PETROBANK
ENERGY AND RESOURCES LTD.

FREQUENTLY ASKED QUESTIONS (FAQ'S)
ABOUT THE THAI™ TECHNOLOGY

Q: What is THAI™?

A: THAI™ is a revolutionary combustion technology for the in-situ recovery of bitumen and heavy oil that combines a vertical air injection well with a horizontal production well. THAI™ integrates existing proven technologies and provides the opportunity to create a step change in the development of heavy oil resources globally. Petrobank owns all the intellectual property rights associated with the THAI™ technology.

Q: How does THAI™ compared to SAGD (Steam Assisted Gravity Drainage)?

A: THAI™ offers many potential advantages over SAGD, including higher resource recovery (70–80) percent of the original oil-in-place, lower production and capital costs (one horizontal well and no water treating and handling), minimal usage of natural gas and fresh water, a partially upgraded crude oil product, reduced diluent requirements for transportation, and significantly lower greenhouse gas emissions. The THAI™ process also has potential to operate in reservoirs that are lower in pressure, containing more shale, lower in quality, thinner and deeper than SAGD.

Q: Why is Petrobank the first to try to apply this technology?

A: Petrobank recognized early that THAI™ could be substantially more economical than SAGD because it uses single horizontal wells, does not recycle water and did not depend on low gas prices, and so it acquired the patents to the technology. Unlike larger companies, Petrobank has no sunken investment in SAGD. New technologies are often pioneered by small or medium- sized companies.

Q: What is the nature of the patent protection?

A: The technology has been patented in Canada, the United States and Venezuela and has been scrutinized for validity and enforceability. A crucial new World Patent has been filed which will cover 120 countries. A number of other patents are in preparation, establishing a 'Patent Pipeline'. Third parties could not use the technology without establishing a business arrangement with the patent holder. Another major asset for Petrobank is the know-how gained in the engineering design of the pilot, and the know-how that will be obtained through the start-up and operation of the pilot.

Q: Conventional Fireflooding (CFF) using vertical wells has been tested in the past and generally has not been economic. Why is the THAI™ process different?

A: CFF, with only vertical wells, cannot be applied in a virgin Athabasca reservoir because the bitumen is immobile. In reservoirs with mobile oil, the CFF flow is laterally between the wells, which accentuates the hetrogeneity of bedding planes and undermines control of oil and gas flow, causing low oil recovery. THAI™ operates with oil drainage vertically, taking advantage of gravity. The application of horizontal wells allows the combustion process to be applied in a "short distance displacement" mode. The resulting geometry overcomes the primary limitations of conventional in situ combustion in much the same way that SAGD overcame the limitations of steam drive using vertical wells.

Q: What are the major risks in the pilot?

A: 1. Air breakthrough - Laboratory physical modeling and extensive reservoir simulation have consistently indicated that air breakthrough will not occur at the pilot conditions. The twin control levers of air rate and production rate will serve to control the combustion process. An additional level of protection is the subject of patenting.

A: 2. Excess temperature - The engineering design provides safety well beyond predicted temperatures. The pilot is extensively instrumented to monitor temperatures continuously. Steam will be available to moderate any temperature excursions.

A: 3. Corrosion - There will be no liquid water present under reservoir conditions, however high temperature steam, trace oxygen and acid gases will be present. As with SAGD and refinery operations, metallurgical testing will be conducted to select optimal downhole and surface equipment.

Q: How do you start combustion?

A: As with SAGD, both well bores are preheated with steam to initiate oil mobility. Upon injection of air, spontaneous ignition of heated oil will occur. Athabasca oil is extremely reactive as demonstrated in numerous laboratory fire-tube tests and field pilots. The ability to initiate combustion is a proven process.

Q: How do you know the oil will burn over the horizontal well and not in a different direction?

A: All reservoir fluids (liquids & gases) move in response to pressure gradients created by injection and production operations. Injected air will move toward the pressure sink created by the removal of fluids from the horizontal well. The flow streamlines will always be between the injector and the producer and the air (and hence combustion front) will have to follow the streamlines. In the case of Athabasca bitumen, the cold immobile oil outside the heated mobile oil zone acts like a container along with the cap and bottom rock.

Q: How will the well bore be designed to deal with sand production and the potential for plugging/erosion?

A: Sand screens or slots will be designed for minimal sand production and the well will be drilled at a low angle to minimize erosion at the turn. Oil will coat the well bore base in any event and moderate sand erosion. Plugging is not expected to be a problem as no fluids or sand will accumulate in the well bore because of high gas and oil velocity. Coiled tubing will be installed for plug removal.

Q: How will the pumping system be designed to handle Combustion Gas with high temperatures and a high gas/oil ratio?

A: Gas lift will be provided by the high gas-oil ratio. Also, water will be in the gas phase and contribute to lift. No pumps will be required.

Q: How does water or shale breaks impact the process?

A: Water legs are not expected to have an adverse effect as high temperatures are expected to vaporize the water. Shale lenses will be desiccated by the high combustion temperatures and will not provide a flow barrier.

Q: How is the produced water handled?

