Title

Tracing factual claims for environmental policy dialogue: An analysis of the Alberta oil sands greenhouse gas controversy

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Abstract

Environmental policy issues are perhaps the most important of our time, but their inherent complexity leaves the surrounding information vulnerable to misinterpretation and misrepresentation by competing advocacy coalitions, which undermines the deliberative search for consensus and effective policy advice. To identify and classify some of these problems in detail, an exploratory case study of the controversy over greenhouse gas emissions from the Alberta oil sands was conducted through a claim-tracing document review. Emerging challenges included: speaking different languages, unclear ultimate sources, vague assumptions and processes, lack of academic sources, potential magnification of misinformation, and poor direct engagement. Broadly addressing such problems might require a more central role for science in policy controversy and the use of physical institutions of deliberation. While such findings may apply to environmental policy controversies in general, this paper concludes by explaining why the Alberta case may be particularly intractable and making suggestions for further research.

Keywords

advocacy coalitions; claim-tracing; deliberation; misinformation; oil sands; policy controversy

Introduction

Environmental issues like climate change exhibit a unique complexity for public policy. Responding to them often entails a reliance on uncertain scientific predictions to show that ecological harms will occur under a given scenario of action or inaction; it can be challenging to galvanize the necessary action before such harms are immediately observable by non-scientists (Marx et al., 2007). In addition, due to the myriad of overlapping interrelationships in most ecosystems, environmental problems require an interdisciplinary and holistic mixture of natural sciences to fully understand, which means that many accounts may be incomplete or contradict others since they are rooted in different disciplines (see Wilson & Anderson, 2006). While complex, environmental issues are also important. In recent years, the international scientific community has submitted a number of warnings to society at large (e.g. Intergovernmental Panel on Climate Change [IPCC], 2007), cautioning that if significant policy action is not taken to curb human impacts on the natural environment soon, the resulting harms will be substantial and irreversible, severely constraining resources available to future generations. Environmental policy problems demonstrate both a unique complexity and importance.

It is especially crucial, then, for policy actors (i.e. stakeholders, decision-makers, interest groups, etc.) to reach some agreement on these questions, even though it may be particularly difficult for them to do so. The collective effect of the uncertain and

interdisciplinary nature of environmental issues is that much of the surrounding discussion is left open to subjective or arbitrary interpretation. For example, if a scientific study were to report a certain estimated chance (e.g. 75%) that going ahead with a particular industrial project would substantially damage a rare nearby ecosystem, it would be acceptable to acknowledge the study's findings on the balance of probability (and oppose the project on this basis) while it would also be completely legitimate to concentrate on the uncertainty of the estimate, question the supporting methodology, or demand further investigation (supporting the project in the meantime). Different coalitions may independently come to these conflicting conclusions, depending on their own interests directly related to the project (i.e. maintaining the same position they had before the study was released), and thus be unable to engage in a productive discussion with the other side where consensus on the issue might be reached; they might argue over the interpretable areas of the uncertain science when their real disagreement could be deeper (e.g. on the extent of our obligation to future generations). It is problematic that the science has such little impact on environmental policy positions when its acknowledgement of probability and complexity (Bradshaw & Borchers, 2000) should afford it an influential role. In order for appropriate and informed action to be taken on pressing environmental matters, it is crucial that opposing positions speak a similar language and subscribe to some common principles of deliberation; potential areas of consensus must be found while illegitimate (e.g. misinformed) positions must be discarded.

Thus, the purpose of this paper is to demonstrate some existing problems with environmental policy dialogue and make suggestions for designing institutions (either physical or social) that would facilitate more productive dialogue over the associated

science. Greenhouse gas emissions (and thereby also climate change) associated with oil sands development in Alberta will be used as a case study to draw out lessons for such a purpose, since the surrounding controversy is prominent, polarized, and complex. In this light, the sections of this paper will accomplish the following: develop the preceding arguments and clarify the rationale for the study through a background review of the relevant literature, describe the methods used in completing an exploratory document review about the Alberta case, present the results from the review to paint a picture of the ineffective deliberation taking place over the oil sands issue, discuss consequent lessons for creating more meaningful systems of environmental dialogue, and conclude by summarizing the key findings and making suggestions for further work in this area.

Background

To understand policy controversies, it is useful to conceive of the various actors and stakeholders involved as belonging to a small number of coalitions with conflicting beliefs. Sabatier's (1988) framework accomplishes this by organizing the relevant actors in a given policy subsystem (i.e. the variety of actors concerned with a particular policy problem) into "advocacy coalitions" based on their beliefs. Often, a policy subsystem is made up of two major coalitions (i.e. one for a certain policy and one against it), which will engage in an analytical debate and use evidence to persuade more neutral "policy brokers" (usually government decision-makers) to act in a certain way. The set of shared beliefs within a coalition is what ultimately defines it and encourages coordination among its members. Such beliefs are relatively stable and not easily changed, thus coalitions will often resist information that is counter to their beliefs. These influential coalitions, through their

processing and manipulation of information, are arguably the most important actors in policy controversies, and their effect is exacerbated by the particularly complex nature of environmental policy problems like climate change.

Demonstrating that uncertainty is particularly pernicious for the issue of climate change, Hulme (2009) provides the example of two publications released in February of 2007. First, two American scientists published a book called *Unstoppable Global Warming: Every 1,500 Years*, which argued that climate change is due to natural cycles in solar energy and that attempts to control greenhouse gas (GHG) emissions are essentially pointless. At roughly the same time, the IPCC released its Fourth Assessment Report, claiming that most of the increase in average global temperatures during the 20th century is very likely due to anthropogenic emissions (p. 72). The theses of these two works are contradictory: "The observed warming cannot be largely due to changes in solar energy *and* at the same time be due mainly to rising greenhouse gas concentrations. Both claims might be wrong, but they cannot both be right. One common expectation of science is that it should be able to distinguish between such competing claims to truth" (p. 73). Since policy actors and the general public see science as a somewhat objective arbiter, normally being able to determine which of such claims are true (Pielke Jr., 2007), it becomes possible for coalitions to simply choose which claim better fits with their previous understanding, values, and interests. After all, both studies appear scientific, so it is just as easy to assume that one has come to the incorrect conclusion as it is for the other, especially since non-scientists may have little appreciation for the nuances of peer-review, methodology, probability, and statistical significance.

