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Alberta Oil Sands Development Conflict

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***Abstract*—A systems approach to integrative adaptive management of brownfields on Alberta's oil sands development sites is presented. In particular, the Graph Model for Conflict Resolution (GMCR) is utilized to understand underlying development conflicts among stakeholders, which arise due to competing economic, environmental and societal objectives. The conflict model provides a formalized hypothesis-testing platform for determining responsible policies, which are those that enhance integrative adaptive management in order to utilize this resource responsibly.**

***Keywords*—integrative adaptive management, sustainable development, conflict resolution, policy development**

I. Introduction

Tar sands, which are often referred to as oil sands, are lands in which bitumen is mixed with soil, usually sand and clay, on the surface of the land or underground. Special processes are needed to remove the bitumen from the sand and, subsequently, carry out appropriate refining to obtain oil products. In addition to conventional oil reserves, Canada is especially blessed with an abundance of tar sands in its western provinces of Alberta and Saskatchewan. In fact, with proven oil reserves and oil sands, second to Saudi Arabia [1], Canada possesses a non-renewable natural resource which, if managed appropriately, can strategically strengthen Canada's renewable energy resource-base. Norway's Government Pension Fund, which obtains its funding source from petroleum revenues [2], and the industrial leadership of EnCana®, Chevron®, and Shell® in providing seed funding for renewable energy technology [3], are examples of how present profits from nonrenewable resource exploitation can be strategically reinvested for intergenerational transfers of wealth and future prosperity.

Oil sands developments, which are notorious for high water usage, carbon emissions, tailings ponds and habitat destruction, face major economic, environmental and societal challenges under present conditions which are exacerbated by future uncertainties [4]. How these challenges are handled will determine whether win-win resolutions of underlying conflicts among stakeholders are reachable and whether Canada can establish itself as a key player in the emerging green economy.

Achieving sustainable development requires a systems perspective and a management framework in which present decisions are made in an integrative and adaptive manner to carry out win-win strategies, and to respond effectively to changing environments and unpredictable consequences. Among the many challenges in tar sands exploitation is the reclamation of mining and in-situ extraction sites and their surrounding areas. The unintended consequences and risks of contamination by oil sands activities are materializing [5][6][7], and the rapid growth of oil sands developments is raising public concerns [8][9][10]. To assist in group decision-making and policy development, the Graph Model for Conflict Resolution (GMCR) is used to analyze the inherent conflicts among stakeholders in oil sands developments. Effectiveness of policies at achieving sustainable development within an integrative adaptive management framework may be tested with the GMCR model.

II. Integrative Adaptive Management

A. Integrative Natural Resources Management

An integrative approach to natural resources management considers the effects of development on land, air, water, and society and seeks to manage the relationships among the various systems within the larger environment. The goal is to maintain integrity of healthy ecosystems alongside societal and technological systems which, together, form a system of systems [11]. Hooper et al. [12] argue that the need and scope for integration depends on the given context, and that management solutions need to be customized in time and space. In general, an integrative approach is needed when the causes for resource scarcity or environmental degradation are multiple and interconnected [12]. Problems that arise in a system-of-systems context require an integrative response because they inherently involve multiple participants with multiple objectives [13]. A customized solution requires serious consideration of stakeholders' values and interests, carried out through a coordinated interactive decision-making process with full participation by all concerned stakeholders and users at all levels [14][15]. Balancing the needs of the ecosystem with the needs among humans is a difficult task in practice [16]. While win-win strategies are not always obvious and require time and resources to develop and implement, an integrative approach first attempts to develop a better understanding of the problem from multiple perspectives. When a common understanding is reached among stakeholders, cooperation, coordination and negotiation may be achieved in light of conflicting values and competing interests.

