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Greenhouse Gas Emission Considerations in Environmental Assessment for Alberta's Oil Sands Projects: Management Plans, Compliance Strategies, and Technology Development

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Abstract: Given the growing importance of climate change as a global issue and the potential to link project planning to the broader management of climate change issues, in 2003, the Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment issued guidance on incorporating climate change considerations in environmental assessment under the provisions of the *Canadian Environmental Assessment Act*. At the provincial level, Alberta, Canada's largest energy producing province, developed the Specified Gas Emitters Regulation (SGER) which requires large emitting facilities to reduce their greenhouse (GHG) emissions intensity by 12 percent. This study examines GHG management plans according to project-level environmental assessments for proposed oil sands projects in Alberta. Management plans are compared with current GHG compliance at regulated facilities across the province under the SGER. The analysis also considers GHG management plans and compliance strategies as a precursor to GHG technology development. Through the SGER's market-based compliance options, technological change is being fostered through near-term investments at regulated and unregulated facilities while long-term investments in transformative technology are occurring through the provincial technology fund.

1.0 Introduction

Alberta is Canada's largest energy producing province accounting for nearly three quarters of all liquid hydrocarbon and natural gas production. Alberta's natural gas and oil reserves make up 55 percent and 98 percent of Canada's total reserves respectively (CAPP, 2011). Of the 3.0 million bbl/d of crude produced in Canada in 2011, 2.1 million bbl/d is produced in Alberta with1.6 million bbl/d of that being derived from oil sands deposits (CAPP, 2012). The province's intensive oil and gas production has helped to make Alberta the largest greenhouse gase (GHG) emitter in Canada with emissions of 234 $MtCO_2e$/year (Environment Canada, 2011).

Given the growing importance of climate change as a global issue and the potential to link project planning to the broader management of climate change issues, in 2003, the Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment (FPTCCCEA) issued guidance on incorporating climate change considerations in environmental assessment under the provisions of the *Canadian Environmental Assessment Act* (FPTCCCEA, 2003). According to the FPTCCCEA, a project's GHG Management Plan should address emissions through established jurisdictional regulations to confirm consistency with requirements and initiatives. In 2007, Alberta became the first jurisdiction in North America to impose legislated targets for reducing emissions from large industrial facilities (Hogg, 2008). Alberta's 2008 Climate Change Strategy committed to a 50 $MtCO_2e$ reduction in GHG emissions by 2010 and a 200 $MtCO_2e$ reduction by 2050 (AENV, 2008). To help achieve this emission reduction goal, the Specified Gas Emitters Regulation (SGER) required large emitting facilities (i.e. those that emit more than 100,000 tCO_2e/year) across various sectors to reduce their GHG emissions intensity by 12 percent, as of July 1, 2007 (Province of Alberta, 2007). Emissions intensity, under the Alberta *Climate Change and Emissions Management Act* (Province of Alberta, 2003), is defined as the quantity of GHGs released by a facility per unit of production. For example, the unit of production for a Steam Assisted Gravity Drainage (SAGD) oil sands facility is tCO_2e/bbl bitumen produced.

Recognizing that market-based mechanisms are considered to be a more flexible and cost-effective management policy than command-and-control regulations (IMF, 2012), the SGER gives regulated facilities four choices to meet their GHG compliance target (Kollmuss et al. 2010):

- Reduce emissions by improving facility operations;
- Use banked Emission Performance Credits (EPCs) from previous years in which a facility exceeds its compliance obligation or purchase EPCs from other regulated facilities that have exceeded their compliance targets;
- Purchase Alberta-based offset credits from emission reduction activities that occur at non-regulated facilities;
- Contribute $15/$tCO_2e$ to the Climate Change and Emissions Management Fund (CCEMF).

2.0 Approach

The purpose of the study is to examine GHG management plans according to project EIAs for proposed oil sands projects in Alberta and compare this with current GHG compliance at regulated facilities across the province under the SGER. The analysis will also consider GHG management plans and compliance strategies as a precursor to GHG technology development.

The focus of this analysis is limited to project GHG emission and mitigation considerations and not climate change impact considerations or adaptation strategies. Integrated Applications for oil sands projects were examined to determined project-level GHG considerations. Integrated Applications combine information required under the *Oil Sands Conservation Act* (OSCA) (Province of Alberta, 2000a), the *Water Act* (Province of Alberta, 2000b) and the Alberta *Environmental Protection and Enhancement Act* (EPEA) (Province of Alberta, 2000c). Oil sands projects where an EIA had been submitted to the Environmental Assessment Director for review as of February 2013 were analyzed (AENV, 2013a). Where project EIAs had undergone technical review and Supplemental Information Requests (SIRs) had been issued, only the projects' Integrated Applications were reviewed.

