

Third Meeting of the Heavy Oil Working Group
Thursday, April 19, 2012
Presidente Intercontinental México
México DF, México

Overview

The Heavy Oil Working Group was launched in April 2010 at the Energy and Climate Partnership of the Americas Ministerial in Washington, D.C. This Group brings together regional partners from the Americas to share experiences with heavy oil, provide updates on the current state of technology, and discuss other areas of mutual interest, such as environmental and policy issues involved with heavy oil development.

The third meeting of the Heavy Oil Working Group was held on Thursday, April 19 in Mexico City, Mexico. The meeting included participants from government, academia and other organizations from Brazil, Colombia, Mexico, Trinidad and Tobago, the United States and Canada.

Marc D'Iorio, Director General of the Office of Energy Research and Development, Natural Resources Canada and Eduardo Camero Godinez, Director General of Exploration and Exploitation of Hydrocarbons from the Secretaría de Energía, México provided opening remarks to begin the meeting. Both emphasized the importance of a forum for dialogue on heavy oil issues that could identify the challenges and opportunities for the sector as well as seek solutions. The importance of energy security, environment, regulation and monitoring were all touched upon.

The meeting was moderated by Dr. Guillermo Domínguez Vargas and Dr. Edgar Rangel German of the Mexican National Hydrocarbons Commission. The meeting included a combination of presentations, question and answer periods and breakout sessions to foster discussion on particular issues.

Introductory Presentation – Heavy Oil Outlook 2012

Enrique Sira, Senior Director Research, Latin America at IHS CERA (Cambridge Energy Research Associates) provided an overview of the current state of the heavy oil industry and outlook for 2012. Mr. Sira spoke about the main challenges in heavy oil in Latin America and what new technologies could potentially help overcome these challenges and unlock commercial value.

Mr. Sira noted the enormous potential of heavy oil in the Americas, particularly amongst the Andean countries. While the resources are present, the main challenge facing the region is how to develop those resources, taking into account:

- Technology development
- Managing environmental impacts
- Capital costs and investment

- Fiscal terms/regulations –e.g. Ecuador and Venezuela don't have good fiscal terms to generate interest in the development of these
- Prices

Mr. Sira touched on the situation in countries such as Colombia, Venezuela, Ecuador, Canada and Peru, noting that technology development will be particularly crucial to unlock reserves that were previously unreachable. Reserves will not run out as long as technology keeps advancing. As producing and upgrading heavy oil can consume a significant amount of natural gas, involve the use of large quantities of water and lead to higher GHG emissions, Technological advances will be key to managing these issues.

Progressive fiscal regimes will also lead to more development of heavy oil resources. Countries such as Peru and Colombia have “progressive” fiscal regimes as opposed to countries such as Ecuador, where companies have to pay a lot to develop fields where there is a high level of risk. Conversely, in Peru, the government does not charge royalties until the company's internal rate of return (IRR) is positive. As the company's IRR grows, the country's royalties also grow. Finding skilled labour was identified as a challenge in Canada, and a number of other jurisdictions.

Breakout Sessions

Following the introductory presentation, the meeting had two breakout sessions where participants split into three small groups that brainstormed and discussed certain issues. The findings of these breakout sessions were then presented to the larger group. These sessions were intended to draw from the perspectives of the participants to:

- Gain a greater understanding of how each country is affected by these issues
- Exchange ideas based on experiences
- Generate discussion on specific issues and potential solutions to these issues

Breakout Session 1 – Current Operating Environment

Group 1: The potential effects of fuel quality regulations on the heavy oil industry in Latin America

During the discussion among the group, three foci emerged as central to heavy oil as it intersects with environmental concerns:

- 1) build-out of refining capacity with the capability to run very sour crudes while meeting ultra low sulfur fuel standards
- 2) the adoption of low carbon fuel standards in export markets
- 3) upstream environmental issues which raise problems with local stakeholders, particularly water usage and disposal.

