

Gone Fission...

Alberta on the Threshold of the Nuclear Age

The idea of using nuclear power for oilsands production has long been an intriguing but distant notion. **Duane Pendergast** looks at the economics – and physics – of recently proposed projects, and wonders whether this is an idea whose time has finally come.

A short time ago, Albertans heard much about the idea that nuclear energy might one day produce steam and electricity for the oilsands. The significant upside was the freeing-up of vast quantities of natural gas and the reduction of greenhouse gas emissions. Today, talk has turned to conventional nuclear electricity production to be connected to the grid. Energy Alberta initially proposed the construction of two Canadian CANDU nuclear plants, first at Whitecourt and then near the town of Peace River. AREVA, the French nuclear giant, has also announced an interest in providing generating stations. What brings this change of focus?

Without a doubt, nuclear energy could be integrated right into oilsands production – but not without considerable technical challenges. A March 2007 report, *The Oil Sands: Toward Sustainable Development*, prepared for the federal government by the Standing Committee on Natural Resources, cites, for instance, the difficulty of piping steam over long distances as well as the possibility that current nuclear plants are too big to fit oilsands operations.

The report recommends that “no decision be made on using nuclear energy to extract oil from the tar sands until the repercussions of this process are fully known and understood.” The federal government responded, “It will be industry, working within the framework of provincial laws and regulations, that will determine whether nuclear energy is used to extract oil from the oilsands,” and that “any proposal to build new nuclear power stations in Canada would have to meet all requirements of the Nuclear Safety and Control Act and the Canadian Environmental Assessment Act in addition to relevant

provincial laws, regulations and policies.” This clearly placed the nuclear-energy ball in the provincial court.

The patch needs more power

Given the need to jump extra hurdles to use nuclear energy directly in the oilsands, it is understandable that the focus has changed. Well-known methods to simply produce electricity for sale to customers within and outside the oil industry are a logical first step. Environmental assessment and licensing would be relatively straightforward. It is also no coincidence that the Alberta Electric System Operators projection of a need for a whopping 3800 MW of additional capacity by 2016 fits nicely with proposals for nuclear power plants in Alberta from Bruce Power Alberta, the buyers of Energy Alberta, who are spearheading the development of nuclear energy in the province (see sidebar).

The use of electricity in the oil patch will grow, too. News reports and websites discuss electrical resistance heating to warm hydrocarbon deposits so they can be pumped to the surface. Shell Oil has developed such a process for the Colorado oil shales. Alberta's E-T Energy Ltd. is developing this concept as electrical adapted to oilsands deposits near Fort McMurray. Should they be deployed, these processes could substantially increase the demand for electricity.

Another potential growth area in electricity use could come from initiatives to sequester carbon dioxide underground, as that will require significant energy for compression and pumping. Still, current nuclear electricity plants transfer about two-thirds of the energy they pro-

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duce to cooling water. That energy is thus wasted, and actually can become a water-warming problem. Thus the incentive to directly and more efficiently integrate nuclear energy with oil production processes remains strong.