3.0 Results

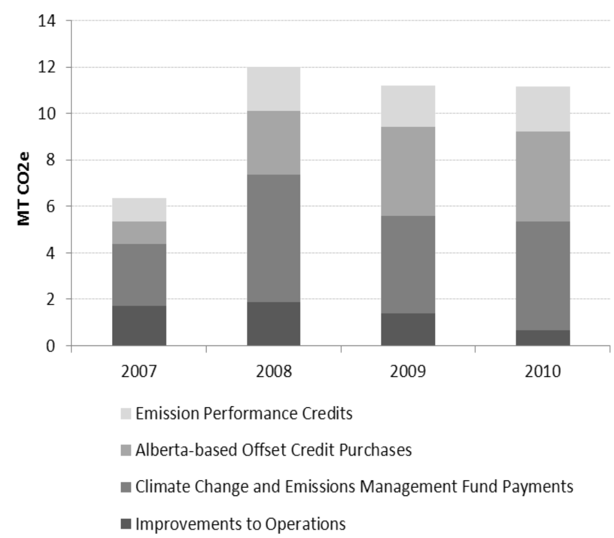
3.1 GHG Management Plans

Oil sands projects currently undergoing EIA (AENV, 2013b) were analyzed according to emission considerations and GHG management plans (see Table 1). Emission considerations include operation emissions on an annual basis, the projected GHG intensity of the product produced, and the contribution of project GHG emissions to the emission inventories of both Alberta and Canada. In most cases, the relative contribution of project emissions were calculated against jurisdictional GHG inventories from the latest National Inventory Report (UNFCC, 2012) at time of EIA submission. Aspects of GHG management plans that were compared for projects include: mitigation strategy, CCS (carbon capture and storage) implementation considerations, and use of market-based mechanisms for compliance. Mitigation strategy was limited to items explicitly stated under the relevant project development section or air quality assessment of the EIA. Related activities that may result from project technology (e.g. solvent use in recovery, cogeneration, or energy efficiency) that were included under other sections of the EIA were not included in the analysis.

3.2 GHG Compliance Strategies

In order to compare GHG management plans with current GHG mitigation at regulated facilities, SGER compliance information was analyzed (AENV, 2011). From the inception of the program in July 2007 to the end of 2010, facilities regulated under the SGER have used the CCEMF for 42 percent of all emissions over the program's 12 percent intensity reduction target. Improvements to operations combined with EPCs accounts for 30 percent of facility's compliance. Offset credits are the least used compliance option accounting for 28 percent of facility compliance (see Figure 1). This equals emission reductions of 16.99, 11.44, 6.64, and 5.67 MtCO_2e from the CCEMF, EPCs, offsets, and improvements to operations respectively since the program began. For the 2010 compliance year, CCEMF payments and offsets accounted for 4.67 and 3.86 MtCO_2e of facilities' emission reduction obligations respectively. EPCs accounted for 1.96 MtCO_2e and improvements to operations accounted for 0.68 MtCO_2e of 2010 system-wide compliance.

Figure 1 - Compliance results under Alberta's Specified Gas Emitters Regulation for 2007-2010 for large final emitters



Note: 2007 represents half-year compliance as the regulation came into effect July 1, 2007
Publically available information: http://environment.alberta.ca/01838.html

3.3 GHG Technology Development

Emission mitigation options under project GHG management plans focus on technology options that are commercially available. In the near to medium term, the SGER offers regulated facilities compliance flexibility in the form of market-based mechanisms to meet their compliance obligations. While Alberta-based offset credits focus on technological innovations outside of the regulated sector, and EPCs are generated within the regulated sector, both options provide facilities with a price signal to invest in GHG emission projects (AENV, 2012). Over the long-term, industry investments through the CCEMF will act as a catalyst for the development and deployment of clean technology (CCEMC, 2012a).