Refinery upgrades

It was the general sense among the participants that adapting local refining capacity to deal with heavy sour crudes would not be a major impediment to the development of heavy oil projects. Specific comments discussed included:

- Lower sulfur standards for gasoline and diesel are being adopted across Latin America, with Colombia implementing its 15 PPM low sulfur standard by 2014.
- Capital allocations for construction of expanded refining capacity meeting the new standards are in place and fully funded.
- The costs of building out this capacity are already reflected in the wide grade discounts for heavy sour crudes.
- The current pattern of “round tripping,” in which heavy sour crudes from Latin America flow into US Gulf Coast refineries and a substantial amount of gasoline and diesel is exported back to those same countries may be interrupted by Latin America’s increasing self-sufficiency in refining.

Low Carbon Fuel Standards (LCFS)

There was general agreement among the participants that the adoption of fuel standards which make a well-to-tailpipe evaluation of the crude streams used to produce fuels would not be a substantial impediment to development. While the European Union (EU) and California have adopted systems which could pose disadvantages to the competitiveness of heavy oil in those markets based on how they evaluate carbon emissions from the upstream, there does not seem to be a high probability that this will be implemented globally. There are a number of other markets in which this type of evaluation is not performed. The group touched on the need for fair and science-based evaluation prior to the implementation of fuel standards. In particular, the US Gulf Coast will remain a key market for heavy oil from Mexico and Colombia, and is not likely to be affected by carbons constraints. Improvements in production technologies are reducing emissions and will continue to reduce the carbon footprints of heavy oil development.

Water Production and Disposal / Stakeholder Relations

It was broadly agreed among the participants that the biggest environmental challenge to heavy oil development is from water issues – competition for water with other users, proper disposal of produced water, and the perception of local communities that the industry is failing to deal with these issues adequately. Specific areas of discussion included:

- Permitting lead times are a major challenge in Colombia. Local communities, including indigenous groups, are often distrustful of the industry and fearful of the potential consequences of heavy oil development, to a much greater degree than is warranted.
- There is definitely a need to reduce the water consumption of production technologies.
- Proper disposal of produced water is critical, and in some cases the industry has failed to do so. The track record is improving and needs to continue to improve.

Group 2: Identifying common challenges for heavy oil development in the Americas

Group 2 discussed the political, financial and environmental challenges in the Americas. Of importance on the political side are the challenges associated with disruptions caused by changes in government (i.e. elections/ new government administrations, changes in leadership) as well as the openness of jurisdictions to pilot projects and the capacity/willingness to fund them.

Group 2 stressed the need to develop key performance indicators that are sustainable regardless of political uncertainty, and to take advantage of synergies between countries. While on one level, many of the countries in the Heavy Oil Working Group are competitors, they also face common issues, and could work more closely to facilitate pilot projects that would benefit everyone.

On the economic side, the main issues were identified as: government budgetary constraints, large upfront capital costs, the need for long-term investment, tax/royalties structures, competition for skilled labour and experienced workers, differing training and certification standards among jurisdictions, and propriety of technology.

In terms of environment, members of this breakout session discussed the need to have a standardized approach to lifecycle analysis (LCA) to ensure that projects can be fairly compared across jurisdictions. Global standardization to inform discussions and calculate/manage risk was also raised as a key issue for energy efficiency and eco-efficiency.

