JOINT REVIEW PANEL FOR THE ENBRIDGE NORTHERN GATEWAY PROJECT
COMMISSION D'EXAMEN CONJOINT DU PROJET ENBRIDGE NORTHERN GATEWAY

Hearing Order OH-4-2011
Ordonnance d'audience OH-4-2011

Northern Gateway Pipelines Inc.
Enbridge Northern Gateway Project
Application of 27 May 2010

Demande de Northern Gateway Pipelines Inc.
du 27 mai 2010 relative au projet
Enbridge Northern Gateway

VOLUME 13

Hearing held at
Audience tenue à

Ramada Hotel Downtown
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Prince George, British Columbia

January 18, 2012
Le 18 janvier 2012

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HEARING /AUDIENCE
OH-4-2011

IN THE MATTER OF an application filed by the Northern Gateway Pipelines Limited Partnership for a Certificate of Public Convenience and Necessity pursuant to section 52 of the *National Energy Board Act*, for authorization to construct and operate the Enbridge Northern Gateway Project.

HEARING LOCATION/LIEU DE L'AUDIENCE

Hearing held in Prince George (British Columbia), Wednesday, January 18, 2012
Audience tenue à Prince George (Colombie-Britannique), Mercredi, le 18 janvier 2012

JOINT REVIEW PANEL/LA COMMISSION D'EXAMEN CONJOINT

S. Leggett	Chairperson/Présidente
K. Bateman	Member/Membre
H. Matthews	Member/Membre

ORAL PRESENTATIONS/REPRÉSENTATIONS ORALES

Métis Nation of BC
- Mr. Gary Ducommun

C.J. Peter Associates Engineering
- Mr. Christopher Peter
- Mr. Norman Jacob

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--- Upon commencing at 6:01 p.m./L'audience débute à 18h01

(Opening Prayer)

7109. **THE CHAIRPERSON:** Thank you very much for that opening prayer.

7110. Good evening, everyone. Thank you for joining us for this Joint Review Panel community hearing for the Enbridge Northern Gateway Project.

7111. My name is Sheila Leggett and I'm the Chair of this Joint Review Panel. My Panel colleagues are, to my right, Mr. Kenneth Bateman, and to my left, Hans Matthews.

7112. Hans, did you have any opening comments you wanted to make?

7113. **MEMBER MATTHEWS:** Just thanks for inviting us out to Prince George in the Métis territory and the First Nations territory; we really appreciate being here. We look forward to hearing from you.

7114. Thanks.

7115. **THE CHAIRPERSON:** Excuse me; we're going to need quiet in the room. Thank you very much.

7116. Kenneth, any opening comments you'd like to make?

7117. **MEMBER BATEMAN:** Yes. Thank you for inviting us to the community. We look forward to hearing the perspectives and the views that will be shared and we'll listen carefully and wish you well on this cold night.

7118. **THE CHAIRPERSON:** I'd like to introduce you to the Panel Secretariat members who are in attendance with us. These are the people who work with us to create and deliver a transparent, fair and respectful process.

7119. In addition to helping the Panel, they're here to answer any process-related questions you have.

7120. You can identify all these individuals, as they will each be wearing a name tag. And as the room is pretty crowded, we may not be able to spot all of them, but I'll read their names and just ask them to identify themselves if they can.

7121. Ms. Louise Niro and Ms. Deb Gilbert, at the front table here, are our Regulatory Officers; Ms. Ruth Mills, our Hearing Manager; Ms. Sarah Devin, our Panel Manager; Mr. Nelson Peters, our Safety and Security Officer; Ms. Margaret McQuiston, our Process Advisor; Ms. Rebecca Brown, counsel; Ms. Kristen Higgins, Communications Advisor; Mr. Joshua Bourelle, our Socio-Economic Specialist at the back of the room; and Ms. Jessica Fung, our IT Specialist.

7122. In addition, we have two contractors here to help us tonight, Mr. Dale Waterman, our court reporter, as well as Mr. Jon Konecny, our sound technician.

7123. Before we start today's session, I just point that if we did need to exit the room, the exits are at the back of the room immediately behind all of us here.

7124. All of the oral evidence given throughout the community hearings will be transcribed. Transcripts will be posted on the public registry, which is on the Panel's website. The session this evening is being broadcast live on the Panel's website.

7125. On May 27, 2010, Northern Gateway Pipelines Limited Partnership applied to the National Energy Board for approval to construct and operate the Enbridge Northern Gateway Project. That project would include two 1,172-kilometre pipelines between Bruderheim, Alberta, and the new marine terminal at Kitimat, British Columbia.

7126. In addition to a review under the *National Energy Board Act*, the Application requires an environmental assessment pursuant to the *Canadian Environmental Assessment Act*.

7127. The review of this project has been ongoing since its filing. Much of that review to date has been conducted in writing. You'll find a complete record of the review process that has occurred on our website. The record includes all of the information that the Panel will consider in making our decisions.

7128. We will not consider any information that is not in the record. All of the information you share with us will be taken into consideration as we deliberate.

7129. The website will continue to be the source of the record for this review, up to and including the release of our decisions.

7130. Sharing your personal knowledge and views on the impacts that the

proposed project may have on you and your community and how any impacts could be eliminated or reduced is of great help to us, and we appreciate the intervenors who have chosen to be here today.

7131. We're here today to listen to oral evidence from intervenors who have previously registered with the Panel. As we've outlined in previous written communications, oral evidence is information that is relevant to the matters the Panel will be considering, as stated in the List of the Issues in the Hearing Order, but that cannot be provided as written evidence. We're here today to listen to you.

7132. Before we begin to listen, I'd like to summarize some of the review steps the Panel has already undertaken with the participation of many parties.

7133. In July of 2010, the Panel began seeking input from the public and Aboriginal groups on certain aspects of the Joint Review. Specifically, we consulted on the List of Issues, if additional information was required, and the locations for the hearings.

7134. Through this comment process, the Panel received a large number of written comments and heard from dozens of interested individuals and groups in oral public sessions held in Whitecourt, Alberta, and Kitimat and Prince George, British Columbia.

7135. All of the information received was helpful to us, and we considered all of the written and verbal comments before we issued the Panel session results and decision document in January of 2011.

7136. Guided by the input we received, the Panel revised its draft list of issues, which provided further clarity on the scope of our review, and required Northern Gateway to file further evidence on the record.

7137. On May 5th, 2011, we issued a document called a Hearing Order, which established the overall process and set some initial deadlines for the review. Over the last few months, we have also issued several procedural directions to provide additional details on the review process.

7138. The Hearing Order and the most recent procedural direction are set out on the table at the side of the -- towards the back of the room here.

7139. The process for the joint review includes two sets of hearings: the

community hearings, of which we're here to have one of those this evening, where interested parties and participants can provide evidence to the Panel orally; and the final hearings, where Northern Gateway and other parties can be asked questions about their evidence and provide their final arguments to the Panel.