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B. Natural Resources Adaptive Management

An adaptive management approach recognizes the need to be responsive and resilient to changing and unpredictable variables [17][18], which abound in the markets and the environment. Aggregate human behaviour and cumulative environmental impacts are difficult, if not impossible at this time, to predict quantitatively. An effective management scheme may not be able to optimize its operations to handle variability. In fact, Holling and Meffe [19] argue that "command-and-control" resource management, which focuses on efficiency, leads to unsustainable outcomes and eventual collapse of the system. Instead, adaptive management suggests that complexity and uncertainty should be handled with a deliberate iterative learning process that maintains a continuous cycle of plan, act, monitor, and evaluate [20]. In practice, it is simply the application of the scientific method through the highlighting of uncertainties (problems), specifying and evaluating hypotheses, then testing hypotheses in a structured and controlled way in the field [21]. Active adaptive management, where designed experiments are deliberately carried out to evaluate several policy alternatives, requires careful monitoring and "active learning" [22]. Arguably, some learning will occur regardless of which management approach one takes. However the key to adaptive management is a structured methodology through which more efficient learning can occur [22], in the same way that better decisions can be made when using a systematic approach [23]. As with integration, an adaptive approach requires resources for planning, implementation, monitoring and evaluation, as well as an institutional structure which is flexible and learning-driven, and not simply centered on self-interests [21]. Essentially, by practicing adaptive management, it is expected that resiliency and responsiveness of the system's operations are enhanced to be better equipped in situations of surprise.

C. Systems Methodologies for Resources Management

Integrative adaptive management is naturally supported by formal systems methodologies for carrying out strategic decision-making. Modelling and analyzing decision-making processes may lead to invaluable insights, which can then guide the management of natural resources in an equitable and sustainable way [24]. Systems tools, which transcend disciplinary boundaries, are inherently integrative by incorporating different perspectives and knowledge into a unified system domain, and by examining different dimensions of the problem in a holistic manner. In this way, systems techniques and methodologies are used to reframe and reinterpret a problem such that learning can be achieved and as a result, decision makers may enhance their adaptive capacities.

The Graph Model for Conflict Resolution (GMCR) [25] is a flexible decision support system in which an analysis of decision makers and their strategic interactions provides a system's perspective on the conflict and its resolution. Interactions are influenced by the options available to the decision makers and their preferences on the potential outcomes of the aggregated actions of all of the decision makers. A conflict model can be constructed for a dispute at a specific moment in time and the analysis can trace the evolutionary development of the conflict's resolution. Using several solution concepts, states that are equilibria can be identified. The information is helpful to decision makers as it provides a prediction of likely resolutions, which can guide the implementation of individual actions in a strategic way. Uncertainties can be acknowledged and their effects can be documented through sensitivity analyses. Preferences can change with unpredictable events that are external to the conflict, such as a recession or drought. Decision makers are encouraged to consider adaptive strategies that are resilient and responsive to surprises. In a group or negotiation setting, decision makers are encouraged to examine deeply embedded values and belief systems and entertain new strategies that will result in win-win resolutions.

III. Alberta Oil Sands Development

The Alberta oil sands developments present a plethora of challenges, most of which involve multiple stakeholders with competing objectives due to conflicting interests. A general model and analysis of the underlying conflict among economic development, environmental protection, and societal values in the context of the Alberta oil sands and the restoration of brownfields is presented in this section.

A. Background

Oil sands cover an estimated area of 140,000 km^2 in Alberta, Canada, in three regions, Athabasca, Peace River, and Cold Lake. As world demand and high oil prices encouraged a boom in the industry from 2000 to 2008, the rapidity of oil sands development attracted the attention of the media, and has forced the Alberta government to seriously consider the impacts, and its strategies to achieve responsible development. Both governments of Alberta and Canada released reports on the oil sands and its challenges in 2006 [26] and 2007 [4], respectively. The Alberta government has recently outlined a 20-year strategic plan for the development of the oil sands [27]. While the report has been criticized as an image-building document that is part of a larger public relations campaign to bury the "dirty oil" label [28], it sets out key environmental, societal and economic goals, as well as, goals for Aboriginal relations, research and technology, and performance measurement systems. Actually implementing the strategic plan is quite another feat, which will likely rely on the degree of integration and adaptation in carrying out tactical-level operations and management.