In the same vein, Bradshaw and Borchers (2000) use climate change as a central example in their analysis of the general challenges created by scientific uncertainty. Like Hulme, they argue that climate science is particularly uncertain: "The IPCC reports represent a wealth of both accumulated knowledge *and* uncertainty. Unlike more tractable, data-rich scientific problems that readily yield understanding from statistical analyses, science in the IPCC reports appears to confound policy makers who prefer more 'certain,' contained estimates of risk" (par. 13). The concept of cognitive dissonance, the resulting state when new information conflicts with an individual's existing behaviour and belief, also features prominently in their argument: "According to theory, the inconsistency and psychological discomfort of cognitive dissonance can be reduced by changing one's beliefs, values, or behaviour. Dissonance can be avoided by rejecting or avoiding information that challenges belief systems or by interpreting dissonant information in a biased way" (par. 8). Together, these ideas lead to the realization that uncertainty may be exploited by policy actors who stand to lose something if certain scientific findings are accepted. Indeed, Bradshaw and Borchers point out that even unprecedented efforts of international scientific consensus, such as the IPCC, have failed to lead to corresponding policy consensus and decisive environmental action (par. 1). Overall, their analysis demonstrates that uncertain scientific findings (e.g. estimates of future impacts on an ecosystem) may lead to subjective interpretations by biased policy actors (e.g. advocacy coalitions), being unable to shift positions on environmental policy in any lasting fashion.

So it is clear that the uncertainty and complexity of climate science leaves it vulnerable to political interpretation and we know that policy actors may desire to interpret associated findings in their own self-interest, but Gilovich (1993) demonstrates *how* exactly

everyday people achieve this and why they may not even realize their own oversights or misinterpretation. He illustrates that flaws in individual human rationality can lead to seeing statistical trends where there are none, over-interpreting incomplete data, biased evaluation based on expectation or desire, over-reliance on second-hand information, and imagining the agreement of others. For example, when people are given a random set of binary outcomes (e.g. coin flips, or in his case, hits and misses for basketball shots), most of them will identify the naturally occurring clusters as non-random and suggest that a statistical trend is occurring, even though there is none (p. 16). So while scientific analysis relies on objective measurements, statistical tests, and estimations of probability, the common sense often employed by non-scientists might involve eyeballing, recognition of simple patterns, or non-rigorous pseudo-science (e.g. averaging a set of data without considering the weight that should be afforded each element). Government, industry, media, and non-governmental organizations (NGOs), or any combination of these as an advocacy coalition, may simplify or exploit information in this fashion to more effectively communicate their position in public debates over environmental issues. This practice is problematic since such methods are ultimately prone to the misinterpretation of data.

Bringing these theoretical observations together with their investigation of "biased processing", Teel, Bright, Manfredo, and Brooks (2006) empirically confirm the dangers of exaggerated or "spun" information for debates about the environment or natural resources. They administered questionnaires about the issue of drilling for oil in the Arctic National Wildlife Refuge to undergraduate students at the University of Colorado and exposed them to fictional, exaggerated information on both the pro- and anti-drilling sides of the debate (pp. 449-451). Since the study measured attitudes toward drilling both before and after

information dissemination and also asked the participants to evaluate the quality of information presented, Teel et al. were able to find strong evidence of biased processing: "subjects with a pro-drilling attitude tended to assign a higher rating of quality to the pro-drilling reading and to discount the quality of the information presented in the anti-drilling reading, while those opposed to drilling tended to more positively rate the quality of the anti-drilling reading" (p. 455). The implication of this study is that when competing information (perhaps resulting from uncertainty) exists on an environmental issue, the amount of exposure that individuals have to either side seems to have limited impact on their opinions, even given the high amounts of effort put into producing the information by the opposing groups. Perhaps more importantly, the Teel et al. study demonstrates that exaggerated, spun, and misrepresented information rarely receives widespread criticism from the public, and certainly not from those who want to believe it. A system of deliberation where illegitimate information could actually be rejected would be more constructive.

While the Teel et al. study gives evidence of biased processing among individual members of the general public, Sarewitz (2004), through his study of the 2000 US Presidential election, suggests that political decision-makers do the same. On the topic of climate change, he argues that "those holding different value perspectives may see in the huge and diverse body of scientific information relevant to climate change different facts, theories, and hypothesis [sic] relevant to and consistent with their own normative frameworks… Put simply, for a given value-based position in an environmental controversy, it is often possible to compile a supporting set of scientifically legitimated facts" (p. 389). He also gives points to the challenge of different disciplines competing with

one another to understand the scientific basis of environmental controversies (i.e. due to their interdisciplinary nature) being tied to competing value-based ethical or political positions (p. 385); complexity can lead to subjective interpretation. Overall, Sarewitz agrees with the above assessment of the current problems with environmental dialogue, concluding that the interpretable nature of uncertain scientific information leads to political stalemates where each side claims to have science backing them, there being little discussion about the interests underlying their opposing interpretations and little opportunity for universally accepted critiques of their claims (i.e. criticisms that are accepted as legitimate and are made on a basis to which all have agreed).

Finally, Simpson, Jaccard, and Rivers (2007) bring the above theory and broad observations of behaviour to light, confirming the associated dangers with the concrete example of climate change policy debate in Canada. They argue that the two major positions (or coalitions) in this case, that is, pro-regulation (environmental NGOs) and anti-regulation (the oil and gas industry), hindered the potential for effective deliberation through unwavering commitments to their own self-interests and their associated subjective interpretations of the relevant science. On the one hand, "even when environmentalists privately admitted that meeting the Kyoto target was unwise, they could not stop demanding that the target be met… That short-term focus was a shame, because serious debate ought to have been about what to do after the first phase of Kyoto – that is, post-2012 – rather than being fixated on an unrealistic target that Canada was not going to meet" (p. 144). On the other hand, "nowhere, at least in its public statements and policy positions, did the industry try to get ahead of the GHG policy curve. Rather, the industry fought a rearguard action against serious measures, correctly chastising governments for accepting

unrealistic emissions targets to reduce GHGs but never offering a serious policy alternative that might move the country in that direction" (p. 157). Given the substantial efforts that interest groups put into dialogue over such environmental controversies, it is extremely problematic if their efforts are detrimental, rather than helpful, to the process. Thus, further investigation of the specific problems that are occurring through the interpretation and use of scientific information by opposing advocacy coalitions on environmental issues would be a valuable undertaking.

