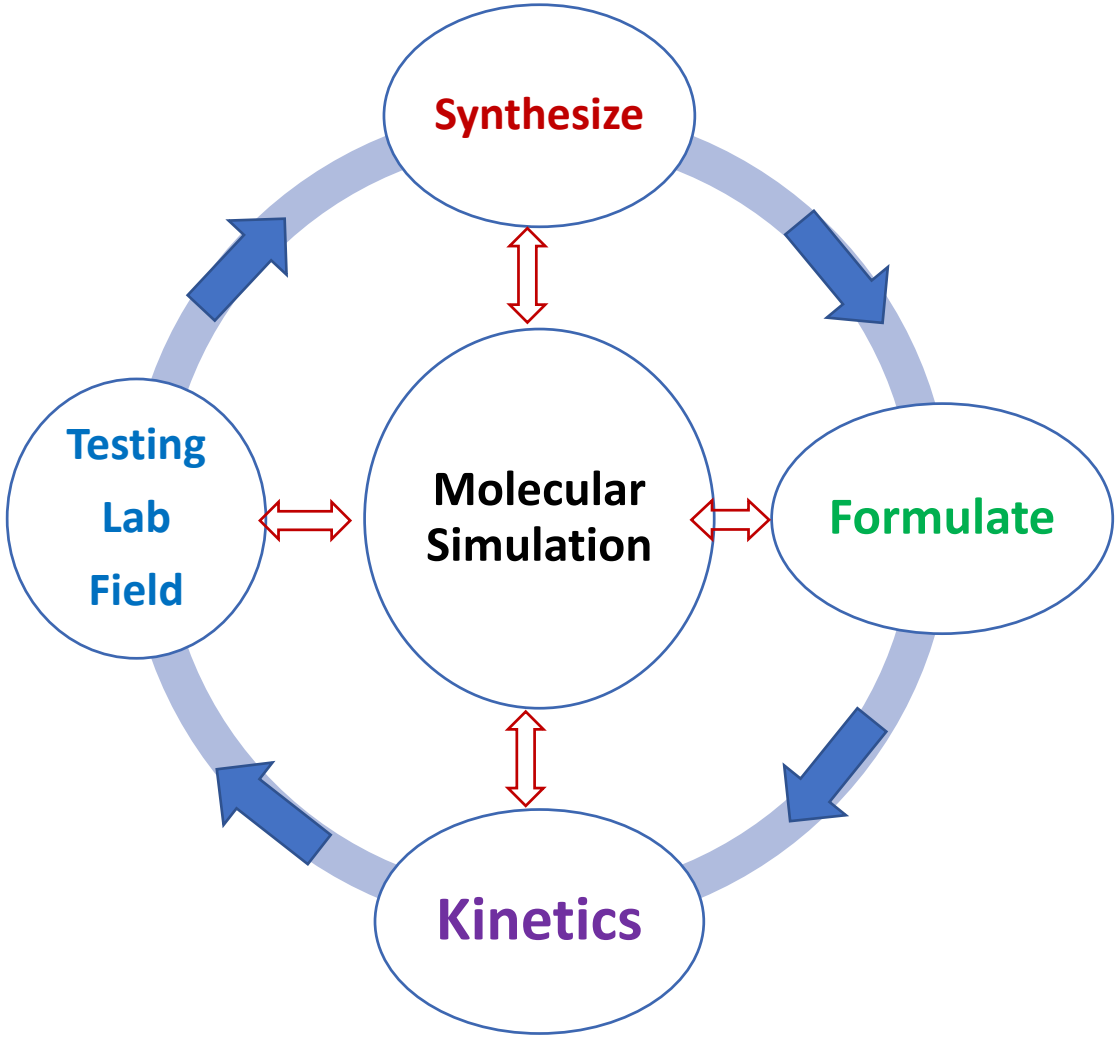

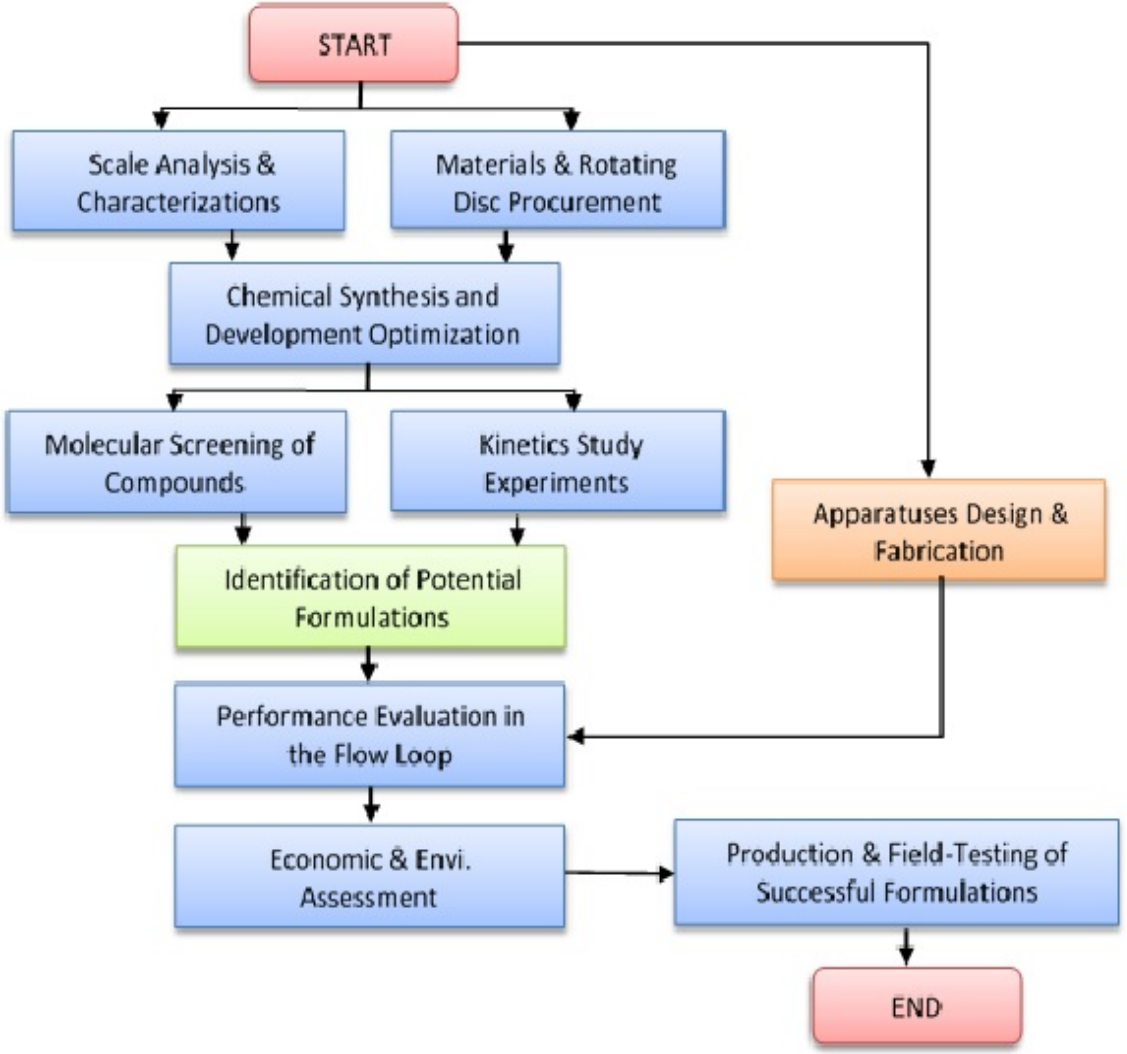

Anticipated Outcomes

- **Direct:**
  - ✓ viable, effective, and cost-efficient formulations
  - ✓ A scale type and characteristics database for the Bakken and Three Forks formations will be built using XRD, XRF, and SEM techniques.