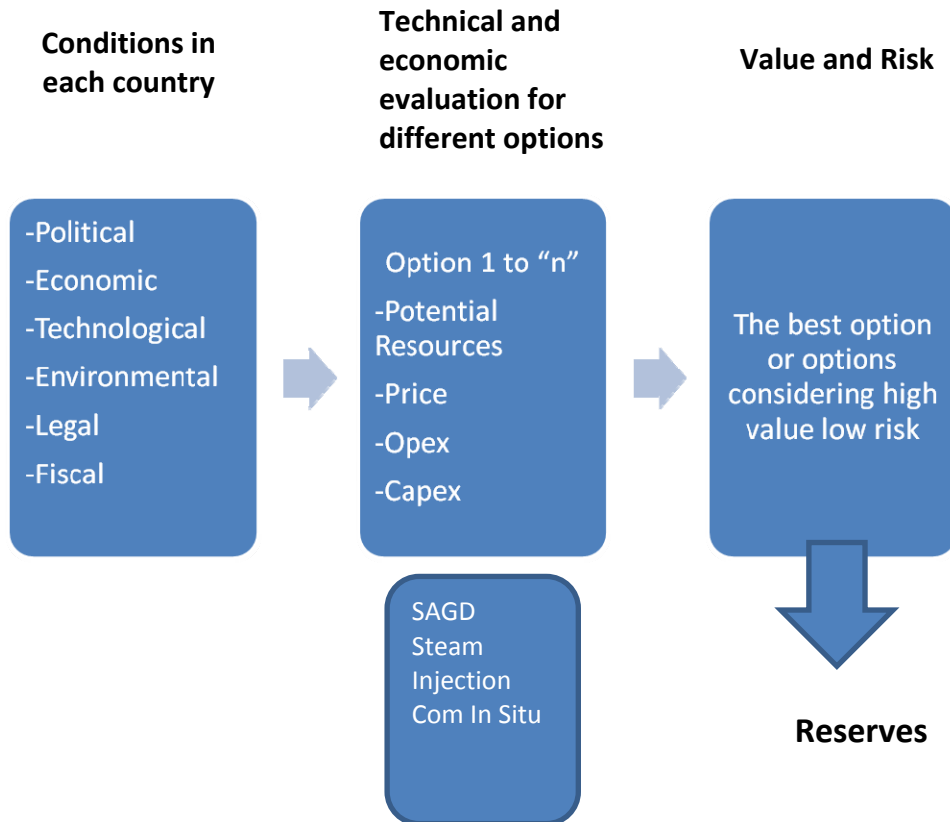
On the social side, the main challenge identified was fostering good relationships between producers and various stakeholders, such as local communities.

Group 3: Current reserves vs. resource potential

Group 3 discussed the need for a clear process to value reserves so that all resources are evaluated, but not overestimated. The geology of a reserve is important in order to have a solid knowledge base from which to work.

Group 3 used the following method to discuss how to move potential resources to certified reserves, and noted the importance of being realistic when evaluating the potential of technologically recoverable reserves.

Reserves vs. Potential resources
General Process to Evaluate Options
Resources → Reserves



Technology is related to resource potential; as certain new technologies are applied, the amount that can be technically recovered from a reserve increases. In order to certify reserves, countries should follow a stringent process which includes undertaking studies, modeling and then developing fields with proven technologies.

Breakout Session 2 – Focus on Technology

Group 1: How to get the right cooperation along the chain – moving technology from discovery to scale-up

Group 1 discussed that in order to get the right cooperation along the chain, there needs to be collaboration and integration between operators and service providers. Specific research and development programs, for example amongst companies, could help to tackle a particular problem and ensure that knowledge is shared. This would also help companies that are committed to improving their processes gain a comparative advantage in the market. Knowledge sharing while balancing intellectual property rights was also noted as key.