Methods

As the existing literature on the role of science in environmental policy dialogue is largely theoretical, consisting of fairly broad observations (e.g. regarding national or international debates over climate change), this study will adopt a smaller-scale case study to delve deeper into the issue and, at the same time, investigate a policy controversy that has been somewhat ignored by the academic literature (a notable exception being Hoberg & Phillips, 2011). Alberta's traditional oil wealth has recently been supplemented by rapid development of the province's oil sands, seemingly limitless deposits of oil resources with one important drawback; the related operations, a combination of in situ removal (usually done by injecting steam into the deposit through a process called Steam-Assisted Gravity Drainage or SAGD) and surface mining, are far more intensive that those for conventional oil. As well, the extracted bitumen must usually be upgraded (through another intensive industrial procedure) to synthetic crude before it is useful. Basically, the oil sands produce oil at a higher financial and environmental cost than conventional oil, but oil is such a profitable resource that many companies have already engaged in extraction. Oil sands

projects now comprise a significant portion of the provincial economy. Alberta's development of the oil sands is certainly a controversial issue, as evidenced by the combative nature of the provincial government's recent "Tell it like it is" campaign (see Government of Alberta, 2011b). Note that consequent critics of the oil sands consist primarily of environmental NGOs and think tanks such as the Pembina Institute, a Canadian organization concentrated in Alberta with an interest in sustainable energy systems (Pembina Institute, 2011). Overall, a simplified account of the controversy can describe it as consisting of two advocacy coalitions (see Sabatier, 1988): a "supportive" coalition of industry and government that favours development, and a "critical" coalition of environmental interest groups, journalists, and first nations groups that opposes it[*]. As such, oil sands development in Alberta is an appropriate case example for this study of environmental policy controversy and information.

In addition, this study focuses on only one environmental aspect of the oil sands controversy, greenhouse gas emissions. Illustrating ineffective environmental deliberation does not necessarily require a comprehensive assessment of the issue – any examples of misinterpretation or non-engagement by either side on any aspects of the issue will be sufficient for initial lessons to be drawn from the analysis. The aspect of GHG emissions was chosen because it fits well with the literature on environmental controversy (much of which, as shown above, focuses on climate change), is talked about by both sides (unlike energy efficiency, for instance, which is discussed primarily by the critical coalition), and is fairly straightforward to analyze (in comparison to, for example, water use, which involves

[*] It must be emphasized that this account of the controversy is a simplification. There are, of course, many diverse groups on all sides of the issue (i.e. more than two sides could certainly be conceived), and each has its own nuanced opinion, but some abstraction is necessary to facilitate a cogent analysis.

a number of additional complicating factors such as seasonal flow rates, groundwater vs. surface water, freshwater vs. saltwater, the different basins and watersheds, etc.).

A document review was conducted in April of 2011 to explore the case study of the controversy over GHG emissions associated with Alberta's oil sands. Essentially, a central document from each side of the debate (i.e. supportive and critical) was collected and its factual claims regarding greenhouse gas emissions were scrutinized. That is, any sources cited for such factual claims were themselves investigated for legitimacy, allowing facts to be "traced" through other documents to their ultimate origins, any interpretation along the way becoming apparent through the process. While there do not appear to be any systematic guidelines behind such a method in the relevant literature to date, it does share some assumptions with Pilon's (2009) analysis of media coverage regarding the 2007 debate over voting system change in Ontario, namely the importance of information relying on concrete evidence instead of broader rhetorical strategy to make a point. In his case, only the presence or absence of any appeal to evidence (e.g. use of an example) was recorded for each article (p. 10). However, this study is concerned with individual citations and investigates the legitimacy of such provided evidence. The method is also very similar to strategies used by authors on either side of the broader climate change debate, who have investigated citations and sources in order to undermine the factual claims of their opponents (e.g. see Friel, 2010). However, for this study the review attempts to scrutinize both sides of the debate, comparing and contrasting their use of information. Overall, this method is not only simple to conduct, but is a promising way of assessing which documents use information more legitimately and determining whether some strategies of interpretation or manipulation are common to both sides.

Specifically, the document review involved the steps below. First, a generic internet search for pdf files was conducted (using pdffinder.net) for the terms "Alberta Oil Sands Greenhouse Gas Emissions". The focus on pdfs made the search more likely to collect official publications of the relevant coalitions and avoided less useful sources of information such as personal weblogs, internet encyclopaedias, and poorly cited web sites. In addition, the use of a generic search engine removed any bias of the researcher in picking representative documents (acknowledging that a search engine might have biases of its own) as well as returning results that were most relevant to the search terms and as recent as possible. Second, the documents chosen for analysis were the first results from the search for each side of the controversy that were substantial enough to include citations. These publications were Pembina's "Canadian Oil Sands and Greenhouse Gas Emissions: The Facts in Perspective" briefing note (see Pembina Institute, 2010a) and the Government of Alberta's "Oil Sands Greenhouse Gases Fact Sheet" (see Government of Alberta, 2011a) – fortunately, they also appeared to have similar purposes (i.e. presenting the "real facts" about the oil sands' greenhouse gas emissions)[*]. Third, competing factual claims were identified from each document: the amount of greenhouse gases emitted for each unit of oil produced from the oil sands. Fourth, the factual claims were traced through the sources cited in each publication, subsequent sources being investigated as they arose (and any associated interpretations being identified), until they could no longer be traced effectively through publicly available documents or terminated at raw data or peer-reviewed academic sources (which we can generally assume are more legitimate sources of facts than interest

[*] Note, again, that this study is exploratory, only examining in-depth one document from one group in each coalition. The findings highlight potential problems, but they should not automatically be generalized to the broader coalitions.

group publications). Fifth, any supplemental data or criticisms of the opposing side's factual claims provided in the initial two documents were considered in order to provide context for the debate.

Results and discussion

This section first presents a record of how the document review process actually unfolded and explains the initial results at face value. It then discusses observations that arose through the process as well as their implications for more effective deliberation on this controversy. Figure 1 "maps" the traced factual claims, illustrating their ultimate sources. The relevant text, figures, tables, and citations from each source are included in Appendix 1, along with notes (in brackets) on how the data was presumed to have been transformed from piece to piece. Through the course of this document review, it was possible to identify several factors that may be compromising effective dialogue on the topic of GHG emissions associated with Alberta's oil sands: speaking different languages, unclear ultimate sources, vague assumptions and processes, lack of academic sources, potential magnification of misinformation, and poor direct engagement.