Technology development is often characterized by two polarized views about the innovation process: "technology push" and "market pull" (Grubb, 2005). The "technology push" view holds that GHG mitigation should focus on development of technologies through publicly funded R&D programs as opposed to regulatory emission thresholds. The "market pull" view is that technology deployment best occurs

Table 1 – GHG emission considerations and management plans for oil sands projects undergoing environmental assessment

Project Information			Emission Considerations			GHG Management Plan		
Proponent	Project	Production Capacity (bbl/d)	Annual Operation GHG Emissions (Mt CO_2e/y)	Projected GHG intensity (kg CO_2e/bbl)	Emissions contribution to Alberta & Canada	Mitigation Strategy	CCS Implementation	Planned use of market-based mechanisms
BlackPearl Resources Inc.	Blackrod Commercial SAGD	80,000	1.999	68	0.85% & 0.29%	1. Implement technology; 2. Consider recovery process improvements; 3. Control fugitive emissions	Determined not viable	No
Canadian Natural Resources Limited	Grouse In Situ Oil Sands	50,000	1.505	82	0.60% & 0.20%	1. Optimize energy efficiency (EE); 2. Use natural gas; 3. Use vapor recovery units; 4. Minimize fugitive emissions	Not considered	No
Canadian Natural Resources Limited	Kirby In Situ Oil Sands Expansion	85,000 (plus 50,000 approved)	4.400	81	1.80% & 0.60%	See above	See above	See above
Cenovus Energy Inc.	Pelican Lake Grand Rapids	180,000	5.438	82	1.86% & 0.63%	1. Target measureable improvements in GHG emissions/ long-range forecasting; 2. Minimize steam to oil ratio (SOR) in design; 3. Optimize EE; 4. Develop technology through the Energy Efficiency Fund and Environmental Opportunities Fund	The project is “Carbon Capture and Storage-ready”.	May purchase provincial emission reduction credits, if necessary
Cenovus TL ULC	Telephone Lake	90,000	4.124	Not Specified	2.50% & 0.60%	See above	See above	See above
Devon NEC Corporation	Pike 1 Project	105,000	3.496	91	2.12% & 0.51%	1. Solvent addition; 2. Optimize EE and waste heat recovery (WHR); 3. Invest CCS research	Will invest in research and development	Offsets will be considered as part of GHG management strategy for oil sands projects
Harvest Operations Corp.	BlackGold Expansion Project	20,000	0.731	Not Specified	0.29% & 0.10%	1. Optimize EE; 2. Use natural gas 3. Use vapor recovery units; 3. Reduce flaring; 4. Reduce fugitive emissions	Not considered	No
Ivanhoe Energy Inc.	Tamarack	40,000	1.398	100	0.57% & 0.19%	1. Optimize EE; 2. Use vapor recovery units; 3. Reduce flaring; 4. Reduce fugitive emissions	Not considered	No
Laricina Energy Ltd.	Germain Expansion	155,000	4.72	81	2.02% & 0.68%	1. Use vapor recovery units; 2. Reduce flaring; 3. Contribution to the CCEMF; 4. Solvent addition and cogeneration	Not considered	Will meet compliance through contribution to Alberta’s CCEMF
MEG Energy Corp.	Surmont	123,000	4.122	91.8	0.60% & 1.76%	1. Optimize EE; 2. Produced gas utilization; 3. Optimize WHR; 4. Reduce SOR through high reservoir quality results; 5. Implement cogeneration	Evaluated as a potential option	No
Southern Pacific Resource Corp. (STP)	STP McKay Thermal Project – Phase 2	36,000	1.092	125	0.16% & 0.47%	1. Continuous improvement for technologies; 2. Consider CCS; 3. Trade GHG offsets; 4. Contribution to the CCEMF	Determined not viable	Will investigate carbon offset purchases and contribution to Alberta’s CCEMF as a compliance option
Teck Resources Limited/SilverBirch Energy Corporation	Frontier Oil Sands Mine	277,000	5.194	46	2.22% & 0.75%	1. Review GHG technology; 2. Undertake research and development; 3. Optimize EE; 4. Study emissions from tailings areas and mine face; 5. Evaluate green-energy initiatives	Not considered	Will continue to evaluate and invest in green-energy initiatives to reduce or offset GHG emissions
Value Creation Inc.	Advanced TriStar	75,000	3.589	138*	1.53% & 0.52%	1. Optimize WHR; 2. Optimize EE; 3. Compare performance metrics against initial design plans; 4. Develop quantification tools to track and monitor GHG emissions	Will provide the plot space and design provisions for CCS	Will consider compliance through purchase of GHG offsets, or contributing to Alberta’s CCEMF

*Includes integrated bitumen extraction and upgrading. GHG emissions intensities for SAGD facilities do not take into account energy expenditures downstream when the bitumen is upgraded.
Publically available information: http://environment.alberta.ca/02313.html

through regulatory limitations such as emission caps or a carbon tax incenting emission reductions in the private sector. Alberta's SGER incents technology development through both processes. The "technology push" comes in the form of CCEMF investment in transformative technologies that help to build a lower carbon economy. The "demand pull" comes from the $15/t$CO_2$e price on carbon for facilities that exceed their GHG intensity thresholds. Innovation in the energy development industry inherently involves large capital investment and long timescales where each of the three stages in the innovation chain (i.e. public R&D; commercialization; and market penetration) can take a decade (Grubb, 2005). Systematic investments in technology, through the "technology push" and "demand pull" approach, should serve to accelerate and improve environmental performance and decrease emissions reduction over the long term (Lehtila et al., 2005).