Oil sands developments intersect with a multitude of policies and frameworks. Among them are Alberta's land-use framework, clean air strategy, water for life strategy for sustainability, climate change strategy, provincial energy strategy, First Nations Protocol Agreement on Government to Government Relations, the heritage savings trust fund, the new royalty framework, and so on [27]. Integration of autonomous government bodies is a complex task. Moreover, change in behaviour, organization, and legislation to adapt and ensure that the necessary institutions and regulations are in place to carry out this system of strategies within the prescribed frameworks require concerted effort.

Coordinated and progressive work is sorely needed to address the long-term cumulative environmental impacts [29] and to guide appropriate management plans. The Pembina Institute has advocated for stronger environmental rules

[8][30][31], which have generally been relaxed to encourage oil sands development. Despite the requirement that industry must file an environmental impact assessment for each project, it is generally agreed that the full impacts of tailings ponds, greenhouse gases, and other oil sands products that interface with the boreal forest and surrounding wetlands are not well understood [32][33]. It is however understood that full restoration of sites which have been disturbed by oil sands activities is impossible, because processes that took thousands of years cannot simply be replicated [32][34]. Of the land dug up since 1963, only 0.2 percent has been certified as reclaimed as of 2008 [9]. The reclaimed site was used for placement of overburden material removed during oil sands mining and was no longer in use since the 1980s [35]. Actual mining sites will likely require much longer time, hence much more money. Based on past Canadian experience of reclaiming old mining sites, Canadian tax-payers can expect to pay over 20 times more to tidy up contamination than that which was received through royalties [9]. Moreover, a report by the Environmental Law Centre notes that, as land pressures escalate, some locales such as upstream oil and gas sites, which were remote when first contaminated, will become increasingly urbanized and will eventually need to be redeveloped [36]. Hence, reclamation of oil sands sites is an inevitable task, not only for environmental reasons but also for societal and economic benefits.

B. *Modelling and Analysis of Development Conflict*

The present development problems of economic, societal and environmental nature are inextricably linked to future reclamation and redevelopment challenges. Sorting out issues now may avoid conflicts in the future, particularly legal challenges with respect to water and social tensions from losses of employment and growing gaps in the local communities. As well, the way in which current shortcomings are handled in the present will affect the opportunities that emerge in the future. A strategy of continued growth compared to production caps and a moratorium on new leases will lead to a significantly different future state in the amount and concentration of toxic tailings ponds. Now is the time to confront the uncertainty and complexity of the environmental, economic and societal challenges presented by the oil sands development process, which cannot be understated. They are huge. To understand whether brownfields, which are created by the development of the Alberta oil sands, may be managed in an integrative and adaptive manner, a GMCR model of the current development conflict among stakeholders is presented and analyzed in this section. The model consists of the identified decision makers (DMs), their options (Opts), and their preference vectors over the possible outcomes of the modeled conflict.

1) *Decision makers*

For our model, three distinct groups of decision makers are identified as Industry (I), Government (G), and Community (C), as shown in Table I. Industry accounts for private investment interests and includes firms such as Suncor and Syncrude, which undertake the work of mining/extraction, upgrading, and reclamation. Government refers to public interests of the majority of Canadians and includes both provincial and federal levels of government. These public bodies have shared jurisdiction over the protection of the environment, however Alberta has unique jurisdiction over the development of its natural resources. Finally, Community joins together the local interests of stakeholders that are uniquely affected by the activities of oil sands development, including First Nations, environmental groups, and permanent local residents. It is assumed that the Community is made up of minority groups, which are thus underrepresented by government. At this time, the international community is not considered, however it is recognized that US foreign policies, the North American Free Trade Agreement (NAFTA), the Kyoto Protocol, and possible other climate change agreements may affect the decisions of industry and government.