7140. Before beginning these community hearings, two rounds of information requests by the parties have been answered by the Applicant, and written evidence from intervenors and government participants has been received.

7141. The Panel has also asked a number of information requests to the Applicant.

7142. In Procedural Direction No. 3 we focused on the community hearings. One aspect of these hearings addressed within this document was our decision to not allow any motions during the community hearings.

7143. When you're providing oral evidence, there's no need for you to repeat any information that you've already filed in your written evidence. Oral evidence is intended to allow parties to relay information to the Panel firsthand that cannot be provided in writing, such as oral traditional knowledge.

7144. This is not the time to provide the Panel with your arguments and opinions on the decisions that you would like the Panel to make. That opportunity will be the last step in the review process before the Panel begins its deliberations.

7145. One of my roles as the Chair of the Panel is to ensure that these hearings unfold in a respectful manner. Being courteous and respectful of one another allows everyone in the room and those joining us through the internet to concentrate on listening to the person who is speaking. Kenneth, Hans, and I appreciate your cooperation in this regard.

7146. We have two parties registered tonight in our Order of Appearances to provide oral evidence.

7147. Before any individual provides evidence, they will be asked to swear or affirm that evidence, and Ms. Niro will lead through that process.

7148. So with that, I would call the Métis Nation of B.C. Mr. Ducommon, I see you're already at the table. Can you affirm that you remain under oath?

7149. **MR. DUCOMMON:** I remain under oath.

7150. **THE CHAIRPERSON:** Thank you, Mr. Ducommon, please proceed.

GARY DUCOMMON: Resumed

--- ORAL PRESENTATION BY/REPRÉSENTATION ORALE PAR MR. GARY DUCOMMON:

7151. **MR. DUCOMMON:** Thank you.

7152. First off, I'd like to acknowledge and make a minor correction or small correction, but a significant one. We are in Lheidli T'enneh, Carrier Sekani territory, and Métis people are one of the people who've been here for a couple of hundred years, but we are not the original people of this land.

7153. Having said that, I'm here today to talk about the serious and significant concerns that Métis have regarding the pipeline proposal and its potential impacts on our way of life, our culture, and our wellbeing of our citizens.

7154. So I'd like to start with a little bit of background, a little bit of history to put in context the reason why Métis are here today to talk to the Panel about our concerns. Métis history or at least documented history in this area began in about 1793 when the Northwest Company first came to this land.

7155. One of the first explorers by the name of Alexander Mackenzie came. There's a lot written about Mackenzie. There's not a lot written about the people who guided him here, but there is a list of names which are Métis people, including Mackay, Landry, Doucette, Beaulieu, Bisson, Couteau and Beauchamps, and all of those names still exist in the Métis community within British Columbia today.

7156. A few years later, Simon Fraser came to the area and built Fort George, historic Fort George, 1806, and with him were a number of Métis individuals. Lachapelle, Baptiste, Dallaire, Lacerte, Boucher, Gagnon, Bourbois and Lagarde are in the record -- in the formal record of those days.

7157. And as the labour force, if you will, of the fur trade, Métis were well established by about 1812 in this area and, in fact, Alexander Henry, who was a fur trader and a Métis patriarch as well, wrote in 1812 that the Northwest Company had

50 men in Fort George and several hundred in posts west of the Rockies by that time.

7158. Métis have an oral history and our oral history tells us that as descendants of Cree, of primarily Cree people on the other side of the mountains, that Cree actually came here to trade, sometimes to war, since time immemorial, and we understand or we believe within our culture that our people were at least this far, even prior to documented history.

7159. But interestingly enough, Métis are documented, and part of the reason is because of their connection to the fur trade that we show up in some of those old records.

7160. One of the things that Métis Nation B.C. has done is we have a Métis -- a British Columbia Métis research team and it's affiliated with the University of British Columbia. One of the things that we've done is we've gathered historic records, and a lot of what I'm going to tell you about the history of Métis comes from those records.

7161. Currently, the historic document database, we call it, has an estimated 60,000 documents. Approximately 8,000 of those have been indexed. So university students have actually read them. And the database is searchable. We can search by patronym, by name, by activity, by place.

7162. So I'm going to give a couple of examples of some kind of non -- we would call it non bias writing that was done about Métis around the turn of the century, and one is a paper written by James Tate.

7163. James Tate was an ethnographer. He worked in the area south and also east of Fort George in the late 1800s and he primarily was researching the Shuswap people, the Secwepemc people, First Nation people.

7164. But one of the interesting things that shows up in his manuscript that was published in 1909 under the Jessup North American Expedition is a description of the neighbours of the Shuswap people to the north in the area of Tejon, and Tejon is east of here, between here and Jasper Park, for instance.

7165. One of the things that he says about those people is that they were an Aboriginal people that lived around Tejon and that they had been there since about 1816, and that the Shuswap called them "le Michif", meaning half-breeds in French. And to this day, as our Elder indicated, it's actually the name that we give our

language, which is a Creole language, which is part Cree and part French.

7166. Interestingly enough, he also said that the people that lived there spoke primarily Cree and French and some Shuswap. So we believe that what he was describing was a Métis community that was established as early as 1860. And then we see some other evidence of that.

7167. Another really good history of Northern B.C. was actually written by Father Maurice, published about 1904. He speaks a lot about this area. It was the history of the northern interior of British Columbia, and he talks about a lot of half-breeds.

7168. And I mean no disrespect. I grew up a half-breed. Métis, to many of us, is a fairly new word. It's a word that came with the Constitution in order to be politically correct.

7169. But he speaks at length about a number of half-breeds, and one of them is Jean-Baptiste Boucher who was a very notorious person in this area and out to the west towards Fort St. James, south towards Fort Alexander.

7170. In his works, Father Maurice actually acknowledges three Hudson Bay men, he calls them, that being Murray, McGuiness and Hamilton, and we know through our research that those were all Métis people that worked for Hudson Bay Company.

7171. Towards the north, from here, just north of Prince George, eastward towards the Alberta border, there's actually -- I guess there was, historically -- because of the Rocky Mountains there was historically kind of a bit of a barrier there.

7172. And we know that our Métis community, primarily in the Athabasca and the Peace River country came from the other side into that area around Monkman Falls, Monkman Park, which is south of Dawson Creek in Chetwynd, is named for Alex Monkman who was a Métis man who trapped there who happened to tell somebody that the river actually flowed into the mountains and not out of the mountains at that point and thereby identified that there was a pass going to Alberta that nobody had known about previously.

7173. And there was a lot of work in the 1930s and '40s to try to develop that into the access into the Peace River country because B.C. and its Peace River country were not connected by road at that time. It wasn't until some time later that the Pine

Pass Highway was put in from Prince George to Chetwynd

7174. Alex Monkman, by the way, was a cousin of my grandmother's. So my great-great-grandmother, actually, was a Monkman.

