

Mobilizing the world's minds and resources to improve environmental performance.



## Finding steam additives for SAGD performance improvement

<b>SOLUTION DESCRIPTION:</b>  Novel steam additives designed to optimize thermal recovery processes.	<b>INNOVATION OPPORTUNITY CHAMPION:</b>  COSIA's members have identified 'de-risking steam additives for SAGD performance improvement research priority', which if realized, would help reduce the amount of steam needed per barrel of oil produced.
<b>CREATED: (April, 2022)</b>  All project proposals are evaluated and actioned as they are received.	
<p>For more information on this COSIA Innovation Opportunity please visit</p> <p><a href="http://www.cosia.ca/innovation-opportunities/greenhouse-gases">www.cosia.ca/innovation-opportunities/greenhouse-gases</a></p>	

**SUBMIT YOUR IDEA [HERE](#)**

Canada's Oil Sands Innovation Alliance (COSIA) accelerates the pace of environmental performance improvement in Canada's oil sands through collaborative action and innovation. COSIA Members represent more than 90 per cent of oil sands production. We bring together innovators and leading thinkers from industry, government, academia and the wider public to identify and advance new transformative technologies. Innovation Opportunities are one way we articulate an actionable innovation need, bringing global innovation capacity to bear on global environmental challenges.



## FINDING STEAM ADDITIVES FOR SAGD PERFORMANCE IMPROVEMENT

### WHAT TO SUBMIT TO COSIA

COSIA requires sufficient non-confidential, non-proprietary information to properly evaluate the technology.

Some items that will be especially important to present in your submission are:

- Technical justification for the approach (e.g. laboratory batch or continuous experiments; pilot or demo plants; process modeling; literature precedent)
- IP status of your proposed technology

### FUNDING, FINANCIALS, AND INTELLECTUAL PROPERTY

COSIA Members are committed to identifying emerging technologies, while protecting the Intellectual Property (IP) rights of the owner of the technology.

### HOW TO SUBMIT TO COSIA

Submit a summary of your solution using COSIA's Environmental Technology Assessment Portal (ETAP) Process, available at:

<https://cosia.ca/focus-areas/e-tap>

Please note: ETAP is a staged submission process. The initial submission requires only a brief description and limited technical information. Upon review by COSIA, additional information may be requested. Instructions for submission are provided on the ETAP site. All information provided is non-confidential. COSIA will respond to all submissions.

### THE ASK

Based on this Innovation Opportunity, COSIA participants are looking for steam additives from chemical suppliers, researchers, and innovators that have shown potential to improve thermal recovery (operating conditions of 1000 kPa - 3500 kPa, 185degC - 240degC). The additives will be included in a testing program using defined and confidential laboratory screening methodology that would help the SAGD operators understand the possible benefits and applicability for a field trial and potential commercial application in the future. Preliminary laboratory test data and proposed mechanism of action for the different additives will be valuable prior to starting the screening phase. Primary objective of this initial ask is to assemble

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a list of possible steam additives that could work under SAGD conditions, establish their expected working mechanism, and define a path forward for laboratory screening.

### PROBLEM STATEMENT

Uncertainties based on several unsubstantiated assumptions limit the commercial deployment of steam additives in steam assisted gravity drainage (SAGD) operations. These uncertainties include:

1. The formation of emulsions in the reservoir. Do emulsions actually form in a SAGD chamber, and if so, what type are they? Is there a benefit from reversing this type of emulsion?
2. Interfacial Tension (IFT) reduction. Compared to IFT at SAGD conditions,
  - a. Can IFT be further reduced? and
  - b. Are there oil rate or residual oil benefits to further IFT reduction?
3. The state of wettability in a steam swept zone and the ability of additives to alter that state.
4. Thermal stability of the injected chemical over extended durations.
5. The ability of chemical additives to transport to the steam chamber condensation front and affect the emulsion properties during/after condensation.

The new technology could either be in development or commercially available and currently applied in other sectors.

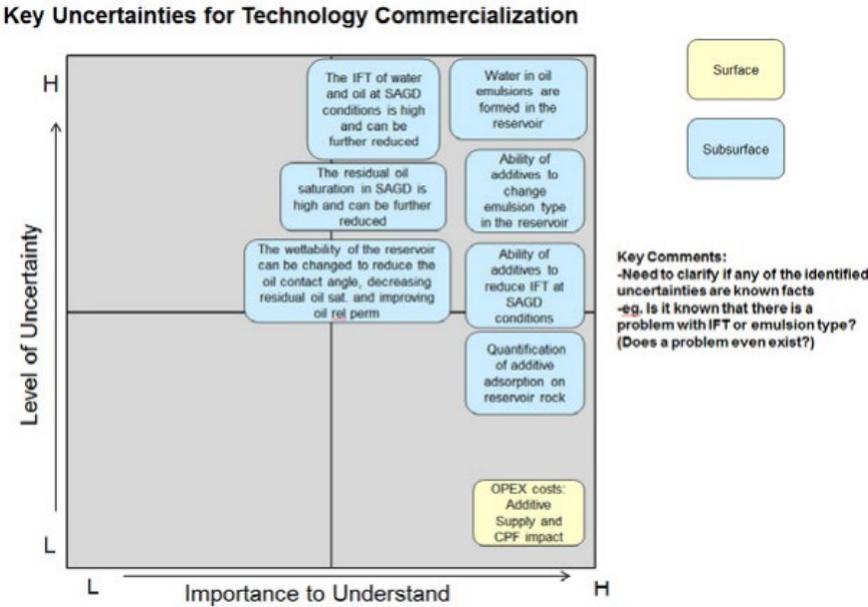
Material and energy flow diagrams for a standard 33,000 BPD Steam-Assisted Gravity Drainage (SAGD) facility are provided below.