First, each document appears to have adopted its own language for discussing the issue, one that makes their argument seem stronger and thus is poorly equipped to engage in productive discussion with opposing claims. The supportive document uses a measurement of emissions over the entire life cycle of a barrel of oil, from the time it is extracted from the sands to the time it is burned as fuel in a vehicle (i.e. "well-to-wheels"). However, once a barrel of oil has been refined, its source no longer matters; the average emissions from fuel combustion will be the same. Fuel combustion is also the most GHG

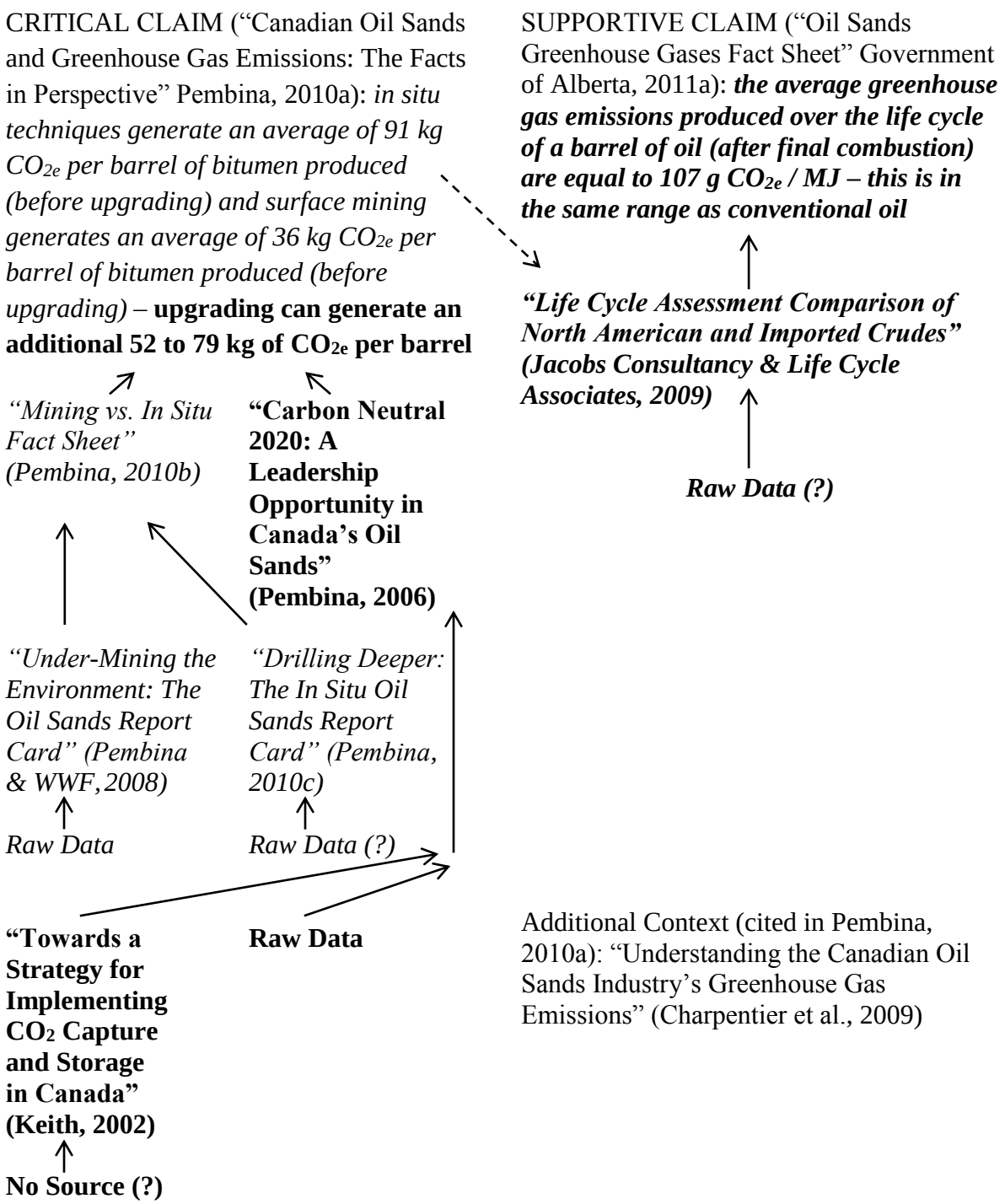

Figure 1. Traces of factual claims found in opposing documents regarding the greenhouse gas emissions of the Alberta oil sands. Different claims are traced by font style. Note that arrows indicate sources and subsequent sources of information. The dashed arrow represents a critique of one document by another. Question marks indicate when a source was not clear. A relevant peer-reviewed academic publication is also included.

intensive stage of the life cycle. As such, supporters (e.g. the Government of Alberta) can present life cycle statistics to make oil sands emissions appear scarcely higher than those of conventional oil. At the same time, the critical document presents measurements from the extraction and upgrading processes alone, giving a more precise impression of the differences between different extraction techniques (i.e. mining vs. in situ) but lacking context for the numbers presented. The intensity of in situ techniques, which appear to emit three times the GHGs as mining techniques, is perhaps exaggerated by the omission of life-cycle numbers. More importantly, the sets of numbers provided by the opposing sides cannot easily be checked against one another. Hypothetically, the critics' extraction and upgrading numbers could be derived from the life-cycle estimates (converting the units of g CO_{2e}/MJ to kg CO_{2e}/barrel) given in the Jacobs Consultancy and Life Cycle Associates (2009)[*] document (used by the Government of Alberta publication), but it is unclear which rows of data would qualify as belonging to the extraction and upgrading phases and whether they include "upstream natural gas" as the critical claim does. In addition, it should be possible to check the life-cycle numbers against academic findings (e.g. in Charpentier, Bergerson, & MacLean, 2009), but converting between the units of g CO_{2e}/MJ and kg CO_{2e}/km is complicated and would require making assumptions about mileage. Note, however, that the critical numbers clearly fall into the range of academic estimates (indeed, the academic article was sourced in a critical document). Overall, each side has chosen a way of presenting the numbers that best makes its point, but it has resulted in a situation

[*] Note that Jacobs Consultancy and Life Cycle Associates are independent consulting agencies, presumably contracted by the supportive side of the debate to collect and report information about the oil sands' emissions.

where the numbers cannot easily be confirmed or compared to one another and are thus somewhat meaningless to the overall debate.

Second, as factual claims were traced to their origins, it was established that the initial data leading to such claims was often unclear and thereby unverifiable. The Jacobs Consultancy and Life Cycle Associates (2009) document relied upon by the supportive document is poorly sourced, with an unclear description of where the numbers were extracted from and only one generic citation from the US Energy Information Administration (i.e. it does not refer to any specific part of the text and no page numbers are provided) at the end of the data-rich section on life-cycle estimates and tables. The oil sands numbers could not possibly be from this source as it reports only US statistics. In addition, the critical numbers on emissions from upgrading are based on Keith (2002), which provides no source for its claim about the ratio of emissions to hydrogen production for bitumen upgrading. As well, it was never indicated in Pembina's (2010c) "In Situ Oil Sands Report Card" how exactly the critical numbers for greenhouse gas emissions from in situ processes were determined, although it is likely safe to assume the same method used in the World Wildlife Fund's (WWF) and Pembina's (2008) "Under-Mining the Environment" report card on the oil sands was used here (i.e. data was extracted from project applications submitted by industry) since the two documents appear to be "sister" publications (i.e. the former is about in-situ extraction and the latter is about surface extraction but they are otherwise very similar). Altogether, a number of factual claims appear to be rooted in sources that are unclear or absent and cannot truly be verified. Positions formed on, or debates occurring over, such numbers are frivolous if those numbers are incorrect or inappropriate to begin with.