7175. Some of the other things that we see in our document database are -- we look at the census records and in 1901, in 2001 and in 2006 there are census records that are particularly important to Aboriginal people because they -- in those three particular years they asked racial origin.

7176. In 1901, they actually asked primary language, what was your first language. And for instance, I know that my grandmother's first language in 1901, she was six years old at that time, was Cree. And I've never learned my language. My mother has never learned her language. So there's a disconnect that happened somewhere around the early 1900s with Métis people.

7177. But I think the interesting thing, I did a -- I checked on those records, actually, just this afternoon to refresh my memory and from our best estimates of who was here and where they were, there was about 1,735 Métis in B.C. in 1901. There was 59,448 reported in British Columbia in 2006, which was about a third of the Aboriginal population of the province. And there's somewhere right around 4,000 Métis reported to be living in Prince George in 2006. So along the pipeline route it's definitely one of the larger Métis populations.

7178. As you know, because I've been following along the meetings, it's part of a population of Métis people that really spans the length of the pipeline and I think we won't be speaking on the Alberta side -- Métis Nation Alberta will do that -- but I would just say at this point that we have Métis in Chetwynd. We have Métis in places like Fellers Heights, which is outside of Dawson Creek, Dawson Creek and right to the -- essentially to the border of Pouce Coupe.

7179. We know for sure that we have Métis citizens of Métis Nation B.C. in Pouce Coupe, which is -- it's not rock-throwing distance, but it's definitely hiking distance from the Alberta border.

7180. Métis people have a long history of conservation ethic. It's not something new. Over the course of the last few Panel hearings, we hear that there is a reasonable amount of concern at the higher levels of Canadian government about conservationists or environmentalists, if you will, and I felt it's important for us to say today that Métis are conservationists. We are concerned about the ecology, the

environment, and it's not something new.

7181. Métis people historically felt the same way. In fact, we -- our people codified the first wildlife and habitat protection law into our own system because we are self-governing. We've always made our own laws. And we codified our first laws in 1873; that's a long time ago.

7182. And at that time, they made laws against wasting parts of buffalo because the buffalo were starting to dwindle within the prairies. Métis people, as you are aware, live right from Ontario westward to the Pacific.

7183. They also made laws against burning grass in the prairies which, really, we view as an environmental law, and so that existed quite some time ago.

7184. Having mentioned the buffalo and the fact that the buffalo disappeared in the late 1700s, Métis people have experience with losing a natural resource on which their culture depends.

7185. Within the Prairie Provinces in that time, Métis were called "the buffalo people" and losing that resource, you know, upset their culture. It led, actually, to assimilation of many, many, many Métis people into the European lifestyle. And whether that was good or bad, I'll let scholars decide, but definitely it led to some significant cultural hardships.

7186. But one thing it also led to was the first species at risk recovery plan in the history of Canada. It started in 1873 with Métis who captured buffalo calves, bison calves. and put them together with their milk cows and raised them over a period of about 30 years. There was three Métis people, one First Nations person and two non-Aboriginals who are documented, and well documented, as having saved the buffalo from extinction.

7187. The two final farmers that owned the buffalo herd were half-breeds by the name of Pablo and Allard, and in 1907 they sold 716 bison to Canada, to the Government of Canada, and those primarily went to Banff National Park, Elk Island National Park in Wainwright and they are the basis of hundreds of thousands of buffalo that exist now.

7188. So I use that -- I'm a little long-winded, I'm sorry, but it shows that our interest in conserving the species that we depend on, conserving the diversity of our environment and working towards improvement are all things that Métis people have

done for a long time.

7189. Okay, the issues. I spoke yesterday in Burns Lake briefly about the fact that we had crossed the watersheds and we were then in Fraser River. And today, in Prince George, we're quite close to a third major watershed that the pipeline will cross and that's just north of us. It's the Peace River system where the pipeline will cross in the Parsnip Drainage.

7190. And I think at this point we would really like to indicate that the pipeline has been called unprecedented in many ways. One of the ways that maybe is not -- is not quite that complimentary, I guess, is that it's unprecedented in that it crosses watersheds that go to Hudson Bay, the Saskatchewan system, near Bruderheim.

7191. It crosses watersheds that go to the Arctic, to the Beaufort Sea when it crosses the Athabasca and also the Peace River. It crosses the Fraser watershed, which goes to Southern British Columbia, and it crosses the Skeena watershed that goes to Northern British Columbia.

7192. And other than the St. Lawrence and maybe the Columbia River, I don't think there's much left out in Canada as to where water flows from where that project will exist if it's built.

7193. I guess, more specifically, we continue -- Métis people in Prince George are fish-eaters. We don't have much opportunity to catch fish, to capture fish up here anymore, particularly salmon, which we've always either traded with our First Nations friends here or captured ourselves. And that really, obviously, is not Enbridge's fault, but it brings up the issue of cumulative effect.

7194. And the problem is that we have problems in this upper watershed with salmon resources now and the problems often are linked to water temperature. They're linked to habitat degradation. In some cases, they're linked to management of those fish away from here; for instance, fisheries in the lower river and the ocean.

7195. But the reality is that there are problems in the northern part of the Fraser watershed with salmon now and we have a huge concern that any other stressors or any other risks to that resource may tip those populations over the edge to a situation where they are extirpated. They're not extinct because there may well still be sockeye salmon in the lower watershed, but that they're unavailable to Aboriginal people here.

7196. We have some concern as well and some of our traditional knowledge

holders have indicated that they are aware and that they are concerned that in the Peace River drainage, in particular, the Parsnip. The Parsnip is a grayling -- is an Arctic grayling system and Arctic grayling are listed, I think, under the provincial -- I think they're -- I won't say what their listing is, but I think they're listed under the provincial species at risk definitions.

7197. And we've also talked to traditional land users who say, particularly in that Parsnip area, there's caribou there, mountain caribou, which as well are under stress. I believe that that population is the most northerly population of what's called the southern mountain caribou of British Columbia. I believe there's about 30 southern mountain caribou populations, and I don't believe any of them are at a level that's considered not of concern from a population standpoint.

7198. Mountain caribou are extremely sensitive to disturbance; similarly, boreal caribou, which are the populations further up on the other side of the Rockies. And there's some concern within our members that they have -- they remember -- the Elders remember the time when caribou was the primary meat source and that moose were less abundant. And now we've had a switchover where moose are more abundant and caribou are less abundant.

7199. And so there's some concern there, particularly in the upper Parsnip. And in fact, I've actually seen those caribou herds in the winter up along that part of the country as well, and I can attest that they are there.

