Backgrounder

Below is a summary of the enhanced oil recovery projects that received Saskatchewan Advantage Innovation Funding (SAIF) approval.

Mapping of In-Reservoir Oil Flow
Project Lead: Petroleum Technology Research Centre (PTRC)

This is the second phase of a multi-phase project designed to develop the technology needed to map the flow of oil in reservoirs, particularly those that have been subjected to the extraction process known as Cold Heavy Oil Production with Sand (CHOPS) that has been widely used in Saskatchewan's heavy oil fields. CHOPS involves the deliberate production of sand along with the oil it contains. Since after seven or eight years of production, wells produce mainly water rather than oil, it is theorized that channels (worm holes) have been created that become a preferential path for the recovery fluids (water) resulting in the recovery fluids no longer coming into contact with the oil that remains in the formation. Being able to map wormholes will allow:

- Placement of new in-fill wells that avoid intersecting wormholes to access oil that is not on the wormhole path; and
- Improved design of new enhanced oil recovery technologies.

<u>Deliverables in this project include:</u>

- Field injection and transmission of blank motes to better understand transmission probability in relation to mote size;
- Field injection of imaging sensors and/or florescent blank motes and retrieval of optical data and/or RFID data to acquire geometric information of wormhole entrances in the wellbore area to increase understanding of mote diffusion;
- Data on the transmission of sound through wormholes and its translation into wormhole characteristics (geometry, porosity, presence of different fluids);
- Flow loop testing to determine position resolution and accuracy based on inertial navigation;
- Assessment of the feasibility to use ultrasound transducers in mote geometries to provide in-reservoir ultrasound imaging;
- Evaluation of motes capable of logging temperature and pressure as a function of time via their use in field injection experiments; and
- A report compiling the findings of the work undertaken, conclusions regarding the feasibility of using motes to map wormholes and their structural characteristics and the identification of future steps required to commercialize the technology.

Radio Frequency (RF) Heating EOR
Project Lead: Petroleum Technology Research Centre (PTRC)
SAIF support is for Phase one of a two-phase project designed to assess the potential of RF Heating as an Enhanced Oil Recovery technology in Saskatchewan's heavy oil. RF heating technology holds considerable potential for volumetrically heating heavy oil formations and mobilizing hydrocarbons. RF heating works by volumetrically exciting bipolar molecules and instantaneously heating a volume. This technology holds promise for reservoir heating due to both its instantaneous properties, and the ability to reach out many meters. Deliverables in Phase one include:

- Reservoir model analysis and report;
- Mechanical concepts conceptual design presentation package;
- Antenna conceptual design including results of modeling and simulation;
- Product development baseline;
- Business model based on single well economic model; and
- Report including analysis and recommendations regarding proceeding to Phase two, field demonstration.

Microbially-Generated Biosurfactants for Heavy Oil EOR
Project Lead: Dycor Technologies Ltd.
The project will focus on the stimulation of naturally-occurring biosurfactant producing microbes, and testing of those biosurfactants in heavy oil reservoirs to enhance petroleum oil recovery (EOR) in the Lloydminster area. The project is the initial project within an iterative program of developing a biosurfactant approach to heavy oil enhanced recovery. This project will:

- Isolate and identify biosurfactant-producing microbes indigenous to the reservoir from samples taken from a range of wells in the reservoir;
- Conduct trials to optimize nutrient mixtures to maximize indigenous production of surfactants;
- Conduct trials to investigate effectiveness of surface-grown biosurfactants;
- Conduct testing to determine impact of introducing a foreign bacteria or non-indigenously produced biosurfactant into the reservoir;
- Subject resulting biosurfactants to modeling and bench-testing to determine characteristics (interfacial tension, PVT fluid analysis, sandpack and coreflood studies) to test the effectiveness of the surfactant in model reservoir conditions;
- Assess the performance of the best surfactants for scale-up and use in field test in heavy oil reservoir;
- Deliver those biosurfactants found meeting the criteria for success in the field to an index client in the Saskatchewan oilpatch for field testing; and
- Compile findings into a report.

Oil Cut Meter Development
Project Lead: Dycor Technologies Ltd.

This project will address a challenge faced by most producers of conventional oil – that of being able to cost effectively measure the amount of oil produced at the well head. As wells mature they produce less and less oil and more and more water. The majority of conventional wells produce fluids that contain less than 5 per cent oil – with some producing 100 per cent water and no oil. Removing the "water producers" saves the production and water handling costs associated with those wells and frees battery capacity to take on suspended wells that were taken offline in times of lower prices.

The project will develop and test a meter that will address the wide variety of conditions that it will encounter in the field. Collaborators in the project, including Dycor, ESI Environmental Sensors Inc. and the Saskatchewan Research Council's Pipeline Flow Test Facility will build and test sub-system prototypes and the assembled product during the development process with actual oil and water samples from an index client in Saskatchewan's oilpatch, with varied API, density, temperature, chemical composition, and presence of sand or entrained air.

The project will deliver an instrument capable of measuring the amount of oil in the fluid produced at each well. Key steps in the development include:

- Sensor design;
- Drive circuit design;
- Mechanical system design;
- Pipeline Flow Test Facility test runs through its various iterations
- Field trials with prototypes that will be very similar to the final product as it will be manufactured commercially; and
- A report describing the instrument developed and its capabilities relative to the design parameters including its ultimate cost to the user.