The Climate Change Emissions Management Corporation in collaboration with industry funded a study to examine technology developments for improving energy efficiency from oil sands developments (CCEMC, 2012b). The study found that GHG mitigation options in the near and medium-term are limited. Near-term operation improvements (1-3 years) have the potential to reduce emission by 3 percent for in-situ development and 2 percent for mining projects. Medium-term (3-5 years) capital improvements have the potential to reduce emission by 9 percent for in-situ and 5 percent for mining. The long term prospects are more promising. Looking at a timeframe greater than 10 years, there is significant potential to reduce GHG emissions (20 percent for in-situ and 30 percent for mining) through technology developments. For in-situ projects, technologies that could be applied to improve energy efficiency include innovations in the areas of steam generation, heat recovery, and alternative extraction processes.

The results of the CCEMC study are consistent with research that suggests there are physical limits to the rate at which new technologies can be deployed. Kramer and Maigh's (2010) *Laws of Energy Deployment* suggest that it can take 30 years for energy technologies to reach materiality, a pattern that is remarkably consistent across energy technologies. Given that technological change is a long-term process, on the time scale of years and decades, there is value in taking a portfolio approach to R&D investments, whereby investments are likely to pay off under differing future conditions (Jaffe et al., 2005). The oil sands sector has begun adopting this type of approach through their project GHG management plans. Technological change is being fostered in the near-term through the SGER's market-based compliance options while long-term investments in potentially transformative technology are occurring through the CCEMF.

4.0 Discussion and Conclusions

Oil sands projects undergoing environmental assessment incorporated both emissions impacts and GHG management strategies. Emission impacts compared in this study include total annual emissions from project operations, product emission intensity, and the relative impact of the project with respect to national and provincial inventories. Generally, the emission impact depends on the project's annual production capacity. The comparison of projected emission intensity provides insight into the efficiency of project operations. This parameter may relate directly to a project's management plan where GHG emission reduction technologies and practices are implemented. Common management strategy elements that were reported across project EIAs include technology development, fugitive and venting emission management, energy efficiency including waste-heat recovery and cogeneration, and in some cases, consideration of carbon capture technology.

Market-based mechanisms were considered in approximately half of oil sands EIAs currently under review. These projects stated their intent to comply with SGER regulation through the purchase of Alberta-based offset credits or payment to the CCEMF. When comparing this to current compliance results from all regulated facilities in Alberta, offset credit purchases and CCEMF payments account for 70 percent of all SGER compliance. According to FPTCCCEA guidance, a project's GHG management plan should consider "mitigation measures, such as international emission credit trading, industry best practices, GHG management plans, compensatory measures, etc." (FPTCCCEA, 2003: 4). To ensure best practices for incorporating climate change considerations in environmental assessment, oil sands projects in Alberta should consistently incorporate SGER compliance considerations including potential market-based mechanisms used to meet GHG compliance targets. Given that market-based mechanisms are used widely for compliance with GHG regulations, this would ensure alignment between the project planning and regulatory compliance.

Through the SGER's market-based compliance options, technological change is being fostered through near-term investments at regulated and unregulated facilities, while long-term investments in transformative technology are occurring through the CCEMF. Market-based mechanisms provide a low-cost compliance option for regulated emitters and have had significant uptake since the inception of the SGER in 2007. This approach to GHG emission mitigation serves to accelerate technology development and decrease emission reductions over the long term. As Alberta's provincial offset-supply tightens (Point Carbon, 2012) there may be need to expand this compliance option beyond the province to include high-quality offsets to be sourced across Canada. In the absence of a national offset system, payments to the CCEMF help to the bridge the gap between technology development and commercialization by investing in the discovery and development of clean technology (CCEMC, 2011). According to work by Giliana and Green (2009) a technology-led climate policy is preferable to mitigation approaches with time-specific emission reduction targets given that low-carbon technologies still require basic research and development. Furthering market-based solutions to mitigate GHG emissions and incorporating this as part of a GHG mitigation plan will help to ensure that new oil sands facilities meet their GHG reduction targets and contribute to national and provincial climate goals.

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6.0 Advisory

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