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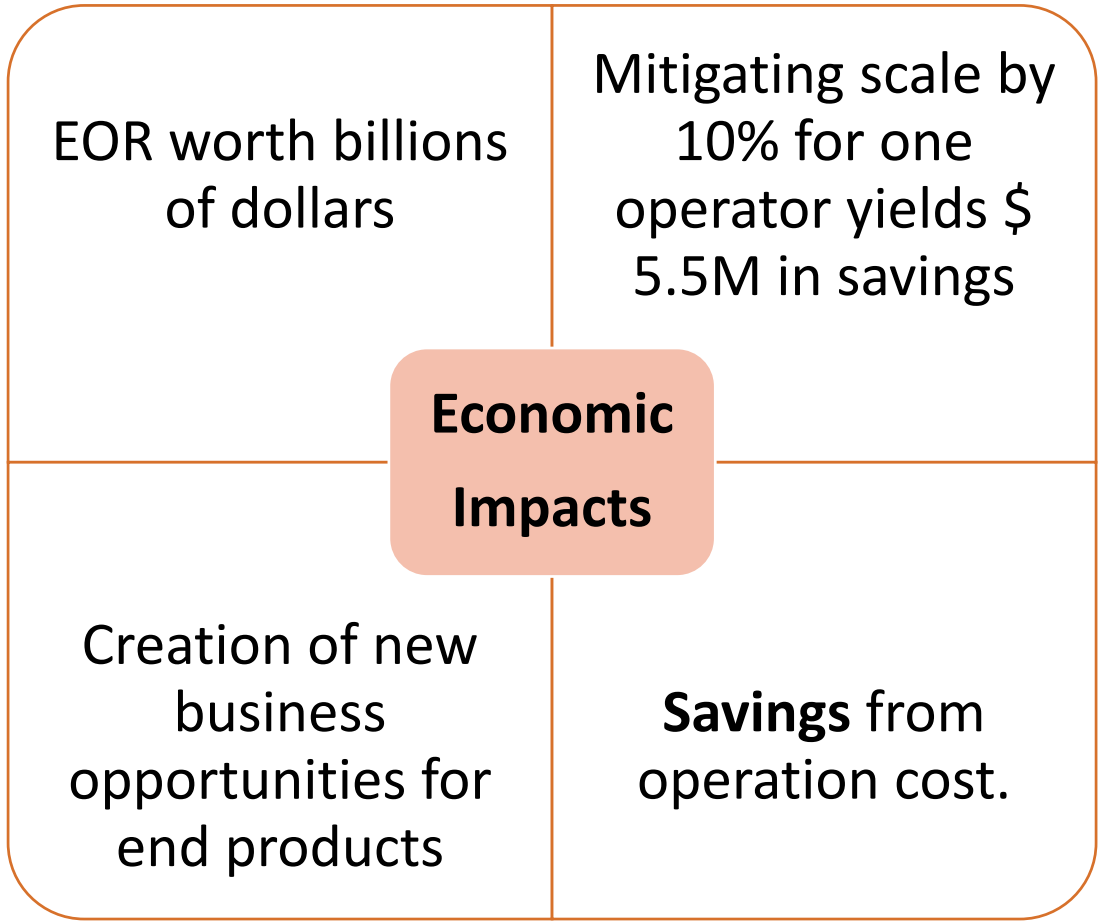
- **Indirect:**
  - ✓ Enhanced oil recovery
  - ✓ Prolonged reservoir life
  - ✓ Lower operation and maintenance costs
  - ✓ Sustainable solutions
  - ✓ Environmental altruism

Ultimate Economic and Technological Impacts



Ultimate Economic and Technological Impacts

Economic Impacts

EOR worth billions of dollars

Mitigating scale by 10% for one operator yields $ 5.5M in savings

Creation of new business opportunities for end products

Savings from operation cost.

Technological Impacts

Application of grafted polymers is relatively **new**.

Reducing **environmental** concerns related to the disposal of produced water (PW)

A revolutionary technology for the oil and gas industry will be created

Improvements to the **scale control procedures and protocols** currently employed by oil and gas companies

Response to Reviewers Comments

Reviewer Comment	Response
"While a short project management plan is provided in the application, it should be more detailed and structured to insure communication takes place throughout the team involved and that adjustments and modifications to the management plan can take place in a timely and efficient manner when needed"	Agreed. The intent in the proposal was to present a **short but concise plan**. Key elements of the management plan were spread throughout the proposal within tables in the detailed work packages (WPs) . The PI intends to consolidate these elements into a stand-alone, comprehensive project management plan (PMP).
"Purchase of equipment is a very small portion of the project cost"	Yes! Only one critical piece of equipment that is NOT readily available (DSL) was requested.

Questions?