7200. I'll briefly just speak to food security. Really, what it boils down to is that there is environmental issues that concern us and that there's food security issues that concern us. And the food security, again -- and I -- this is one thing I will reiterate every time that I speak. Food security is an issue that concerns us because it is intertwined and it is so closely connected to our cultural way of thinking that by removing resources, we damage our ability to teach our culture. We damage our ability to practise our culture, and it's something that our traditional land users, in particular, are very concerned about.

7201. And so just in closing, we, the Métis Nation of British Columbia, will be making a decision on whether to support or not support Enbridge Pipeline in a meeting of all of our elected officials, which will be held in March, and it will be based on the best information that we can provide.

7202. But having said that, to this point, the people who are culturally connected within the Métis Nation, the people who are traditional land users who wish to teach

our children to have our culture, continue definitely to have serious, serious, significant concerns about this project going forward.

7203. Thank you.

--- (Applause/Applaudissements)

7204. **THE CHAIRPERSON:** Thank you very much, Mr. Ducommun. We have no questions of clarification.

7205. C.J. Peter Associates Engineering...? Hello, welcome.

7206. **MR. PETER:** Should we step over to Louise to be sworn in?

7207. **THE CHAIRPERSON:** No, if you just settle down and make yourselves comfortable. Are you both speaking this evening?

7208. **MR. JACOB:** We're both speaking.

7209. **THE CHAIRPERSON:** Okay. So when we've got you comfortably seated, we'll have Ms. Niro come over and swear or affirm you.

7210. **MR. PETER:** Thank you very much.

7211. **THE CHAIRPERSON:** Thank you.

CHRISTOPHER PETER: Sworn
NORMAN JACOB: Sworn

7212. **THE CHAIRPERSON:** Good evening.

7213. I understand that you have filed written evidence with us, and it's on the record, and that you're here to speak to your personal knowledge of that evidence and that that's the piece that you're providing with us tonight?

7214. **MR. PETER:** We are. I would just like to clarify the procedural matter with you of obtaining permission from the Panel.

7215. At the outset, when we made application on July the 13th, 2011, we asked for permission from the Panel to provide oral evidence. And we're now just going to

reiterate what we said at the time.

7216. We have to provide four things to the Panel in order to get permission to provide oral evidence, and the first was our reason for making the request, and that is to clarify, by means of a PowerPoint presentation, which is filed with the Public Registry as Exhibit A2K4V4, the calculated energy return on investment from the project.

7217. And the written submission is complex and needs elaboration in order to be understood. So we're dealing with a concept that actually bridges the gap between what we perceive to be the two opposing viewpoints in this debate, which are the economic viewpoint and the environmental viewpoint.

7218. And the component that is common to both of those is energy. The energy is given a value by the finance people. The product being transported by the Enbridge Northern Gateway Pipeline is in fact energy.

7219. But at the same time, in the biosphere, the environment uses energy and all of the complex interactions of living organisms are actually processing energy.

7220. So there is what we perceive to be a missing component to the discussion, to the public debate, which is the discussion of actually what is going on at the energy level. Putting aside both, the environment and the economics of the situation, we would like to speak strictly on the energy.

7221. Now, we are required to request permission from the Panel to provide oral evidence and we are asking for that now. We will promise not to take more than an hour of your time.

7222. Do we have your concurrence?

7223. **THE CHAIRPERSON:** Yes, we're interested, like I say, in hearing the oral evidence piece of it. And with that, let's proceed.

7224. **MR. PETER:** Okay. Thank you very much indeed.

7225. **THE CHAIRPERSON:** Thank you.

7226. **MR. PETER:** We greatly appreciate that.

7227. **THE CHAIRPERSON:** Thank you.

--- ORAL PRESENTATION BY/REPRÉSENTATION ORALE PAR MR. CHRISTOPHER PETER:

7228. **MR. PETER:** Firstly, I would like to thank the Members of the Joint Review Panel for allowing us to give oral evidence and also to acknowledge the assistance of Margaret McQuiston in setting up the presentation.

7229. When the project was first proposed, it was intuitively obvious that the extraction, dilution, ground and ocean transport, and processing of the resource was going to consume a quantifiable amount of energy.

7230. As the hearing process developed, it became evident that the Proponent's application, the information requests and their answers and the evidence being submitted by the intervenors did not contain a key component which was the discussion of the actual energy being moved by the pipeline.

7231. Now, we perceive that as energy consultants with 25 years experience, we had the necessary tools to calculate the energy consumed by the project over and above that consumed by conventional light crude oil refined close to the source.

7232. In the 1.3 in the List of Issues is the economic feasibility of the proposed facilities, and the analysis of energy return on investment is a major component in assessing economic viability of the project. This is the reason for making this presentation.

7233. Norman Jacob will be providing a context within which our calculation of energy return on investment can be placed after I have finished.

7234. Now, a little bit about us. We're a mechanical engineering consulting firm located in Prince George, B.C. We've been here for a considerable length of time. I, myself, have got 25 years experience in building mechanical design energy modelling, energy conservation engineering. We've designed and retrofitted major buildings throughout Nunavut, Northwest Territories, Manitoba, Alberta and B.C.

7235. And I want to say a little bit about the leadership in energy and engineering design accredited professional designation and the certification of buildings under LEED, because this is relevant.

7236. Forty (40) percent of the carbon emissions of all buildings -- 40 percent of the carbon emissions and energy consumption of all of North America is contributed by buildings. So LEED buildings consume approximately 25 percent less energy on average than comparable commercial buildings.

7237. In 2011, LEED buildings worldwide saved energy equivalent to 8.29 million tonnes of coal, reducing carbon dioxide emissions by 9.4 million tonnes.

7238. In 2011, nearly 5.8 billion vehicle miles travelled were avoided by the occupants of LEED buildings thanks to efficient locations and a myriad of alternative transportation options supported by LEED, reducing carbon emissions by 2.5 million tonnes.

7239. Now, much has been made of American involvement in this process, and I just want to state that we are the members of the Cascadia Building Green Council, which is a joint chapter that is -- a joint chapter of the Canadian Green Building Council and the U.S. Green Building Council, and our territory is Washington, Oregon, British Columbia, the Territory of the Yukon and the State of Alaska.

7240. So this is essentially an industry that knows no bounds, similar to the oil industry, but we're concerned with the actual wise husbanding of resources in the form of energy.

7241. So that's just a little background on us. We also want to state that we have received no funding of any kind from anyone, including what I understand to have been an offering by the Canadian Environmental Assessment Agency at the outset of this process, but we have done this entirely on our own budget.

7242. So energy return on investment or energy return on energy invested is a measure of the quality of an energy resource. Mathematically, it is the ratio of the amount of usable energy acquired from a particular resource to the energy expended to acquire that energy.

7243. In order to make the concept as clear as possible in this presentation, each time an energy input to recover, transport or process the resource is accounted for, an oil barrel appears on the left side of the screen, showing the net energy remaining in the barrel after that energy input has been expended.