Third, not only were the ultimate sources sometimes unclear, but the processes by which factual claims were transformed from document to document were also often unspecified. For instance, the "oil sands average" life cycle emissions of 107 g CO_{2e}/MJ, as reported by the supportive document, has clearly been derived from the data in the Jacobs Consultancy and Life Cycle Associates (2009) report along with the other numbers in the comparison chart, but it is unclear how this average was calculated from the six numbers associated with the oil sands in the relevant table; a flat average would have been about 111 g CO_{2e}/MJ. On the other hand, when the critical document presents the average for extraction emissions from surface mining (i.e. 36 kg CO_{2e}/barrel), it has clearly been calculated through a flat averaging of estimates from the eight development projects for which the authors had access to the data, although they do not explicitly say so. However, a flat average is not particularly appropriate for the data on the critical side; the projects vary in size, some producing more barrels than others, and so the data from the larger projects must carry more weight to give an accurate picture of the average emissions per barrel. In fact, since the larger projects tended to have lower emissions per barrel, the flat averaging mechanism chosen by the critical side inflated their estimate of GHG intensity. It is misleading for both sides to claim that they are using data from another document when in actuality they had *calculated* data from another document using their own undisclosed process, spinning it to make their point. Such practices are damaging to the process of deliberation since third parties (e.g. the general public or whatever other groups the coalitions are appealing to) cannot properly form an educated opinion when the real data is hidden from them.

Fourth, the authors of the opposing documents made little use of the available academic research on the issue of oil sands GHGs, preferring instead to do their own investigations or hire independent agencies to do it for them. While Charpentier et al. (2009) is indeed mentioned in the critical document, it is done so only to supplement numbers independently calculated by Pembina, instead of the findings themselves being presented as the relevant information. Using the article in this way is puzzling given that it reports numbers similar to Pembina's, synthesizes the results of numerous studies, has been peer-reviewed (and thus likely has a more rigorous and transparent methodology), and would have less of a perceived bias than Pembina's independent research. Contrarily, the supportive documents do not appear to make reference to academic findings at all, which is even more questionable. If environmental policy dialogue does not make use of existing academic studies on any given issue at hand, redundant independent research may be conducted by biased policy actors and it will be more difficult for opponents to find a neutral ground from which to discuss mutually important issues, such as the best ways to reduce GHGs from the oil sands.

Fifth, many of the dialogue problems discussed above are compounded by the number of times each factual claim is repeated. Some of the critical claims about emissions from upgrading, for example, were ultimately based on an un-sourced, approximate ratio from Keith (2002) of 5 Mt CO_2/year emitted from hydrogen production for each million barrels/day of synthetic crude upgraded. The ratio was converted into 14 kg CO_{2e}/barrel, displayed in a table in Pembina's (2006) "Carbon Neutral 2020" document, and seemingly arbitrarily designated as a low emissions estimate. Finally, it was put together with data from some other sources (that were not publicly available) to form the most recent critical

claim about the range of emissions from upgrading bitumen (i.e. 52 to 79 kg CO_{2e}/barrel). The number of nested citations in the tracing of this factual claim indicates ample opportunity for numbers to be interpreted inappropriately or arbitrarily (e.g. the initial ratio hardly seems to be a legitimate measurement) and then hidden with a citation. It is very difficult for the public or opposition to scrutinize factual claims when their bases are not immediately clear. A single citation for a claim is not enough to verify its legitimacy (i.e. the citation itself must be investigated), but it is often treated as if it were. Note that, while the trace for this particular critical claim was long, many of the claims in the supportive document could not be traced at all, which is an even greater problem.

Finally, despite the plethora of problems discovered above, the authors of the documents under review rarely critique the opposing coalition's use of information directly, instead engaging with the issue independently. The only instance of criticism identified through the document review was an attack on the methodology of the Jacobs Consultancy and Life Cycle Associates (2009) report by Pembina's (2010a) briefing note on emissions from the oil sands. As such, ample opportunity exists for either side to demand sources from the other, convert the opposing claims to a common language, compare opposing findings to those of academia, reconcile opposing calculations, and expose ultimate sources of the opposing side. Given that most of these deliberative actions have not been taken by either document in any substantial fashion, much of their respective claims appear to talk past the other's and appeal to third parties like the general public, which does not necessarily have the interest or the time to scrutinize presented data. Such indirect dialogue is less likely to be productive than one where opponents demand appropriate data from one another and progress can actually be made as information is refined, positions shift, and

policy brokers are persuaded (i.e. the ideal under the advocacy coalition framework – see Sabatier, 1988).

Lessons learned

Assuming that such observations are indicative of a larger, pervasive problem with the exchange between coalitions, two major lessons can be derived from them. The first is that a more central role for science in policy-making and the related deliberation would be beneficial. Bradshaw and Borchers (2000) suggest increased communication of scientific findings to the public, increased used of scientific best estimates as opposed to ranges of possible numbers, and perpetuating an understanding that science cannot always provide certainty in its findings and predictions (par. 17-19). Hulme (2009) crystallizes similar recommendations in a "co-production" model of knowledge and policy; he argues for recognition that policies and their goals "emerge out of joint scientific and non-scientific (i.e. political or value-driven) considerations" (p. 104) and suggests that an appropriate approach to environmental dialogue would be "to invite open consultation across society about what dimensions of risk actually matter to the public, to invite experts to assess and contribute what is known about the risks… and to require politicians and policy makers to argue and negotiate in public about what level of risk is intolerable and to set policy accordingly" (p. 105). This model would see science (i.e. academic research and findings) as commonly accepted instead of discreetly interpreted or performed independently by opposing sides, allowing the discussion to focus on more important areas such as what tradeoffs between environmental preservation and economic prosperity society is willing to accept. If both sides in the oil sands controversy, for example, agreed to use the Charpentier

et al. (2009) results instead of their own, they would have to focus on the real reasons they disagree instead of implying the other side has only settled on its position because its numbers are wrong. A primary reliance on neutral academic data thus addresses most of the problems identified through the document review; there is little need for independent calculations and nested citations when everyone is operating with the same basic data. However, this approach assumes that the necessary scientific findings will always be available and requires the relevant policy actors to agree to such a benchmark in the first place, which might be unlikely since both sides may be unwilling to open up their respective positions (due to cognitive dissonance) to re-examination in the context of numbers not under their control – the refusal of some actors to accept the consensus findings of the IPCC confirms this. Perhaps such a model is too optimistic and theoretical, but it certainly points to the advantages of giving primacy to academic results.