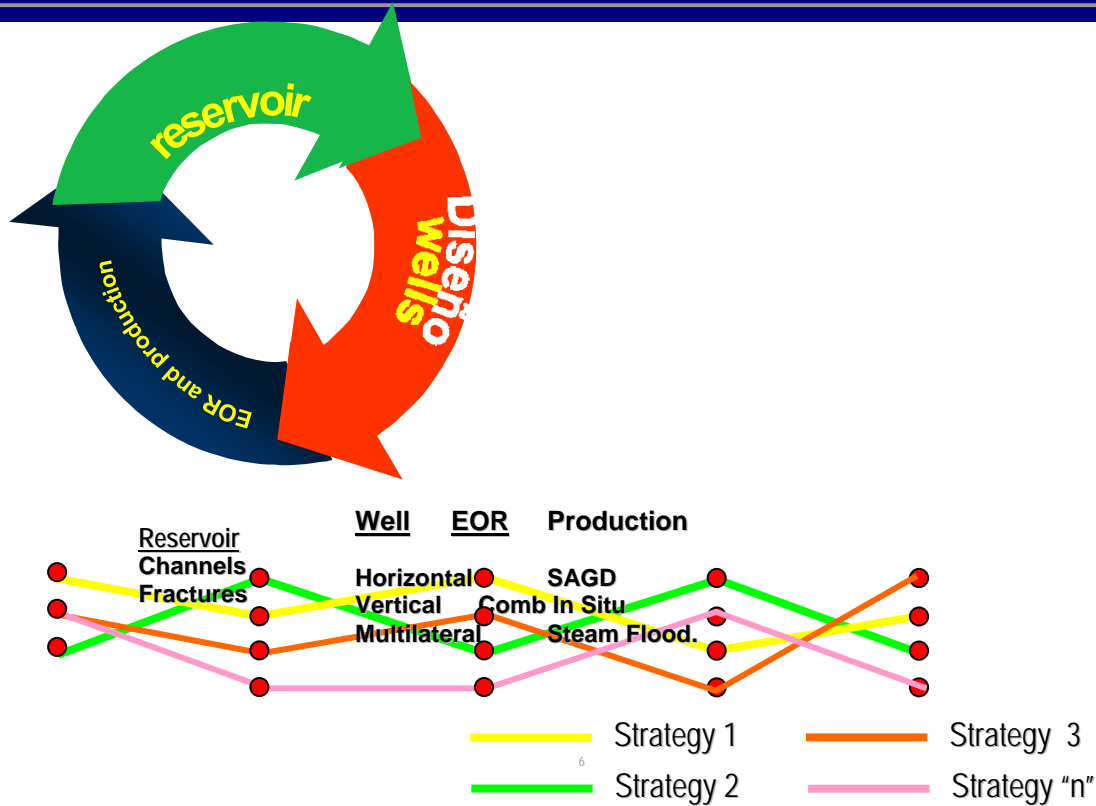
All countries noted that developing capital, including human capital, would be integral to the success of technologies. These are long-term commitments, and there need to be incentives in place to encourage technology development at all stages of the value chain.

Group 2: Evaluation of Heavy Oil Technologies/Criteria for selecting the best technology

Once again, knowing the technical composition of the reserves and the geology were pointed out as the first requirements for selecting the best technology. Having an advanced knowledge of the reserve will help dictate the technology that is most appropriate for the conditions. The environment surrounding the reserve (land, water), access to water, synergy with nearby reserves and temperature also play a role. Projects should seek to “do it right the first time”, and thoroughly evaluate the reserve before selecting the technology. Energy management should also be taken into account, including how technologies can use heat and not waste it.

Group 2 used the following diagram while discussing how to select the best technology. Reservoir characteristics affect well design, which in turn play a role in the production method selected to maximize recovery of heavy oil resources.