7244. So we start with a barrel of oil with the standard 6.142 gigajoules

contained in it, and each time energy is expended, the barrel is depleted. So you see how much of the barrel is usable at the end point of the process.

7245. So what energy resource is the Northern Gateway pipeline being designed to transport? Well, we all know that it's a mixture of diluent and bitumen, known in the industry as dilbit. And this is the saleable commodity being transported and marketed.

7246. Now, we understand that the percentages of the two components vary depending on the viscosities, temperatures and other items, but for the purposes of this analysis, a ratio of 70 percent bitumen and 30 percent diluent was used.

7247. And importantly, for the purpose of this analysis, all energy acquired or expended is expressed as kilojoules per litre of dilbit transported.

7248. As Norm will explain later, the boundaries set for the study were necessarily beyond the input and discharge points of the Northern Gateway pipeline.

7249. They certainly did not extend to the energy embedded in the infrastructure required to extract and deliver the project, nor to the energy lost in its end use, but they included the energy in the extraction of the bitumen, the energy in the transport of condensate by tanker, the energy in the transport of products via the Northern Gateway pipeline, the energy in the transport of the diluted bitumen by tanker and the energy in refining dilbit.

7250. Now, we say the dilbit blend to a saleable product. To be fair, we are not including the energy in refining the dilbit blend into a saleable product, only the energy required to upgrade it equivalent to a conventional crude oil feedstock entering a refinery, so that we're comparing crude oil to this project.

7251. Is that clear? If you have any questions on that, please hit us with them at the end of the presentation.

7252. So the basic unit of the petroleum industry is a barrel of oil. And you'll have to excuse me, Members of the National Energy Board and members of industry, going over a primer in what exactly is going on here. We've just got to recap.

7253. The industry insists that a barrel is a barrel, no matter what type of crude oil is being discussed. So for our purposes, the energy content of a barrel of diluted bitumen equals that of a barrel of crude oil or 6.142 gigajoules of energy.

7254. Now, what does this actually mean? It doesn't mean a lot to most people, but it's equal to -- the energy used by 707 100-watt incandescent -- you know the old filament type -- light bulbs burning for 24 hours.

7255. How is the resource extracted from the ground? Exhibit A -- filing Exhibit A2K2C9 indicates that that of the unconsumed Canadian oil sands reserves, 80 percent are in situ deposits that will need to be exploited by steam-assisted gravity drainage. So we did not consider mining extraction; we considered in situ extraction.

7256. This is an energy-intensive process by which bitumen is melted out of oil sands in one horizontal bore where steam is pumped and drains into another horizontal bore below it from which it is pumped to the surface.

7257. Increasingly, this process is using natural gas, predominantly methane or CH_4 which consists of one carbon and four hydrogen atoms to create the steam needed. There is also a marginal amount of pumping energy involved, electrical energy to pump the material to the surface.

7258. Now, remember that the product being produced is going to be petroleum. So if we look at number 2 fuel oil and we look at the natural gas that's being used to extract it. The combustion of fuel oil creates 36 percent more carbon dioxide and 38 percent more oxides of nitrogen than the combustion with natural gas. And it also emits 218 grams per gigajoule of sulphur dioxide.

7259. So what you're doing here, and as you will be seeing later, bitumen requires not only natural gas, a higher quality energy source at the beginning of the extraction cycle, but right at the end of the cycle, again it requires an additional input of natural gas in order to acquire the hydrogenation that's necessary in the hydro cracker just to get it to the point where it can be refined in the same way that crude oil is refined.

7260. Thus, it can be seen that a high-quality clean burning fuel is being expended to extract a low-quality resource that needs to be upgraded with the expenditure of still more clean-burning fuel to turn it into a less clean-burning fuel.

7261. The energy penalty imposed by this process on the steam-assisted gravity drainage end of things is a substantial one and reduces the energy remaining in our barrel of diluted bitumen to 4.893 gigajoules.

7262. We now move on to the calculation of pumping energy using Enbridge's revised pump sizes listed in Enbridge response to the Joint Review Panel Information Request No. 3.

7263. Calculations of energy input to the pump motor in kilowatts are made by taking the hydraulic horsepower required to move the material through the pipeline, multiplying it by 0.746 and dividing it by both the pump and the motor efficiencies.

7264. These are the -- these calculations have been made using the kilowatts -- primary kilowatts listed in Enbridge's Joint Review Panel Information Request No. 3 response.

7265. It appears that from the preliminary expansion plan for a four-phase increase from 525 to 850,000 barrels per day, that pumps other than the spare pumps will run fully loaded during Phase 1 winter operations, meaning that at the outset of the project, when the pumps are first installed all of the pumps will be running approximately fully loaded in the winter when the viscosity of the oil is at its highest and will be operating partially loaded with impeller or volute changes only after the additional pumping stations are brought on line in later phases.

7266. So this figure of 115,830 kilowatts for pumping diluted bitumen is the sum of the ratings of the operating pumps and it's 12 percent higher than the electrical power consumption of 88 kilowatts per kilometre at 1 degree Celsius and 86 kilowatts per kilometre at 15 Celsius, given in Northern Gateway's response to Round 2 information requests.

7267. Similarly, the figure, the primary power of the pumps of 7,220 kilowatts for pumping condensate is the sum of the ratings of the operating pumps for condensate, and this is actually 68 percent higher than the power consumption of 39 kilowatts per kilometre at 1 Celsius and 37 kilowatts per kilometre at 15 Celsius, given in Northern Gateway's response to Round 2 information requests.

7268. So in order to try and solve this discrepancy, reference was made to the 2010 report, "Low-carbon fuel standard crude shuffle greenhouse gas impacts analysis" by Barr Engineering in Minneapolis, who used AFT Fathom software to calculate the pumping energy for the Northern Gateway Pipeline but assumed conditions of 10 degrees Celsius ambient temperature at an operating pressure of 1,200 psi rather than the 1,263 to 2,430 psi for the diluted bitumen and 1,399 to 1,662 psi for condensate that Enbridge tabulated in response to Panel Information Request 3.1(b).

7269. The Barr Engineering study modeled the power consumption for pumping diluted bitumen from Bruderheim to Kitimat as 20 percent below that given by Enbridge.

7270. Now, for our analysis, we have used the highest of the three levels, but as will be seen, this over-prediction of pumping power is balanced by an under-prediction of energy consumed per unit dilbit, so we're going to come back and compare in Slide 10 the -- our calculated energy with Enbridge's pipeline energy just in order to properly tune this model, calibrate this model.

7271. Any rigorous analysis has to take into account all portions of the transportation route from the point of extraction to the point of use. Enbridge's existing Waupisoo diluted bitumen and proposed Norlite diluent pipelines would be transporting products to and from the Northern Gateway Pipeline north of Bruderheim.