The second lesson emerging from the above observations is that a physical institution (i.e. rather than an intangible set of norms or rules) may be required to facilitate social consensus-building and movement in positions instead of opposing sides simply becoming further entrenched in their initial stances. Hendriks, Dryzek, and Hunold (2007) speak to two types of forums, non-partisan (primarily involving lay citizens) and partisan (primarily involving policy actors). After comparing existing examples of each in Germany, they conclude that the "non-partisan case was clearly superior in terms of deliberative capacity. Though it had clear shortcomings in terms of its perceived impact and legitimacy, it performed no worse and in some aspects better than the partisan forum" (p. 377). The existing discussion over Alberta's oil sands' GHGs seems to be a de facto partisan forum, where influential policy actors are the key participants and the involvement

of lay citizens (e.g. in public consultation) appears to be minimal. Hendriks et al. (2007) might suggest that a citizens' conference on the oil sands, where the available information is actually dissected, would allow some approximate consensus to be reached while lessening the influence of biased actors (see Reed et al., 2007). Complementarily, Chambers (2003) argues that issue conventions (e.g. citizens' conferences) benefit greatly from certain institutional design characteristics. She observes that while group polarization research suggests that each member of a deliberating group will tend to move further in the direction of their initial position, such a tendency does not emerge when the participants are randomly chosen citizens, when moderators oversee the discussions, and when experts provide information and answer questions (pp. 319-320). The new suggestion here is that a moderating influence may be necessary for deliberation to be effective. When biased actors are left to their own devices to engage in dialogue, each actor will likely attempt to verify their initial position instead of change their mind or discover areas of commonality. A forum using a moderating influence that requires the opposing sides to talk directly to one another (i.e. speak the same language) and accept a common metric for legitimate information would address many of the issues identified in the document review; a physical deliberative institution, potentially facilitated by a university, may be necessary if policy actors cannot or will not change the social system of environmental policy dialogue on their own. Even Sabatier (1988) hypothesizes that a professionalized forum with well-understood norms makes movement in policy controversies more likely.

These are general lessons which should be applicable to other environmental policy controversies that experience similar problems with manipulative uses of information that undermine effective deliberation. It would, however, be prudent to give some brief

explanation of the unique intractability of the controversy in Alberta. One of Sabatier's (1988) hypotheses is that policy-oriented learning (i.e. movement in the debate) is most likely when there is only an intermediate level of conflict between the coalitions. Perhaps in the case of the Alberta oil sands controversy the coalitions are so fundamentally opposed in their attitudes towards economic growth and the natural environment that it is naïve to expect much consensus-building on the oil sands issue, which may be somewhat destined for political stalemate. In addition, Sabatier (1988) seems to see government decision-makers as the ideal policy brokers to arbitrate between competing coalitions, but in the Alberta case the government actually belongs to the supportive coalition (Hoberg & Phillips, 2011). This situation leaves only the general public, which is unlikely to scrutinize or arbitrate in any coordinated fashion, to act as de facto policy brokers. As such, the case of the Alberta oil sands is a particularly intractable environmental policy controversy and, as such, will be especially dependent on external actors (e.g. universities) to initiate and facilitate consensus-building and other movement within the discussion.

Conclusion

The complex nature of environmental issues leads to the associated scientific findings and predictions being particularly uncertain and thereby open to subjective interpretation. Due to the effects of cognitive dissonance, individuals (including members of influential advocacy coalitions) may process this information in a biased fashion to confirm their initial opinion on any given issue. The case study of Alberta oil sands emissions suggests that the de facto dialogue occurring between advocacy coalitions may be unproductive; they speak different languages, the ultimate sources of their information

are questionable, they use undisclosed processes and assumptions, they potentially magnify misinformation through nested citations, they make insufficient use of academic sources, and they fail to engage directly with one another. Similar problems will likely be present in other environmental policy controversies with comparable underlying complexity. Existing literature suggests that setting up rules for more effective deliberation (e.g. a central role for independent academic findings, common metrics for determining the legitimacy of information, ensuring that opposing sides are not talking past each other, etc.) through deliberative institutions, such as citizens' forums, would address a number of these issues. As a side note, this study also found the critical document to use information in a slightly more legitimate manner (e.g. its sources were generally clearer and they better engaged with the opposing side). A more extensive review could determine whether this observation holds true for the critical coalition as a whole.

As this paper's purpose was simply to demonstrate some existing problems with environmental policy dialogue and make suggestions for addressing them, there remain several potential studies in the same broad area that would be productive. First, as this study was exploratory in nature, its findings could be reinforced through further research on the same case study; members of the relevant advocacy coalitions, especially those responsible for authoring the documents reviewed, could be interviewed to confirm their motivations and approach to information dissemination. Second, the document review method employed here, the tracing of factual claims to their ultimate origin, could be used to investigate similar questions, refined, and have a more established methodology built around it – claim-tracing was an effective way to investigate the questions of this paper, and was even able to assess which document used more legitimate and transparent

information, but (as far as this author is aware) it has rarely been employed systematically in academic studies to date. Third, a model institution could be devised around the suggestions given in the above discussion. A generic mechanism of deliberation, whether a type of citizens' forum that considers issues independent of influential partisans or an independent moderating organization that extracts relevant information from opposing sides and creates a dialogue between them, could be developed for any policy controversy, but would need more concrete guidelines from the deliberation literature to be practically applicable. In addition, a specific institution or process for better resolving the controversy over Alberta's oil sands could also be developed and perhaps carried out on the scale of an academic study. Indeed, academia may be the starting point for more effective deliberation. Fourth, if academia cannot facilitate the necessary deliberation, more work will be required on how to get policy actors to agree to the above principles, since each side as it stands has an interest in continuing to spin information so that it supports their position. It will be very challenging to convince partisan actors to have a collective interest in a common benchmark for determining legitimate information and interpretations, especially when the government (another body with the potential to set up deliberative institutions) is one of them. Overall, this study has resulted in some telling observations about environmental policy controversy and a few basic suggestions that could address them, but the biggest questions in designing a system of dialogue that leads to more effective movement in environmental policy controversies still require exploration.