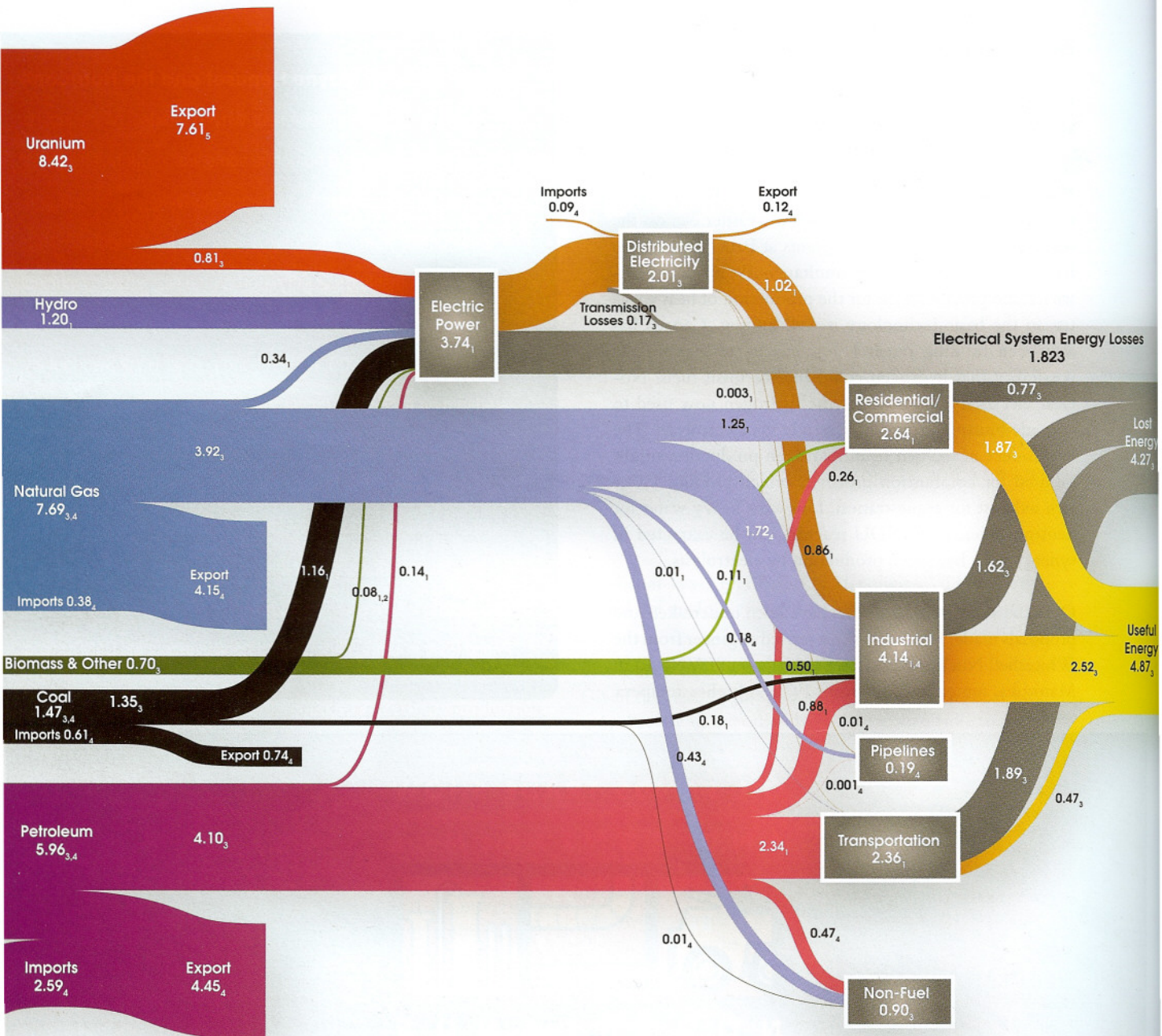
Multiple means of oilsands involvement

Canada's nuclear industry has kept a weather eye on the oilsands for decades. Nuclear plants at Bruce in Ontario have already been used to simultaneously produce electricity and process steam for the production of heavy water, so the basic technology is well known. Canada has also been funding research for decades to explore the possibility that hydrogen could replace fossil fuels. Nuclear electricity can produce the hydrogen now used to upgrade bitumen to synthetic crude via electrolysis. The by-product of oxygen from hydrogen production might be used for combustion processes which produce CO₂-rich exhaust for sequestration. Low-cost heavy water for neutron-efficient CANDU reactors can be extracted in synergy with hydrogen production by electrolysis.

Over the years, several studies have been undertaken and proposals made. Ray Sochaski, a retired engineer from the Whiteshell Nuclear Research Establishment (WNRE) in Manitoba, remembers one from 1976. A higher-tempera-

Energy Alberta: Wayne Huset and the Hurricane

In 2005, Calgary entrepreneur Wayne Huset nearly lost his Florida home to a hurricane some would attribute to global warming. Shortly afterwards, he began studying greenhouse-gas-free nuclear energy, including a review of the Canadian Energy Research Institute's 2003 report on the economics of nuclear energy in the oilsands. This interest quickly spawned Energy Alberta in October, 2005. Huset and partner Hank Swartout entered into an exclusivity agreement with Atomic Energy of Canada to bring Canadian CANDU technology to Alberta. Bruce Power, the operators of the world's second-biggest nuclear generating station in Ontario, saw the wisdom in the Energy Alberta initiative and bought the company late in 2007. Bruce Power Alberta is proceeding with a proposal to build a large nuclear station in the Peace River country, although not necessarily of the CANDU type.