### BACKGROUND

Steam additives for SAGD performance improvement have been evaluated with varying levels of success. Laboratory tests in core floods, steam soaks, and glass chip floods have shown upwards of 30% improvement in recovery efficiency. Despite promising lab results, field trial results for steam additives co-injection in SAGD operations have been inconclusive; hence, they have not been commercialized for SAGD. Small scale laboratory tests such as steam soak and core floods are appropriate to screen the chemicals but lack the ability to replicate real SAGD mechanisms (gravity) and impact on IFT reduction, wettability change, oil-in-water emulsification or viscosity reduction. Physical model experiments with SAGD well configuration and geometrical scaling can be useful in evaluating steam chemical co-injection mechanism, chemical injection timing, and

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performance. The collected data can be upscaled for field predictions. Following a COSIA steam additive workshop, the key uncertainties that prevent commercial deployment of the additives in SAGD operations were identified as below.



During the workshop, it became clear that the industry (operators, research institutes and academia) were not aligned on the problems that need to be solved to enable commercial steam additives applications. There are many assumptions in need of supporting evidence.

**EXPECTED RESULTS**

The expected research outcomes are to reduce the uncertainties in the potential mechanisms related to steam additives performance in SAGD operations. The laboratory experimental program will be designed to:

1. Identifying the physical properties that are targeted for alteration by additives with a justification for doing so.
2. Identifying a target range of operating pressures and temperatures that is beneficial for steam additive applications. Lower pressures and temperatures are an acceptable outcome.

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3. Identify additives in SAGD conditions that meet the following criteria:
  - a. Provide material performance efficiency improvement (>15%) based on scaled/scalable quantitative laboratory experiments
  - b. Low adsorption
  - c. Can be transported to the edge of the steam chamber, unless additive is for increased recovery of residual oil
  - d. Line of sight to low additive cost and commercial application

## CURRENT OR CONTEMPLATED PROJECTS

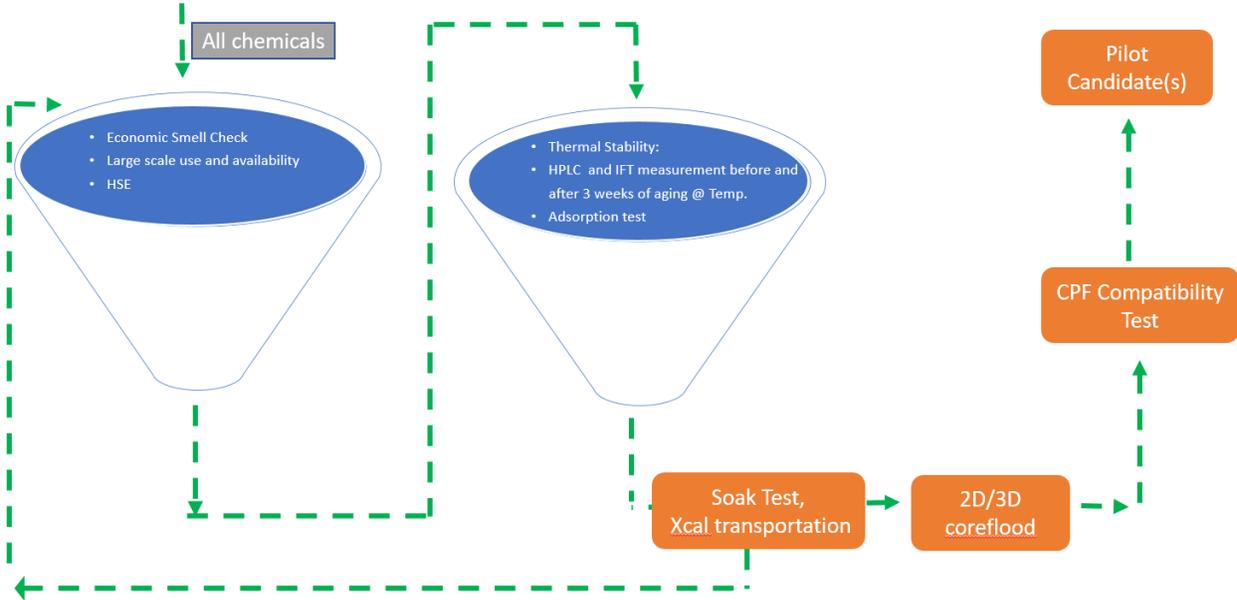
Any or a series of the following projects with a clearly defined path to connect the fundamental outcomes to their end use(s) (e.g. simulation, process design, surface operations):

- Potential steam additives lab test platform to mimic the SAGD process
- Test bed would allow equal comparison of all steam additives of interest
- Requires feedback from academia and commercial labs to determine feasibility
- Measurement of thermal stability (degradation), rock adsorption, IFT and screening related parameters at SAGD conditions
- Effect of additives on emulsion type and properties

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SAGD OPERATORS TESTING WORKFLOW:

To enable the SAGD operators understand the possible benefits and applicability for a field trial and potential commercial application in the future, the identified additives will be included in a testing program using defined and confidential laboratory screening methodology shown below:



Subsequent to thermal stability, IFT, and adsorption testing, the additives will be subjected to Soak test as described below:

SOAK TEST DESCRIPTION

Pre-determined amount of the additive and oil-saturated core will be placed in the set-up vessel under anaerobic condition. The set-up will be maintained at representative SAGD temperature and pressure for a period that may vary from 24 hours to 5 days. The amount of oil extracted from the core during this period will be measured. The oil viscosity, API, TAN, asphaltene, and sulphur content will also be measured pre- and post-extraction.