

Number of HTGRs Hypothetically Required for Future Canadian Oil Sands Needs

1. Purpose

The purpose of this evaluation is to show how many 500 MWt (conceptual size) High Temperature Gas Reactors (HTGRs) would be needed to provide for the process energy requirements associated with present and future Canadian oil sands extraction plant developments.

2. Method

Reference 1 provided projections of oil recovery production developments in the Canadian oil sands region through 2050. The projections differentiate between open mining of near surface oil sands and “in-situ” recovery of bitumen extracted from deposits below the surface by various processes via drilled wells. Figure 1 predicts the production forecasts based on crash program scenarios (i.e., maximum rates of development).

The barrels per day (bbd) forecasted in Figure 1 were converted into a number of hypothetical reactors that could provide the necessary energy for bitumen recovery. The number of reactors was based on a conceptual 500 MWt HTGR with operational capacity factor of 0.85. This is the same basis that was used for the Reference 2 report which estimated the equivalent HTGRs for all industrial process energy needs. Based on the Reference 2 report, the following conversions were used for equating barrels per day (bbd) of bitumen recovery to required process energy in Megawatts-thermal (MWt):

- For Mining: 600 MWt will yield 100,000 bbd
- For In-Situ: 600 MWt will yield 50,000 bpd, based on a SAGD process (steam actuated gravity drain)

These conversions are rough estimates since the actual conversion rates are influenced by the quality of the oil sands and the steam to oil ratio (SOR) required for each well.

3. Summary

Table 1 shows the results of this evaluation. The prediction of 50 HTGRs for in-situ oil sands recovery in 2020, reported in Reference 2, is reflected by the underlined datum. Key conclusions from Table 1 are as follows:

- a. Total annual thermal energy used for oil sands by 2050 is equivalent to 134 HTGRs.

- b. Total annual thermal energy used only for in-situ applications by 2050 is equivalent to 127 HTGRs.
- c. If the lifetimes of oil sands recovery plants are on the order of 30 years, most of the plants in support of mining will likely be in place by 2020. Further, the HTGR has unique capabilities for high temperature steam that is needed for in-situ applications. Therefore, the higher priority focus for HTGR should be toward in-situ plants.

By considering only the energy requirements for in-situ production starts after 2020, based on expected scheduled availability of HTGR plants, then up to 79 HTGRs could be applied by 2050 to oil sands development (see last column in Table 1).

Year	Mining Projection (M bpd)	Number of 500 MWth Reactors for Mining	In-Situ Projection (M bpd)	Number of 500 MWth Reactors for In-Situ	Number of 500 MWt Reactors for all Energy	Number of Reactors for In-Situ Starting after 2020
2005	<i>0.6</i>	<i>8</i>	<i>0.4</i>	<i>11</i>	<i>19</i>	<i>0</i>
2020	<i>2.3</i>	<i>32</i>	<i>1.7</i>	<i><u>48</u></i>	<i>80</i>	<i>0</i>
2030	<i>2.3</i>	<i>32</i>	<i>2.5</i>	<i>71</i>	<i>103</i>	<i>23</i>
2040	<i>2.3</i>	<i>32</i>	<i>3.5</i>	<i>99</i>	<i>131</i>	<i>51</i>
2050	<i>0.5</i>	<i>7</i>	<i>4.5</i>	<i>127</i>	<i>134</i>	<i>79</i>

Table 1 Number of HTGRs Needed to Provide Energy for Oil Sands Development

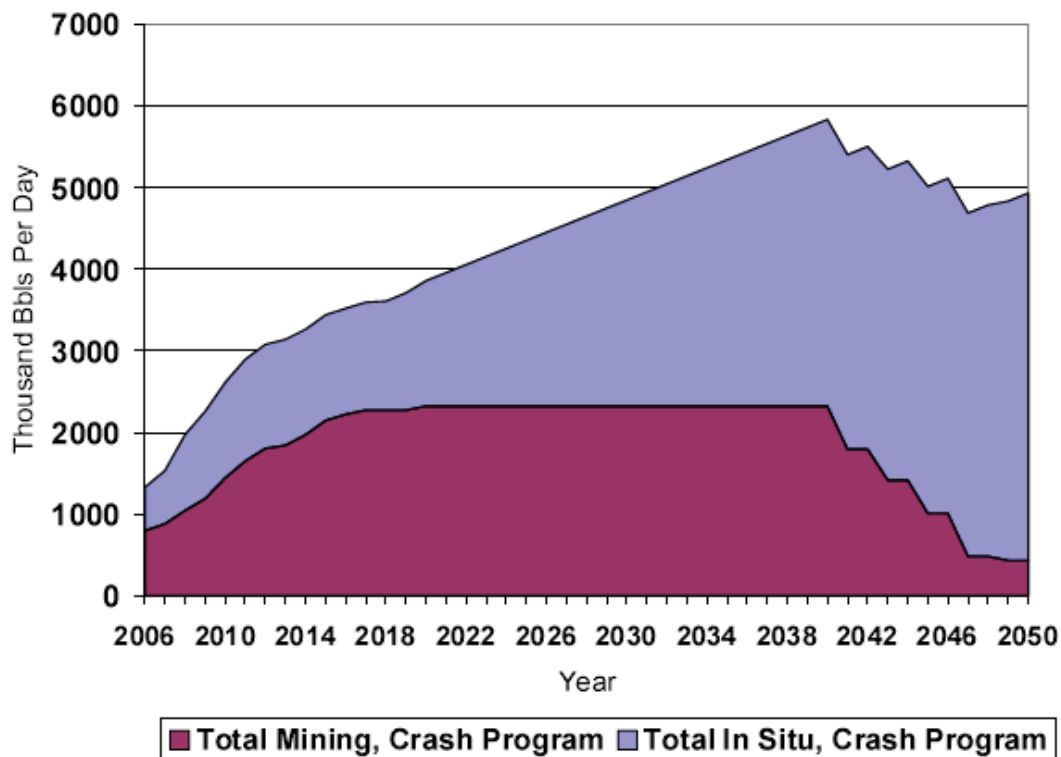


Figure 1: Long Term Oil Sands Crash Program Production Forecast [1]

4. References:

1. B. Söderbergh, F. Robelius and K. Aleklett, "A Crash Program Scenario for the Canadian Oil Sands Industry," June 8, 2006,
<http://www.peakoil.net/uhdsg/20060608EPOSArticlePdf.pdf>
2. Report MPR-3181, "Survey of HTGR Process Energy Applications," Revision 0, May 2, 2008