7272. The Waupisoo Pipeline has a current capacity of 350 expandable to 600,000 barrels per day, and since the Norlite Pipeline is not yet constructed, we have had to extrapolate flow rates and pumping power from the condensate pipeline for the Northern Gateway project.

7273. So here is the summary of pipeline transport energy, over-predicted as discussed, compared with Enbridge's figures.

7274. You can see that there's actually an economy of scale in pumping the larger volume of dilbit through the 36-inch line since there is a decrease in energy per unit pumped compared with the pumping energy for the smaller volume of condensate in the 20-inch line.

7275. But remember that we are calculating all energy as kilojoules per litre of dilbit being pumped west. So remember that for every 525 litres of dilbit being pumped west from Bruderheim to Kitimat, there are 193 litres of condensate pumped east.

7276. This would mean that 193 divided by 525 times the condensate pumping energy of 378.3 kilojoules per litre for dilbit has to be added to the 208.7 kilojoules per litre pumping energy for dilbit, for a total of 347.7 kilojoules per litre of dilbit pumped.

7277. Now, what we actually have calculated here -- and you'll have to bear with me because one of the pitfalls of filing sworn evidence at 11:58 a.m. before the December 22nd noon deadline, as I think all the other parties would agree, is that errors will occur.

7278. And you can see here at the bottom that we have under-predicted this total pipeline transport energy. It's only 113.5 plus 146.1 equals to 259.6 kilojoules per litre of dilbit pumped by the combined Northern Gateway and Waupisoo-Norlite Pipelines.

7279. However, going back to Slide 8 and using Enbridge's power requirements of 87 and 38 kilowatts per kilometre of the Northern Gateway Pipeline for dilbit and condensate respectively, this lower figure, the sum of these two, is actually 97 percent of the 267.2 kilojoules per litre calculated for the Northern Gateway and extrapolated for the Waupisoo-Norlite Pipelines.

7280. So we feel that this model is now tuned to all of the different calculations that can be made; over-predicted earlier, under-predicted here, and within 3 percent of Enbridge's figures for energy consumed per kilometre of pipe.

7281. So we now move on to the next phase of the transport, which begins at Kitimat.

7282. Enbridge has stated in their application that during operations, Northern Gateway expects that between 190 and 250 oil and condensate tankers will call on the Kitimat Terminal each year. On average, this will likely comprise 50 very large crude carriers, 120 Suezmax carriers, and 50 Aframax tankers.

7283. And we can infer from what Enbridge has given in responses to information requests that the Aframax tankers will predominantly carry the condensate. The very large crude carriers and the Suezmax tankers will be carrying the diluted bitumen.

7284. So in order to make our calculation rational and to do a complete mass balance across the Pacific Ocean, we standardized on a Suezmax tanker, which has a capacity of 157,500 cubic metres.

7285. When it's travelling at its economizing speeds, both loaded and empty, its fuel consumption is 36 metric tonnes of fuel a day. When it's fully loaded and riding low in the water, its economizing speed is 13 knots. When it's empty and ballasted,

its economizing speed is 15 knots, so that the time taken to cross the ocean was set by those speeds.

7286. The heating value of the Bunker C or heavy oil that is used, that is burned by these tankers is 42 megajoules per kilogram of fuel. So you're actually able to calculate what is going to occur in the Pacific Ocean and this represents four different processes in a complete mass balance of diluted bitumen and condensate crossing the Pacific Ocean.

7287. Enbridge has indicated in their responses to information requests that it appears that the most likely source or one of the most likely sources of condensate is the Northwest Australian shelf which would pump condensate to the Port of Dampier in Northwest Australia.

7288. So this -- the direct line from Dampier to Kitimat is not on an international shipping route and, moreover, it is our understanding that the tanker would have to refuel since it's carrying something that it can't burn. So we've supposed that it would put into Eastern China to refuel and then proceed across the Pacific Ocean.

7289. Carrying out this process, this two-leg trip for one tanker of condensate, the energy expended per litre of dilbit delivered would be 92 kilojoules per litre and that is -- that is spread out over 2.7 tankers of diluted bitumen coming from Kitimat to Dalian.

7290. Dalian has been selected as a probable location for export delivery of the diluted bitumen. It is a free port in Northeast China. It has a very large oil port there that can dock deep-sea crude carriers. It also has an extremely large refining capacity, including the refining of petrochemicals.

7291. So this single trip made by 2.7 hypothetical Suezmax tankers would consume 146.39 kilojoules per litre of the diluted bitumen crossing the ocean.

7292. So we have to round out the mash balance and in order to do that we have to return 1.7 empty ballasted tankers from Dalian to Kitimat and this would expend an energy per litre of dilbit delivered of 68.7 kilojoules per litre. And to round -- to complete the cycle, one empty tanker has to be returned from Dalian to Dampier which would consume 34.35 kilojoules per litre of diluted bitumen delivered to China.

7293. So that's one cycle. There are other possibilities but this is the one that we

decided to zero-in on based on consultation with one of Petro-China's consultants bearing point in Beijing. And the total energy expended in the tanker transport and condensate transport, including the return of empty tankers, is 341.5 kilojoules per litre reducing the energy in our barrel of oil to 4.797 gigajoules.

7294. I said there were other possibilities for transport and Enbridge's response to information requests did indicate that the Port of Ras Laffan in Qatar, the LNG Port of Ras Laffan in Qatar was also a very good source for potential condensate and this would mean travelling through the straits of Malacca, refuelling in Eastern China somewhere and crossing the ocean.

7295. It's intuitively obvious that this would involve considerably more energy expenditure in the acquisition and delivery of the condensate but there seemed to be a favourable price differential, so it's possible that this may be a source for condensate. We didn't include it in our calculations.

7296. So here we have the summary of all the energy expended in both extraction pipeline transport and tanker transport. And the total has now equalled 8,455.2 kilojoules per litre of diluted bitumen delivered in China.

7297. So this is being offloaded. Where is it being offloaded?

7298. This is a satellite photo of the main harbour in Dalian in Northeast China taken on October the 4th, 2010. Now, three months before this photo was taken, there was a fire and an oil spill on July the 16th, at the oil storage depot, at the Port of Xingang, just out of range of this photo. And it was quite a catastrophic event. It was actually China's worst-ever oil spill.

7299. The China National Petroleum Corporation, the parent of Petro-China, owns the facility where a Liberian registered oil tanker was unloading. A desulpherizer compound being introduced into the pipe, carrying crude oil from the ship, began an uncontrolled oxidation reaction, explosion and fire.

7300. If you look at any Google Earth images of Dalian Harbour, for the decade preceding this spill, the propeller wash of ships are white on a clear ocean background. And this offshore sheen here is not visible.