Acknowledgements

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Appendix 1

Document:
Pembina, 2010a

Claims:
"2007 data used in Pembina reports[17] based on actual emissions reporting and estimates from project application environmental impact assessments indicate that in situ production (without upgrading) weighted an average 91 kg CO_{2e} per barrel compared to mining (without upgrading) at an average 36 kg CO_{2e} per barrel. In both cases, production includes upstream natural gas. It should be noted that in most cases, the bitumen from oil sands needs to undergo an intensive upgrading process to become synthetic crude before it can be used in a refinery like other crudes. Estimates suggest that greenhouse gas emissions for upgrading can be in the range of 52 to 79 kg of CO_{2e} per barrel of bitumen.[18]" (p. 7)

Sources:
"[17]Marc Huot and Simon Dyer. "Mining vs. In Situ Factsheet." Pembina Institute (2010). http://www.oilsandswatch.org/pub/2017." [Pre-upgrading numbers were taken directly from a table comparing mining and in-situ numbers in this document.]
"[18]The Pembina Institute. Carbon Neutral 2020 – A Leadership Opportunity in Canada's Oil Sands. (Drayton Valley, AB: The Pembina Institute, 2006). http://www.oilsandswatch.org/pub/ 1316." [The range of upgrading numbers was taken directly from a table indicating low and high emission intensity scenarios in this document.]

Document:
Pembina, 2010b

Claims:

Oil Sands Impacts: Mining vs. In Situ

	In situ	Mining
Cleared Area Intensity (hectares/million barrels)	1.4	**9.4**
NO_x Intensity (grams/barrel)	132	**146**
SO_2 Intensity (grams/barrel)	**112**	30
Water Use Intensity (barrels/barrel)	1.1	**2.1**
Greenhouse Gas Intensity (kilograms CO_2e/barrel)	**91**	36

Note: These values are weighted averages that represent the impacts associated with the production of bitumen. The additiona impacts associated with upgrading bitumen to synthetic crude are not included. Information on upgrading emissions and water use is available in *Upgrader Alley* (www.oilsandswatch.org/pub/1654).

(p. 1)

Sources:
"Unless indicated otherwise, all data in this fact sheet is derived from the Pembina Institute's two oil sands report cards: Under-Mining the Environment: The Oil Sands Report Card www.oilsandswatch.org/pub/1571 [and] Drilling Deeper: The In Situ Oil Sands Report Card www.oilsandswatch.org/pub/1981" [The mining greenhouse gas intensity number appears to be the average of the eight projects examined in the former while the in situ greenhouse gas intensity number was taken directly from a chart in the latter.]

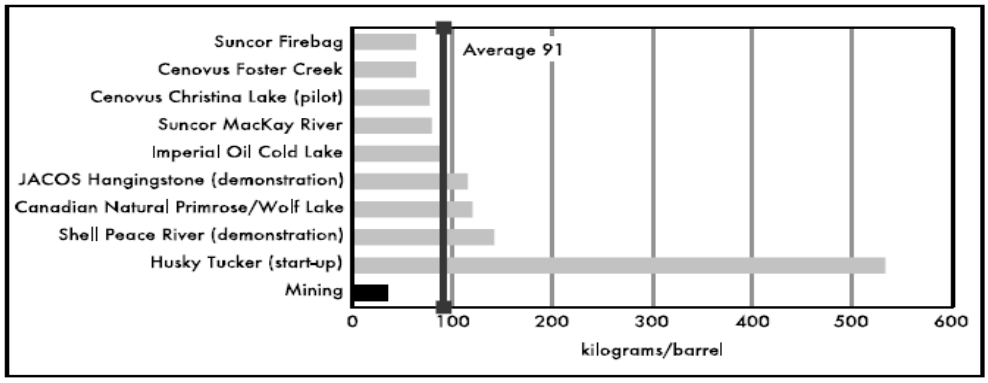
Document:
Pembina & WWF, 2008

Claims:
"Both Canadian Natural and Albian Muskeg's existing operations have significantly lower greenhouse gas (GHG) intensities of 23.34 $kgCO_{2eq}$/bbl and 24.44 kgCO2eq/bbl in comparison with other projects. The Synenco Northern Lights, Fort Hills, Kearl, Jackpine and Joslyn mines have GHG intensities of 41.56 $kgCO_{2eq}$/bbl, 40.50 $kgCO_{2eq}$/bbl, 40.39 $kgCO_{2eq}$/bbl, 36.14 $kgCO_{2eq}$/bbl and 39.87 $kgCO_{2eq}$/bbl respectively. The Albian Muskeg River Mine Expansion projects will produce relatively more emissions per barrel than the other mine projects with a GHG intensity of 44.44 $kgCO_{2eq}$/bbl." (p. 48)

Sources:
"Onsite emission values are sourced, for the most part, from public documents or provided from the respective companies. Offsite emission values are based on emission factors sourced or calculated from publicly available information." [Essentially they derived their statistics from raw data collected from various companies – tracing the factual claim about surface mining greenhouse gas intensity past this point is difficult as much of the data is not easily accessible to the public.]

Document:
Pembina, 2010c

Claims:
▼ *Figure 22: Greenhouse gas emissions per barrel of bitumen produced.*



(p. 54)

Sources:
[No clear sources or methods are indicated in this report, but it is set up in a very similar fashion to the other Pembina report card on the oilsands – above – and so presumably used the same sort of approach to gather raw data, which is difficult to trace any further.]

Document:
Pembina, 2006

Claims:
Table 1. Amount of Emissions Produced by Various Point and Non-point Sources of GHGs for Mining and Extraction, In-situ and Upgrading Oil Sands Processes

Process	Low Emissions Intensity (kg CO_2e /bbl SCO)	High Emissions Intensity (kg CO_2e /bbl SCO)
Mining and Extraction		
Point (utility heaters, power)	17 (61%) [14]	24 (62%) [15]
Non-point (fleet, mine face, tailings ponds)	11 (39%) [14]	15 (38%) [15]
Total	**28 (100%)**	**39 (100%)**
In-situ		
Point (boilers/plant energy)	48 (92%) [16]	55 (92%) [17]
Non-point (fugitive, vehicle fleets, flaring)	4 (8%) [16]	5 (8%) [17]
Total	**52 (100%)**	**60 (100%)**
Upgrading		
Point — Hydrogen Production	14 (27%) [18]	41 (52%) [19]
Point — Combustion Sources (coker, boilers)	37 (72%) [20]	37 (47%) [20]
Non-Point (fugitive)	1 (1%) [20]	1 (1%) [20]
Total	**52 (100%)**	**79 (100%)**
Total[21]	**91**	**127**

