5.4 **Using nuclear heat for in-situ processing of unconventional hydrocarbons: A case for the high temperature gas reactor**

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The need for reducing carbon footprints and natural gas use has led to a half dozen documented studies assessing the use of hybrid energy systems specifically associated with deploying nuclear energy in the expanding oil sands regions of northwest Alberta. This paper provides a review of these efforts and discusses application of lessons learned to processing oil shale. One conclusion is that, even though a High Temperature Gas Reactor (HTGR) is currently very costly (capital costs are high) and licensing requirements and construction time are expected to be arduous and long (NRC has not completed development of licensing requirements for HTGR's), this reactor design represents the best choice for processing unconventional hydrocarbons (oil sands, oil shale, etc.) found in Canada and the Western U.S. Unlike the HTGR, the more mature reactor designs (i.e., conventional Light Water Reactors) (1) have too large a capacity for a typical in-situ recovery processing facility designed to produce between 30,000 and 80,000 Barrels per Day (BPD), (2) are traditionally designed and optimized to produce only electric power, and (3) are not capable of providing the range of steam temperatures and pressures required to accommodate in-situ recovery requirements of large unconventional hydrocarbons deposits. Mass and energy balances show that nuclear heat from an HTGR provides the best thermodynamic return and cost efficiency for processing unconventional hydrocarbons given the increased tendency to use in situ Steam – Assisted Gravity Drainage (SAGD) method for hydrocarbon recovery. Furthermore, small modular HTGR reactor designs appear to provide advantages with respect to current and projected trends in unconventional hydrocarbon recovery operations.