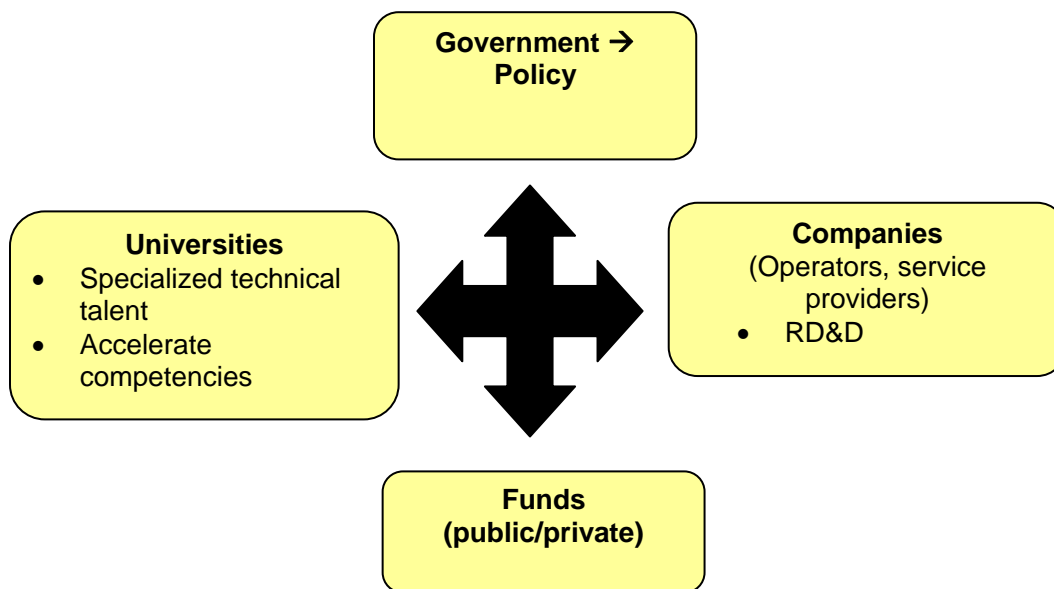
Technical Options and Strategies to Develop Heavy Oil Fields



Who does the evaluation of which technology to select varies in different jurisdictions, between governments, business and other stakeholders. Group 2 emphasized that technology evaluation should also take into account other holistic factors such as impact on local communities and the environment.

Additionally, the group discussed the role that different stakeholders play in developing heavy oil technologies, noting that governments set the general policy direction, but are influenced by other entities. Universities play a critical role, as do companies, and the existence of specialized funds targeted at fomenting technology development.

Role of Stakeholders in Technology Development



Group 3: Technology development in the context of environmental performance

Group 3 discussed the development of technology in the context of environmental performance, noting that we are all in the same boat – regardless of whether government or business. Both government and business share the responsibility for developing and monetizing key environmental performance indicators as well as for developing economic incentive mechanisms.

There was the acknowledgement that there are longer-term costs associated with not addressing environmental factors, and this should be something that is taken into account at the outset of any activity. In order to fully determine the environmental impact of any heavy oil project, it would be best to standardize an approach to LCA so that impacts could be effectively mitigated. This standardized approach would also be more cost effective, so countries that are implicated in any kind of low-carbon fuel standard would not have to start their debates from

ground zero. An agreed upon LCA model could then be further broken down into upstream, midstream and downstream activities.

Lunch Presentation: Dr. Jose Luis Bashbush, Schlumberger

Dr. Jose Luis Bashbush provided an overview of heavy oil in the region, as well as specific research that Schlumberger is undertaking in the field of heavy oil. Schlumberger has research, manufacturing and technology centres around the world. Dr. Bashbush described the heavy oil value chain and various enabling technologies to improve productivity that Schlumberger has developed to “make the unconventional, conventional”. Dr. Bashbush noted that Schlumberger currently invests more than \$2.5 million/day in research. They recognize the importance of understanding the different qualities of crude in the hemisphere, and demonstrated this by asking a number of countries in Latin America for a barrel of their heavy oil. Schlumberger then undertook studies based on these samples from different countries in order to properly characterize and understand the unique properties of heavy crude from different jurisdictions.

Schlumberger has been preparing for years to help obtain the right information to reduce uncertainty of the decisions, to study and select viable alternatives to optimize production and to undertake properly planned pilots for the development of heavy oil reserves.

Focus on Pilot Projects

During this session, participants discussed a number of pilot projects in their jurisdictions.