2) *Options*

An option is a course of action. The level of detail of an option can range from the strategic (high-level) to the tactical (low-level). For this analysis, a high-level perspective is shown. The options available to Industry are of two categories: (a) develop: consists of short-term investments to obtain maximized rate of return within reasonable payback periods, and (b) invest: consists of long-term investments, generally in research and technology, which are justified mainly by future economic factors. For example, setting up new operations with current technology and processes is a “develop” option, whereas, setting up a well-funded nonpartisan research institute for wetlands restoration and remediation is an “invest” option. Government's actions are also grouped into two main categories: (c) regulate: any action or policy implementation which may be construed as an influential factor on Industry's decisions to develop or invest, and (d) invest: involves allocation of money in public coffers to public assets and services, such as infrastructure, research, technology development, or a sovereign fund. Finally, Community's actions are also divided into two classifications: (e) pressure industry: use of media or change in demand to influence industry's decisions, and (f) lobby government: use of media or change in vote to influence government's decisions.

TABLE I. SUMMARY OF DECISION MAKERS AND OPTIONS.

DM	Options
I: Industry	a: Develop
	b: Invest
G: Government	c: Regulate
	d: Invest
C: Community	e: Pressure Industry
	f: Lobby Government

3) *Preferences*

Preference vectors indicate the order in which possible outcomes are favored according to the value system of each decision maker (DM). They are constructed by considering how each DM prefers his own options in combination with the actions of other decision makers. One's actual decisions are likely variable upon how others act and may be supported with more detailed analytical tools. However, at this level of analysis, the aggregate outcomes of generic options are linked to general values of the DM groups to replicate a high-level decision making process. For example, in a free-market economy, Industry prefers to develop in a deregulated market and without environmental regulations. If the bottom-line profits of Industry are affected negatively by a poor public image, Industry may be more inclined to invest to show that it

is genuinely concerned about the environment and society, and intends to be in the community for the long haul rather than just for short-term gains. Suncor, the first enterprise in the oil sands (est. 1967), has demonstrated these behaviors to follow the "prime directive" of protecting shareholders' interests [37]. Also, given the insatiable demand for oil, the lost opportunity cost of not being involved in the oil sands may be too great, hence not developing is least preferred. The resulting preference vector for industry is shown, as an example, in Table II.

For Government, a variety of preference vectors could be constructed by evoking different values of different parties. Under the current circumstances, both the provincial and federal governments are aligned with conservative right-wing values. A popular interpretation of right-wing conservatism may include tax-cuts, free market ideals, and tradeoffs between the environment and the economy. In simple terms, conservatism prefers to conserve the status quo. In complex terms, conservative principles are based on custom, convention and continuity, the link between freedom and property, voluntary community, and recognition and reconciliation between permanence and change [38]. Based on the actions to date, which are generally lacking in regulation and investment [9], Government clearly prefers that Industry develops the oil sands unfettered and prefers not to respond to minority interests, which would slow the economic engine of Alberta, and in many respects, of Canada, whose currency is nicknamed the "petrodollar". The strategic plan of growing production through the royalty framework, which gives away the oil sands resource at 1 percent, has proven to be incredibly successful, in that the milestone of 1 million barrels per day was reached well before its target date [9]. Presented with the rapid expansion of the oil sands development along with its degeneration of the environment and society, Government action appears to be slow. As it tries to reconcile economic progress with protection of the environment and of society, the status quo is likely to persist. Its preference vector thus disregards the actions of the Community and is constructed by ranking states in which Industry develops and/or invests higher than those in which Government regulates and/or invests, where in fact Government would prefer do to nothing (see Table III).