7301. So zooming in on the same photo and you'll see three tugboats that are nudging a super-tanker into a berth. And there's the white wake that you could see on all previous photographs of ships making way in Dalian Harbour.

7302. But there's something else going on and that has never been observed before in any of the previous Google Earth photographs is what appears to be happening here is that three months after the spill that's heavy submerged oil from the spill is being dredged up by the thrust of the tugboat propellers.

7303. And, in fact, the wakes of all vessels underway in Dalian Harbour on this date show the same effect; they're leaving almost like a contrail behind them from a darker heavier substance being dredged up from the harbour.

7304. Well, you may well ask: What has this got to do with energy return on investment?

7305. Simply that this is an example of a rare but actual case where the energy returned on a particular investment approaches zero, at least for the oil that was spilled or burned. And the statistical probability of such an event has to be factored into any calculation of energy return on investment.

7306. No matter what we calculate, sudden events can occur that can cause massive increases in entropy and environmental contamination. And there's vast literature on the subject of this which -- much of which is actually referenced on the public registry. So comment on it is outside of our area of expertise.

7307. I've found one particularly informative paper by Hodson, Collier and Martin, filed as written evidence, Exhibit A2K3D9 by the Haisla Nation on the toxicity of oil to fish and I would refer anyone to that as a very impartial and fine piece of writing on the subject.

7308. So we now move from transportation on to refining.

7309. This flowchart for the refining of dilbit which is one of several shown by Purvin & Gertz in a 2004 report for the Alberta government and a petroleum industry group has been selected after discussion with Bearing Point, one of Petro-China's consultants in Beijing, as being a possible process at a refinery in China that produces a mixture of petrochemicals and fuels from Canadian diluted bitumen.

7310. The units for diluent and bitumen shown here are thousands of barrels per calendar day; this is a large plant. The process of diluent recovery shown here is unique to the processing of dilbit and does not occur in conventional crude oil refining.

7311. You can see here the 270,000 in this case -- but we'll say for our purposes 270 barrels of bitumen -- mixed with C5, which is the diluent, enter the crude distillation unit from which 70 barrels of diluent are returned back into the condensate stream.

7312. This recovered diluent has economic value as it can be recycled but the energy contained in it is lost to the refining process, leaving only the energy contained in the 200 fuel oil equivalent barrels that go on beyond the CDU, into the vacuum distillation unit into these other components here. The light fractions go up, the heavier fractions go down.

7313. We are not petroleum engineers, this is all a result of recent study and we will be happy to entertain questions or discussion on this evidence when the evidence is being questioned later on in the process.

7314. The energy penalty of 8,455 kilojoules per litre expended up to this point on extracting and transporting one barrel or 159 litres of dilbit is now concentrated into 0.74 barrels.

7315. So this is all the energy that is being expended per litre up to this point and, as you removed the diluent, you are concentrating that energy penalty into only 200 barrels in decreasing the amount of energy in our barrel and increasing this 8,452 kilojoules per litre by 2,970 kilojoules per litre.

7316. This increase in the remaining 200 fuel oil equivalent barrels passing through the crude distillation unit reduces the net energy remaining in our barrel of oil to 4.325 gigajoules. This is a very important concept to grasp the business of how the concentration -- the re-concentration of the diluted bitumen back into bitumen increases the energy penalty per unit that is proceeding into the refining process.

7317. And if it's still unclear, please, feel free to question me at the end of the presentation.

7318. It should also be noted that the undesirable impurities, the heavy metals and sulphur which have high percentages in diluted bitumen, are re-concentrated back into the lower fraction.

7319. So this part of the flow chart, down here, shows the non-catalytic hydrogen hydrocracking process. Hydrogen is needed both to remove sulphur which

is present in a much higher quantity in bitumen than in conventional crude and perform hydrocracking or the breaking-up of the long hydrocarbon chains in the bitumen in order to render the product equivalent to crude oil.

7320. The needed hydrogen in a non-catalytic hydrogen plant is produced in a two-stage process known as "steam reforming". In the first stage, the methane in natural gas is reacted with steam at 750 to 800 degrees Celsius to produce carbon monoxide and hydrogen. This is the syngas process.

7321. In the second stage, carbon monoxide is treated with steam at a lower temperature to produce carbon dioxide and hydrogen. You can see that it takes a natural gas input of 23.9 fuel oil equivalent barrels per calendar day to remove sulphur from and hydrocrack 200 barrels of bitumen after it has been through vacuum distillation unit.

7322. This represents a further energy expenditure of 4,616 kilojoules per litre finally reducing the unexpended energy remaining in a fuel oil equivalent barrel to 3.591 gigajoules.

7323. When the material comes out of the hydrocracker, it has had its sulphur reduced and its molecular chains broken up to the same point that conventional light sweet crude oil enters a refinery.

7324. So here is a summary of the energy expenditures: 8,445 kilojoules per litre for extraction and delivery; 2,970 for diluent recovery; 4,616 kilojoules per litre for hydrocracking and sulphur removal for a total of 16,042 kilojoules per litre equivalent of conventional crude oil with an energy content of 6.142 gigajoules or 6142 megajoules per barrel.

7325. So what can be said? What conclusion can we reach from these calculations? What is the ratio of energy gained from the diluted bitumen to energy expended in extracting, diluting, pumping, shipping and rendering it equivalent to crude oil for refining purposes?

7326. When you place the energy output of a barrel of oil above the line and the energy input below the line, the 16,042.1 kilojoules per litre, you multiply the 6.142 gigajoules per barrel by 1000 to get kilojoules per barrel, all of the units cancel out and you are left with an energy return on investment ratio of 2.41 for the entire process, from extraction to the rendering of it equivalent to a barrel of crude oil at the destination.

7327. So how does this relate to other types of energy processes?

7328. In 1930, when oil was being extracted from wells in Texas, conventional oil energy return on investment expended one barrel of crude oil to produce 100 barrels of crude oil; an EROI of 100. Over time, as resources have become more difficult to extract, conventional oil now expends one barrel of oil to produce 14 barrels of crude oil.

7329. Depending on whether the extraction process is mining or in situ, the energy return on investment for oil sands extraction is either greater than or less than one barrel of oil expended to produce six barrels of oil. For the process of which the Enbridge Northern Gateway Project is a part, the energy return on investment is one barrel of oil expended to achieve 2.41 usable barrels of crude oil equivalent at the refinery.

7330. Now, it has to be stressed here that in our analysis, it became evident that the most energy-efficient component of the entire chain of transport was the pumping energy of the pipeline and the -- just as an example, the discrepancy between our higher calculation of the energy consumed in pumping the diluted bitumen and condensate versus Enbridge's calculation which we ended up using 97 percent of in our calculation would have changed this figure by .02 to 2.39 energy return on investment.