(p. 11)

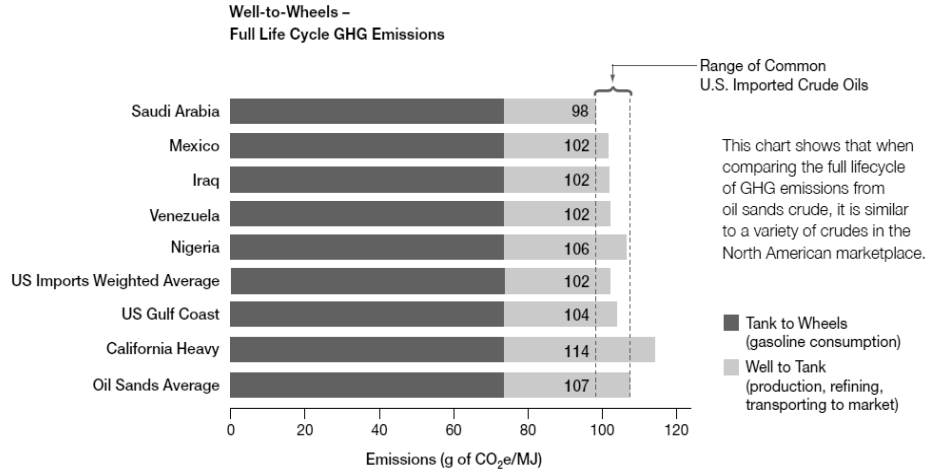
Sources:
"[18]Keith, David. December 2002. *Towards a Strategy for Implementing CO2 Capture and Storage in Canada*." [One of the hydrogen numbers appears to have been calculated from an approximate ratio given in this report – unclear why it is has been designated "low emissions".]
"[19]Suncor Energy. March 2005. *Voyageur Project Environmental Impact Assessment Volume 3*." [This document does not appear to be publicly available, so the factual claim could not be traced any further in this direction.]
"[20]CNRL. June 2002. *Horizon Oilsands Project Application for Approval*." [This document does not appear to be publicly available, so part of the claim could not be traced further.]

Document:
Keith, 2002

Claims:
"Because the largest uncertainty in estimating the potential CO_2 production lies in predicting the future rate of synthetic crude production, it is perhaps most useful to estimate the ratio of H_2-CO_2 production to the output of synthetic crude; that ratio is about 5 Mt-CO_2/year for each million bbl/day of synthetic crude." (p. 10) [The calculation used by the Pembina 2006 report appears to be: 5 Mt CO_2/yr ÷ 365 days/yr ÷ 1 000 000 barrels/day x 1 000 000 000 kg/Mt = 13.70 kg CO_2/barrel.]
Sources:
[It is not at all clear where this ratio came from, so the factual claim cannot be traced past this point.]

Document:
Government of Alberta, 2011a

Claims:



(p. 2)

Sources:
"Jacobs Consultancy and Life Cycle Associates, *Life Cycle Assessment Comparison for North American and Imported Crudes*, July 2009." [Most of the above numbers are from a table in this report – e.g. the Saudi Arabia number is from the "Arab Medium" column –although it is not clear how exactly the "oil sands average" number was derived.]

Document:
Jacobs Consultancy & Life Cycle Associates, 2009

Claims:
Table 8-7.
Life Cycle Assessment of GHG Emissions for Crude and Bitumen to RBOB

Lifecycle Assesment of GHG Emissions		Bachaquero	Maya	Arab Medium	Mars	Bonny Light	Kirkuk Blend	CA TEOR	SAGD SCO - Ckr	SAGD SCO - Eb-Bed	SAGD Bitumen	Dilbit	Mining SCO - Ckr	Mining Bitumen
		RBOB	RBOB	RBOB	RBOB	RBOB	RBOB	RBOB	RBOB	RBOB	RBOB	RBOB	RBOB	RBOB
Rate	BPSD	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Heating Value	GJ/Bbl	5.23	5.16	5.16	5.15	5.34	5.18	5.22	5.19	5.19	5.08	5.02	5.19	5.08
Emissions		g/MJ	g/MJ	g/MJ	g/MJ	g/MJ	g/MJ	g/MJ	g/MJ	g/MJ	g/MJ	g/MJ	g/MJ	g/MJ
Total WTW Emissions		101.9	102.1	98.3	103.9	106.4	101.7	114.2	116.1	118.9	113.1	105.4	108.2	105.4
Vehicle CH4, N2O		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Carbon in Fuel		72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9	72.9
Total WTT GHG Emissions		28.2	28.4	24.6	30.2	32.7	28.0	40.5	42.5	45.2	39.4	31.7	34.5	31.7

(pp. 8-12)

Sources:
[The sources for this information are not particularly clear – it seems to be a synthesis of existing information they acquired – the single endnote for this section refers to a publication by the US Energy Information Administration; some or all of the data may be from there, but it is very difficult to trace with no page numbers given or specific text quoted]

Critique:
[This report was criticized by Pembina 2010a (p. 4), the initial critical document in this review, namely for comparing the oil sands to primarily heavy crudes, insufficient peer and technical review, and measuring emissions from bitumen mixtures instead of only pure bitumen]

Document:
Charpentier et al., 2009

Claims:
"The production of synthetic crude oil (SCO) through surface mining and upgrading (SM&Up) or *in situ* and upgrading (IS&Up) processes is reported to result in emissions ranging from 62 to 164 and 99 to 176 $kgCO_{2eq}$/bbl SCO, respectively (or 9.2-26.5 and 16.2-28.7 gCO_{2eq} MJ^{-1} SCO, respectively), compared to 27-58 $kgCO_{2eq}$/bbl (4.5-9.6 gCO_{2eq} MJ^{-1}) of crude for conventional oil production… On a "well-to-wheel" basis, GHG emissions associated with producing reformulated gasoline from oil sands with current SM&Up, IS&Up, and *in situ* (without upgrading) technologies are 260-320, 320-350, and 270-340 gCO_{2eq} km^{-1}, respectively, compared to 250-280 gCO_{2eq} km^{-1} for production from conventional oil. Some variation between studies is expected due to differences in methods, technologies studied, and operating choices." (p. 1)

Sources:
[These factual claims were reported in a peer-reviewed academic journal and so do not really require tracing for the purposes of this review – this document is included here to provide an alternative source of "more neutral" information outside the actors directly involved in the controversy]