Given an environment which tolerates dissent, an engaged community versus a disengaged one may demonstrate a higher preference for undertaking actions to pressure industry or lobby government when injustices are perceived. An anti-oil sands advertisement placed by the Mikisew Cree First Nation, the Athabasca Chipewyan First Nation and the environmental group Forest Ethics [39], and the large conspicuous banners hung by Greenpeace [40][41] are examples of strategic maneuverings to influence the decisions of politicians and industry executives. Also, a 2007 poll conducted by the Pembina Institute found that 71 percent of Albertans favored a moratorium on new oil sands projects until environmental concerns can be resolved [42]. Development by itself is not considered a bad thing. However the pace of development, which is out of control and much faster than the pace of research, innovation, and ultimately the restoration of the natural environment, is not acceptable according to the Community. The preference vector of Community is thus

TABLE II. INDUSTRY'S PREFERENCE VECTOR[A].

DM	Opt	Most Preferred → Least Preferred															
I	a	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
	b	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N
G	c	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
	d	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	-[b]
C	e	N	N	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N	N	N

a. Note that Industry's preference vector is specified by options a to e; it does not depend on option f.
b. '-' means that it can take the value of Y or N.

TABLE III. OPTION PRIORITIZING TO GENERATE GOVERNMENT AND COMMUNITY PREFERENCE VECTORS.

Government	Community
a	a *&* b *&* c *&* d
b	*NOT* a *IF NOT* c
NOT c	e *IF* a *& NOT* b
NOT d	f *IF NOT* c *OR NOT* d

constructed by ranking the states in which Industry develops and Government regulates the development, and both Industry and Government invest in finding and implementing solutions to environmental and societal impacts of oil sands developments. If any of these components are missing, then Community prefers to take up action, over not taking action, to influence the appropriate decision makers (see Table III).

4) Stability Analysis

A stability analysis of the presented GMCR model produces one state which is stable for all solutions concepts (Nash equilibrium, general meta-rationality, sequential meta-rationality, etc.) which are encoded in the GMCR II software package. A key equilibrium state is where Industry develops and invests (a=Y, b=Y), Government does not regulate nor invest (c=N, d=N), and Community persists in pressuring industry and lobbying government (e=Y, f=Y). This equilibrium state is given as the fourth state from the left in Table II, in which it is assumed that option *f* is selected.

On further contemplation, the most stable solution is also the status quo. Industry is developing according to what the market dictates and invests what it deems appropriate. While investments are cited as being well below the industrial average [4], this percentage may seem unusually low due to the fact that revenues are naturally larger than other industries. Government is slow to regulate the development of the oil sands, and to keep up investments into infrastructure to match the pace of development. While the federal government argues that they have invested more than its fair share in oil sands research and technology, some feel that knowledge transfer activities that transition R&D to implementation are under-funded [4]. Moreover, Alberta has basically stopped contributing to its heritage savings trust fund. The sovereign fund was an original Canadian idea established in 1976 by the Honourable Peter Lougheed, former Premier of Alberta [9]. Later governments stopped contributing from 1987 onwards [9]. Meanwhile, Norway, which took Lougheed's idea, has already amassed $400 billion in savings for the future [9]. Finally, recognizing that Industry only responds to customers' demands and that Government needs to be reminded of its responsibilities to represent all of its citizens, the Community is not afraid to raise its voice, but perhaps too few are being heard.

C. Potential for Integrative Adaptive Management

The result of the stability analysis presents a somber insight into whether brownfields, which are created by the development of the Alberta oil sands, may be managed in an integrative and adaptive manner. The reality conveyed through the model suggests that development will continue without regulation. It may be inferred that expertise among industry and government to deal with oil sands brownfields is unlikely to develop in a timely manner given the pace of development, hence knowing how to deal the risks of tailings pond leakage is also unlikely. Instead, "incremental learning" [9], which is different from the "active learning" of adaptive management principles, is the fallback strategy when problems are encountered. Moreover, integrative arrangements in which governments employ creativity and complexity to simultaneously embrace development (progress) and protection (permanence), have yet to be proven as successful. Multi-stakeholder and Aboriginal consultations in 2007 [33][43] were only the first steps of setting up the capacity to integrate multiple objectives into development plans. Consultation is an ongoing process which should genuinely involve all stakeholders to be part of the solution. Much more still needs to be done to continue the process.

