The Future of Heavy Oil: Opportunities for Canadian Expertise

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ABSTRACT

A consensus is slowly emerging that the production level of conventional oil in the world will peak in the next few years (2005 – 2015). Continued dependence on oil as a transportation fuel, >90% of oil is used in transportation, will require more and more heavy oil and bitumen development. At present, the fraction of world oil production from deposits with an in situ viscosity greater than 50 cP has just passed the 10% mark (i.e. on the order of 8 – 10 MBOD).[1] This fraction will increase inexorably for the foreseeable future, with a number of consequences:

- a long-term world sulfur glut because of the high S content of viscous crude oils;
- increased environmental concern over CO_2 in the atmosphere because of the less favorable C:H ratio in viscous crudes, compared to lighter oils;
- greater concern over waste management for materials such as
    - oily sand-clay tailings (from oil sands extraction),
    - coke (from upgrading operations),
    - CO_2 (from upgraders and thermal processes, for sequestration),
    - produced sand (from CHOPS),
    - process water (recycling for oil extraction and SAGD operations).

Production technologies used for heavy and extra-heavy oil will largely be those developed or emerging in Canada: cold production using horizontal wells and multi-laterals, CHOPS (Cold Heavy Oil Production with Sand), SAGD (with many variats), horizontal well cyclic steam stimulation (HWCS), pressure pulse flow enhancement. Because these technologies were developed largely in Canada and continue to be perfected in Canadian conditions, there exist substantial opportunities for Canadian expertise around the world. Along with Canadian expertise, Canadian investment in off-shore heavy oil and oil sand properties and partnering in projects will be a natural consequence.

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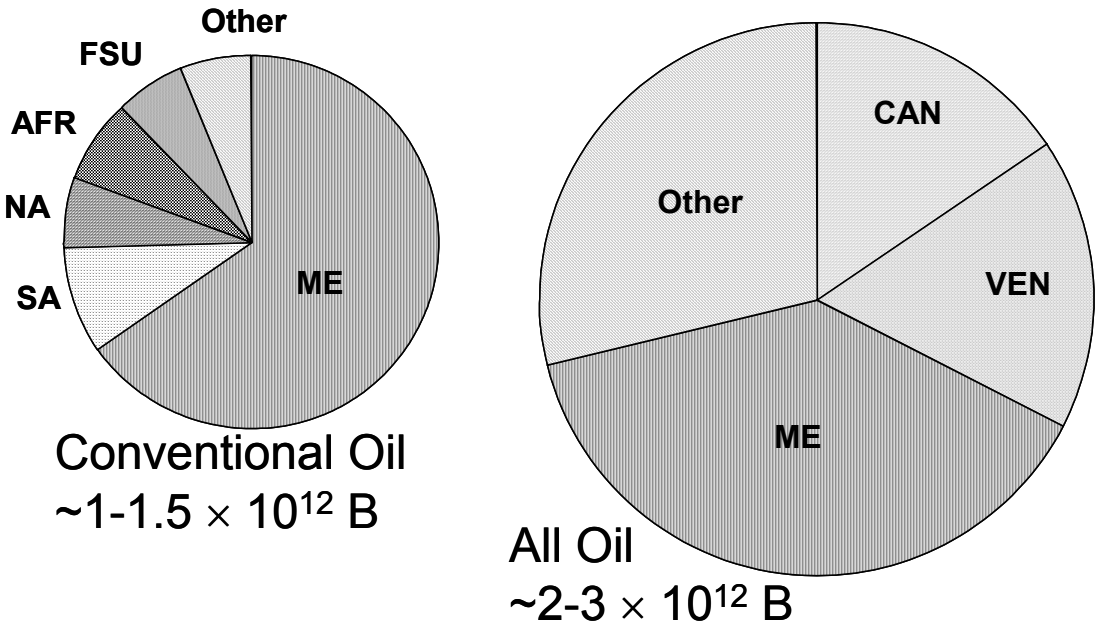
[1] Different jurisdictions use different definitions for “heavy oil”, often based on a specific value of the API gravity (20° or 25°). A more rational criterion is the “produceability” of the oil, which is expressed in part by the viscosity under in situ conditions (with the original solution gas present in the oil). The writer prefers a definition as follows: conventional and intermediate oil is less than 50 cP, heavy oil is between 50 and 10,000 cP in situ, and bitumen has an in situviscosity > 10,000 cP under in situ conditions.

Worldwide, there are on the order of 10-13$\times 10^{12}$ B of liquid petroleum in place, excluding kerogen in oil shale, natural gas and coal. About 25% of this is conventional oil (<50 cP) of which 1-1.5$\times 10^{12}$ B is likely to be economically and technically recoverable. Of the remaining 7-10$\times 10^{12}$ B of heavy and extra-heavy oil, it is likely that 1-2$\times 10^{12}$ B will be recoverable. These numbers are sketched in the Figure, with 0.2$\times 10^{12}$ B economical viscous oil resources, as yet poor delineated, allocated to the Middle East (ME). (SA: South America, NA: North America, AFR: Africa, FSU: Former Soviet Union).



Clearly, the impact of Canadian and Venezuelan viscous oil resources will have a dominant effect in approximately 40-50 years at current consumption rates, barring catastrophic events. The top five oil producers in 2050 are likely to be Saudi Arabia, Iraq, Venezuela, Canada and Russia, each producing between 5 and 8 MBOD.

Several years ago, the IEA published estimates for extra-heavy oil (>10,000 cP), shown in this Table (>10,000 cP, heavy oil not included).

Table 1 Extra-Heavy Oil And Natural Bitumen Resources And Production

	Resources in Place End-2000 (Bn Barrels)	Ultimately Recoverable Reserves End-2000 (Bn Barrels)	2001 Production (B/D)
Canada	1,630	310	654,000
Venezuela	1,200	270	310,000
Russia	1,350	N/A	-
Kazakhstan	80	N/A	-
US	40	N/A	-
Madagascar	21	N/A	-
Total	**4,291**	**N/A**	**964,000**

Source: IEA web site.

Recently, several sources have allocated Venezuela and Canada each approximately 300×10^9 B (current world oil consumption is ~29 BBO/yr) of economically recoverable reserves with current technology. These numbers will gradually rise, probably by an additional 50%, over the next generation as the new oil production technologies are perfected. Also, there are substantial amounts of heavy oil that go unreported in international resource claims because of disinterest, poor delineation, and so on. A number of other countries in South America, as well as Mexico, China, India, and several Middle East countries have large heavy oil deposits that are currently lightly exploited or unexploited. Offshore heavy oil has tended to be ignored because of perceived production problems, but at least two huge heavy oil offshore deposits, one in the Bohai (shallow water - China), one offshore South America (deep water – Brazil), are in active development phases.

Current Canadian political emphasis in the Federal Government is on increasing energy efficiency and meeting Canadian commitments on CO_2 reduction (the "Kyoto agreement"). Many feel these are laudable goals, and indeed the Province of Alberta is taking the lead role in reducing environmental impact of viscous oil development (visit the AERI website). These efforts have already increased the level of Canadian expertise in areas such as CO_2 sequestration, waste management, and energy-efficient homes to the level of world leaders. Combined with the widely recognized superiority in viscous oil production technologies, these national skills represent an unparalleled business opportunity that industry and academia, as well as provincial and federal governments, should be aggressively marketed around the world. Failure to do so means a lost opportunity, as well as decreased efficiency and increased environmental difficulty worldwide. Most of the big heavy oil problems (waste management, extraction, transportation, upgrading) have been solved by Canadians; the world needs this expertise, and we can benefit economically as well.