Canada's Energy Flow (Exajoules)

Energy Equivalents

In terms of energy equivalencies, 1 Exajoule (EJ) is equal to:

- 160 million barrels of oil
- energy consumed annually by 15 million average Canadian single detaches homes

- energy produced annually by 14 Pickering-sized nuclear stations operating at normal capacity

- energy produced annually by over 1,400 square kilometres of state-of-the-art solar cells operating under normal conditions, enough to cover the entire Toronto urbanized area

Sources:

- 1) NRCan Energy Handbook - 2005
- 2) Canadian Wind Energy Association
- 3) Calculated Value
- 4) Statistics Canada
- 5) Natural Resources Canada

Graph generated from 2003 data

ture organically cooled reactor was built and operated at WNRE for several years. Ray and his colleagues worked with Alberta Power, now ATCO Electric Limited, to suggest a reactor of that type producing electricity and hot pressurized water in a cogeneration mode near Fort McMurray.

Although Canada's CANDU reactors are a proficient means of producing energy from uranium due to their neutron efficiency, there are smaller reactor types, which might be considered for oilsands production. Hydrogen can be produced from water more efficiently by thermal cracking at higher temperatures than can be achieved with CANDU reactors. Japan and the United States are working to develop high-temperature gas-cooled reactors that can achieve the temperatures needed. Considerable development is needed to bring most of these concepts to commercial use.

Economists, engineers and politicians all weigh in

A study by the Canadian Energy Research Institute five years ago showed that nuclear energy was economic relative to natural gas for the production of steam. The value of oil and natural gas is inexorably increasing over the long term. The developing constraints and costs on carbon dioxide emissions increase the cost of fossil fuels. Albertans can be sure that industry now has economists and engineers feverishly working to establish and evaluate viable, economic and energy-efficient ways to produce and upgrade bitumen from the oilsands.

Canada's political processes have clearly established Alberta as the authority to focus on nuclear energy in the oilsands. On July 7, 2007, Energy Minister Mel Knight announced in the Legislature, in conformity with federal policy, that industry would take the lead in assessing their requirement for Energy and any fit with nuclear energy. At the same time he confirmed that a concept paper on the use of nuclear would be produced and discussed in public, as suggested earlier by Premier Stelmach on May 2, 2007. Knight delivered on that promise on April 23, 2008, by appointing a panel of four experts to prepare the paper by the fall of 2008.


The Alberta Research Council has also announced a science and engineering study. ARC has contracted with

Idaho National Labs in the United States to undertake a joint study of energy options in Alberta. Ian Potter, ARC's Vice-President of Energy, says a study of nuclear energy will be the first project of this collaboration. This is a most welcome initiative. Alberta's people need an independent, objective source of real information on this topic to understand the risks and benefits of nuclear energy. This study promises that.

The case for nuclear energy in Alberta is becoming compelling. Fossil fuel resources are rapidly becoming more

Uranium Royalties

An interesting dichotomy has developed in royalties. Unknown to many, Canadian exports of uranium already provide nearly as much energy as our exports of fossil fuel – and the potential for energy extraction from that uranium exceeds that from fossil fuel by more than 100 times. Despite this huge potential, royalties for uranium are relatively minuscule, and it is unclear whether Canadians will get the most out of this resource over the long term. Nuclear energy can save natural gas and make more upgraded oil available to our international customers. As fossil fuel depletes and uranium plays a bigger energy role, royalty transitions will be needed to ensure Canadians continue to get optimal value from their natural resources.

valuable, and nuclear energy can be used to stretch them, ultimately serving as an alternative. As we continue, I believe it's imperative that nuclear energy play a bigger role. We hear from our governments about Canada becoming an "energy superpower" based on our fossil fuel and uranium resources. Well, some rhetoric can come true. 

Duane Pendergast, PhD, P.Eng is Principal Scientist at Lethbridge-based Computare.