Shalegas, Tight Oil and Bitumen. Unconventional Problems Need a New Approach to Innovation and Technology Development!

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Abstract

Unconventional energy resources such as shalegas and bitumen, while quite different in detailed technical nature, share many similar generic problems. These resources are large in volume but are very difficult to recover, with current generation approaches being incremental developments of approaches developed for more conventional resources. In contrast to conventional oil and gas resources, where the value is in the resource, in unconventional fossil fuel resources, recovery technology is crucial, with the technical ability to characterize the very heterogeneous resource and the design of effective recovery technologies being key. Currently, while the technologies for reservoir characterization and recovery process engineering have advanced greatly in the last decade, large areas of uncertainty remain, especially in understanding the nature of the resource and recovery technologies are dominated by high energy intervention approaches(eg hydraulic fracturing and thermal recovery methods). These developed incrementally from earlier more conventional resource recovery process designs that relied on natural high native fluid mobility to succeed. We review some recent advances in our ability to characterize these complex resources focusing especially on shale resources.

We also look at possible alternate technology routes to more effective unconventional energy recovery that are practical and show low carbon emissions. While many technologies develop incrementally from combinations of earlier component technologies(e.g. SAGD or hydrofracturing) radical technological advances often appear without obvious parents. Thus the LASER, jet engine, RADAR or the polymerase chain reaction(PCR) represent gamechangeing innovations without obvious ancestors. A key component of such game changing technological revolutions is that a substantial innovation effort is underway with many researchers and technologists involved in a technical revolution, seeking large numbers of possible solutions to a problem. This poses a challenge for the energy technology researchers in todays energy companies and universities.

Research and development activities in the energy industry today are a tiny fraction of the activity levels in the 1980's when many of today's recovery technology elements, such as horizontal wells, SAGD and CSS were developed. Industry R&D funding levels today are very low compared to other technology based industries and are comparable to other resource industries where technology is not a major component of activity. Canadian universities similarly have major challenges, with a predominantly undergraduate teaching based funding model that produces few doctoral graduates relative to other OECD countries and

historically, a successful focus on basic research but with little success in technology development despite large government investments. While Canadian universities have been very successful at basic research and training staff for industry and there continue to be many successful industry-university collaborations, published studies indicate university-industry collaborations are less frequent in Canada than in other OECD countries. Surveys suggest industry sees universities primarily as sources of staff but worryingly, not innovation and technology and this is reflected in the type and level of industrial funding seen in many cases. In an era where low carbon energy technologies are urgently needed and where our reservoirs are complex it would appear we need urgent innovation in the very process of carrying out energy R&D as our existing industrial and academic innovation system would appear to have major problems with structural issues on all sides. We examine innovation strategies in other industries and suggest an alternate model of technology development in the energy sector that addresses the need for lower costs, much more rapid technology piloting and development of an effective, fully integrated and properly funded industry-academia-government research enterprise.

Conclusions

Unconventional energy resources, including shalegas, are a challenge for our existing technology streams but also present a grand challenge and ideal opportunity to innovate and renovate Canada's energy innovation system that desperately needs a major overhaul in both its industrial and academic R&D components.

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