Ing. Rafael Pérez Herrera, Operational Design Coordinator, Samaria Luna, PEMEX Production and Exploration described an alternate steam injection project in the Samaria field, which had the objective of extracting heavy and extra heavy reserves from deposits. The field was developed in four stages, beginning in the 1960s. The year 2007 marked the reactivation of the development of the field, where production was eventually increased from 500bpd to 14,000 bpd. The steam injection pilot project, which was undertaken for two years, proved effective and helped PEMEX gain valuable experience. About 2 mmb of extra heavy oil was recovered in the two years of the pilot through alternating steam stimulation. Mr. Perez noted that understanding the distribution of the steam is one of the challenges to increasing the recovery rates, and described the importance of collecting information for the static and dynamic characterization of heavy oil deposits, in order to minimize risks in the execution of pilot projects.

Dr. Raffie Hosein, Senior Lecturer, University of the West Indies, Trinidad and Tobago described various methods of heavy oil production that have been undertaken in Trinidad and Tobago. Trinidad and Tobago has tar sand reserves of 2.5 billion barrels of oil; however the complex geology of these reserves makes it difficult and costly to extract resources. The reserves vary in depth from surface to less than 500 feet, making it impossible to apply vapour extraction (Vapex) and steam assisted gravity drainage (SAGD) methods. Trinidad and Tobago has done small-scale lab experiments using solvent extraction, electrical heating and microwave heating.

They found that using solvent extraction they could recover 21% by weight percentage, however there are associated costs and environmental and health impacts. Using electrical heating for different periods of time and at varying power, they were able to recover 14.5% by weight percentage. Extraction by electrical heating is not currently economical, so they are currently experimenting with extracting oil from tar sand samples using microwave heating.

Michael Layer, Senior Program Manager, Canmet Energy described work that he is undertaking with colleagues in Mexico and Colombia regarding nationally appropriate mitigation actions (NAMAs) in the oil and gas sector. NAMAs are country specific emission reduction measures intended to identify verifiable mitigation actions and facilitate successful access to financing under international climate change agreements. Mr. Layer's program has received \$3 million in funding to develop strategies in collaboration with PEMEX and Ecopetrol. Mr. Layer noted that they will be piloting several methodologies with fast start funds and encouraged Heavy Oil Working Group participants to be aware of the serious opportunity for resources based on new climate change funding mechanisms.

Tiago Pitchon Sampaio, Petroleum Engineer, Petrobras gave an overview of the complementary development of Siri Reservoir, which is in the conceptual phase. The Bandejo field was discovered in 1975; however the Siri reservoir was not initially tested because there was no interest in heavy oil. A pilot production system was proposed in 2004, and put into place in 2008. There are a number of challenges associated with the reservoir, including water injection, reservoir pressure, and the need to improve the efficiency of well acidizing. Petrobras aims to have a definitive production system for the Siri reservoir in place by 2015.

Conclusion and Next Steps

Focus of the next meeting

Participants discussed a number of potential topics for the next meeting, including:

- Designing the "perfect pilot project"
- Increasing multinational cooperation on heavy oil
- Labour issues associated with heavy oil – how to develop human capital
- Heavy oil production in off-shore fields
- Proposal for "progressive" regulation for heavy and extra-heavy oil projects
- Links between financing and environment for heavy oil projects
- Pilot projects update/Presentation of upstream and downstream heavy and extra-heavy oil projects that are underway in Latin America
- Difficulties associated with the execution of pilot projects
- Transportation issues
- Upgrading/refining issues
- Potential joint projects
- Mechanisms for exchange of information and knowledge
- Enhanced oil recovery methods

Potential dates of the next meeting

Participants discussed a number of potential dates for the next meeting of the Heavy Oil Working Group:

- Before the Colombia Expo Oil and Gas – Monday, October 29, 2012
- On the margins of the SPE Heavy Oil Event in Bucaramanga, Colombia – Tuesday, October 9, 2012
- At the next Heavy Oil Latin America (HOLA) conference in early 2013, location TBC
- National Buyers/Sellers forum February 2013

The date is currently under consideration and will be confirmed in due course.