A: Because we don't inject steam, water rates in THAI™ are low- only 10% of those for SAGD. Also there will be no need to purify the water for re-use. Unlike SAGD, the high heat (plus 400°C) generated by the THAI™ process "flashes" most of the reservoir water producing low-salinity water. Produced water is expected to be of industrial quality after standard biological treatment to remove organics. Because of the low volumes involved in the THAI™ pilot, produced water will be sent to a disposal well.

Q: What is the effect of top/bottom water or gas?

A: In energy- input processes such as SAGD, top gas and bottom water act as thief zones consuming energy and therefore increasing operating costs. Because the THAI™ process is internally exothermic and produces much more heat than is required for oil recovery alone, these thief zone losses do not significantly impact the economics.

Q: What is the impact of Greenhouse Gas emissions?

A: The THAI™ process is more Kyoto friendly. Natural gas is not burned to produce steam therefore CO_2 emissions are lower. Heat from produced fluids and combusted solution gas can be used for power generation, replacing power generated from coal. Less energy is required to pipeline the upgraded oil without added diluent. The high-energy process of refinery coking will not be needed, further reducing emissions.

Q: Are there any reservoir characteristics that are crucial for success?

A: As in other vertical drainage processes, vertical permeability is important. Because much of the drainage process in THAI™ operates in the gas phase, we anticipate that THAI™ will be less impacted by reduced vertical permeability than SAGD. Otherwise the technology is very flexible, and in contrast to SAGD, can be applied to deep heavy oil reservoirs, thinner sands and to lighter oils.

Q: Can THAI™ be used in non oil sands reservoirs?

A: Conventional in-situ combustion has been tried in medium gravity reservoirs with some success to increase overall recovery factors. We anticipate that the added control and elevated withdrawal rates achievable with the use of horizontal wells could prove to be very beneficial. Successful physical model runs have been achieved on oils as light as 30° API and also on steam-flooded sands with permeability over 1-Darcy.

Q: Are there depth limitations to the process?

A: In steam injection projects like SAGD, condensation of the steam under high pressure and wellbore heat losses significantly impact the economic viability of the project for all but shallow reservoirs. Because the heat is created in-situ with THAI™, the process can be applied to much deeper reservoirs. Of course, temperature rises with depth and therefore many deep heavy oil reservoirs already benefit from significant in–situ viscosity reduction, but we anticipate that THAI™ could still be used effectively in these reservoirs to raise overall recovery levels and provide the other THAI™ benefits.

Q: Outside of Canada, where could you see this technology being applied?

A: There are vast amounts of heavy oil internationally where the THAI™ technology could be applied. In particular, the technology has been patented in Venezuela, which is estimated to contain 1.2 trillion barrels of bitumen and heavy oil reserves alone. In contrast to SAGD, THAI™ could be utilized in deep heavy oil reservoirs both onshore and offshore.

Q: How much air needs to be injected? Is this a big cost?

A: The expected air/oil ratio is 1,500 m^3 air/m^3 oil or 8.4 mscf/bbl. The energy for this is well below the energy required to generate high- pressure steam in the SAGD process. Although energy from hot combustion fluids will not be harnessed in the pilot, there is ample energy available to drive the air compressors and make the process energy-self-sufficient.

Q: Does a Conventional Fireflood (CFF) yield upgraded oil quality?

A: Upgrading is at a low level in CFF because sustained temperatures over 400°C are not achieved. Low oxygen flux causes low-temperature oxidation and fingering causes rapid quenching of the combustion gas. Upgraded products are not removed continuously in CFF. They are dispersed in the crude oil or are burned. Some upgrading is sometimes seen in the late stages of CFF.

Q: What operating practices do you have in place to maintain oxygen flux at the burn front and what will be done to restart the process in the event of a production or injection failure?

A: Because the shape of the combustion front is constant after the start-up period, oxygen flux depends only on air injection rate. We operate in the high temperature oxidation mode. Restart would not be a problem because the oil will auto-ignite.

Q: What are the produced gases and how will they be handled?

A: 79% Nitrogen with 15% CO_2, 1% CO, 5% CH_4 and a trace of H_2S. It will be scrubbed for removal of traces of H_2S and vented.

Q: What are the typical reservoir parameters used to model the THAI™ process?

A: The typical THAI™ reservoir parameters are:

- Oil Saturation = 80% assumed, but the process could be used at saturation levels as low as 50%.
- Oil Quality = 8° API or greater.
- Oil Viscosity At Reservoir Temp. = <250,000 cP.
- Vertical Permeability > 0.5 D.
- Net pay = >10m
- Shale Content = No continuous lenses, but shale breaks are not expected to be problematic
- Clay Content = clay is beneficial to catalyze cracking upgrading reactions.
- Thief Zones = not expected to be problematic

Q: What are the typical operation parameters for a 500m long horizontal well and 500m deep bitumen reservoir?

A:
- Fluid Temperatures at bottom hole: 200-300°C
- BHP: 4000 kPa
- Water Rate: 27 m3/d
- Peak Oil Rate: 100 m3/d
- GOR: 1500
- Water Cut: 21%