If the strategic plan which the Government of Alberta has recently released [27] is indeed acted upon, then perhaps the crucial assumptions of this analysis may be proven wrong. In fact, changing Government's preference vector to reflect its intentions changes the outcome completely. Sensitive to Community lobbying efforts, if Government prefers to "regulate" if Industry chooses to "develop", and to "invest" if Industry "invests", this results in a strong equilibrium state in which regulated development and cooperative investments take place. A well-regulated pace of development is expected to give future generations the time to build capacity to handle future challenges. Until such time, suggestions on how to test for the effectiveness of policies in achieving sustainable development are discussed in the next section.

D. Discussion on Sustainable Development

According to the 1987 Bruntland Report [44], sustainable development is defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." To be clear, oil sands development by itself is inherently unsustainable because oil sands are a nonrenewable resource. Addressing the economic, societal and environmental challenges that are met throughout the expected lifecycle of oil sands development is only part of achieving sustainable development. Despite the belief that advances in technology may render the vastness of the oil sands as a practically endless resource, bitumen deposits will eventually be depleted. The challenges that scientists, engineers, politicians and communities face in oil sands development should not be confined to unlocking the abundant resources of the oil sands to meet the needs of the present. But rather should be broadened to using the oil sands resource to simultaneously meet present and future needs. That is, how may we build the capacity that future generations will require in order to meet their own needs, after current generations have exploited nonrenewable resources beyond utility? Restoration of brownfields created by oil sands development will most certainly affect the ability of future generations to handle environmental concerns which will in turn impact society through health risks, and the economy through remediation costs. If future generations are burdened by contamination and clean-up costs incurred by current development, then lost opportunity costs will also be high thus lessening the allocation of resources to renewable energy development.

While sustainable development as a concept is often talked about, actual measurement and validation that development activities are sustainable is not easily definable. Policies, which are hypotheses of methods that achieve sustainability, in effect are not well scrutinized for their merits and shortcomings. What is needed is an integrative and adaptive framework in which policies are tested and implemented. This framework acknowledges that sustainable development is in fact an unknown and possibly dynamic target, subject to the perceptions of multiple stakeholders and changing environments. Commitments are required from industry, government and the community on their responsibilities and roles, which are reinforced by each party. Governments can be pro-business, but it must also be committed to its regulatory duties to protect the environment and society. Given the large amount of uncertainty surrounding the current economic climate and the cumulative environmental impacts, maintaining an adaptive disposition to respond quickly to changing circumstances should also be fostered. In a sense, validation of sustainable development policies may be qualified by its ability to integrate different objectives of stakeholders and how well it fosters adaptability among decision makers. Using the conflict analysis model presented in the previous section, the test of a policy may be: can it move Government to regulate and invest while maintaining the decisions of Industry and Community? The implications are that Industry and Community would have to adapt to new regulations and that Government and Industry could integrate their investment plans such that current and future problems may be addressed more efficiently and effectively. In this way, sustainable development becomes a more likely future, than in the current status quo, given the presented conflict resolution model.

IV. Conclusions

In this paper, a conflict model and analysis of Alberta oil sands development was presented using the Graph Model for Conflict Resolution. Current development conflicts among environmental, societal and economic objectives affect the management of brownfields, which are created by oil sands activities. The modeled conflict suggests that expertise will not be available for future generations to deal with brownfields on oil sands development sites. The costs of remediation will more than likely fall on future generations, unless preventative policies are put into place. In order to achieve sustainable development, it is suggested that policies be designed such that they foster integrative and adaptive management, the goal of which is to satisfy multiple objectives and maintain resiliency in a changing and uncertain environment.

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