7331. So the pumping energy portion of the project really is the most efficient portion, even more efficient than the tanker transport which consumes more energy.

7332. However, to quote Marion King Hubbert who is a -- who was a long-time professor of geophysics and an imminent geophysicist who worked for Shell as well as being the prophet of peak oil:

> *"A society based on fossil fuels will come to a dead-end when the energy cost of recovering a barrel of oil becomes greater than the energy content of the oil."*

7333. I would now like to introduce my colleague, Norm Jacob who will provide a context for our energy return on investment calculation and I would also like to mention Nick Dumaresq who is -- who graduated one month ago from the University

7334. of Northern B.C. in Environmental Engineering and did most of the calculations for the tanker transport and the extraction of our presentation.

7335. Any correct figures that we may have come up with are entirely Nick's doing. Any erroneous ones are entirely mine.

--- (Laughter/Rires)

--- (Applause/Applaudissements)

--- ORAL PRESENTATION BY/REPRÉSENTATION ORALE PAR MR. NORMAN JACOB:

7336. **MR. JACOB:** Thank you, Chris.

7337. Joint Review Panel Members, I'm thinking of that quote from Marion Hubbert and then I also think about the 2.41 and it's still greater than 1 to 1 if we take that Hubbert quote; so what's the problem?

7338. There's a lot of interpretation in that 2.41; so I'd like to give you some context for how people might look at that number. I'd like to establish a context for our calculation of energy return on investment.

7339. That whole project brings me back to a formative time in my life, which is 1973 when I began as an engineering student. I began to gain an appreciation of quality in energy. You'll remember '73 as the year of the OPEC oil embargo.

7340. I learned that energy varies in its quality. A litre -- a joule of electricity is not equal to a joule of natural gas, is not equal to a joule of oil; it's not equal to a joule of coal.

7341. From thermodynamics I learned that while it's true that we never lose energy, it is also true and perhaps more important that energy changes to a lower quality as we use it, decreasing the availability of that energy for certain end uses and increasing the entropy of the system.

7342. The economist, Nicholas Georgescu Roegen, whom I read at that time, proposed that entropy is the foundation of all biological, social and economic activity. I remember the energy analyst, Amory Lovins, who also introduced me to the importance of the quality of energy.

7343. Lovins said that we should choose the softer of two energy paths, conservation and renewable forms of energy over nuclear power.

7344. The main thing I took from Lovins is that an energy source should be selected to fit the quality of the energy required by its end use, or at least that should be our goal.

7345. There was an interest in EROI at that time, 40 years ago. I remember the systems ecologist, Howard T. Odum. He and others suggested that we do a net energy analysis for every decision that is made about a major energy project or comparison between alternatives.

7346. Looking back to 1973, it seems at that point we had a chance of choosing the softer path, but when in the mid-eighties a glut of fossil fuels was again dumped on world markets, EROI was soon forgotten. We are the first group to have done an EROI for this project, as far as I'm aware.

7347. North American governments were quick to embrace what certainly became a hard path. EROI is one of a group of methods of net energy analysis. They include net energy ratio, energy intensity ratio and a quality adjusted EROI.

7348. Ecological economists argue that EROI analyses should be conducted for any major political or financial decision about energy. I take that from Murphy and Hall in a 2010 paper.

7349. EROI applies to biological and technological worlds alike. When animals expend more energy foraging than they obtain from the plant food sources, they die. When more energy is expended in getting energy than is made available for use from an energy source, then energy is lost in the overall transaction.

7350. Societies that ignore EROI necessarily fail. Many authors, Thomas Homer Dixon, Jerrod Diamond and Joseph Tainter, just to name a few, have argued this point in detail.

7351. I'd like to emphasize that the EROI extends not just to the technological and social world, but extends to the biological world, and so it applies to us also.

7352. We did not calculate carbon emissions as part of our EROI analysis; however, it is known that the oil sands industry, due to increased energy spent in

extraction, approximately doubles to triples the amount of CO_2 released per barrel of petroleum used compared to conventional extraction. I take that from Herweyer and Gupta, 2008.

7353. Chris spoke a bit about the boundaries of an EROI analysis. This is a crucial point. If disputes have arisen over EROI of an energy project, it is because the boundaries for the analyses have differed.

7354. Mulder and Hagens, 2008, provide us with a classification of the methods of EROI. They describe first order, second order and third order calculations of EROI. First order is EROI at the mine mouth or well head. Second order is EROI at the point of use, and third order includes the energy required not only to get and deliver, but also to use the energy, a so-called extended EROI.

7355. It is said that an energy technology with an EROI of less than 1:1 is not worth pursuing, but many practitioners of net energy analysis argue that EROI is far greater than 1:1 may bring an energy technology into question.

7356. Charles Hall and his group, in a 2009 paper, argue that a first order EROI of less than 10:1, the mean EROI calculated at the mine mouth for society, may be viewed as being subsidized by the general petroleum economy. Hall's group calculated a third order EROI of 3:1 as being the minimum required to sustain society.

7357. The so-called net energy cliff, the percent of energy delivered to society as a function of EROI, explains why EROIs substantially greater than 1:1 may be viewed as falling below a crucial threshold.

7358. Mirrens created a graph in a 2008 paper showing why decreasing EROI from 100 to 15. The transition from historical to new oil and gas fields has much less of an impact than decreasing EROI from 5:1, the general area in which you find sugarcane ethanol, corn ethanol and tar sands.

7359. There is an EROI threshold occurring at about 8:1, below which the percent energy available to a society declines drastically. Some ecological economists have proposed that energy quality be worked into the calculation of EROI.

7360. Cutler Cleveland, in a 1992 paper, took this approach in comparing the EROIs between oil and coal in the overall U.S. economy.

7361. In the context of the development of tar sands bitumen, we note that a relatively higher quality energy source, natural gas, is used at two points in the extraction, transport, refining system to make useable a relatively lower quality energy source, bitumen. Natural gas is used at the front end of the system in the steam-assisted gravity drainage process to extract bitumen from the sand which holds it.

7362. Natural gas is also used at the tail end of the system as part of the refining process to hydro crack the heavier fraction emerging from the distillation units and remove the sulphur, processes that are of lesser importance in refining light sweet crude. I take this from a report to the Alberta government by Purvin & Gertz, 2004.

7363. Any consideration of energy quality would make this use of a high quality resource a dubious proposition. We needed to limit the scope of our analysis, thus issues of the quality of energy in a sense that I'm speaking of it were omitted. Neither did we take the calculation of EROI to inclusion of the point of use, a second order EROI, or energy returned to society, a third order EROI.

7364. To use Mulder and Hagens 2008 classification of the methods of EROI, Chris took the calculation further than the mine mouth or well head, a first order EROI, but short of the point of use, short of a full second order EROI. The EROI obtained, 2.41:1, was low enough for us to question the value of carrying the calculation to the next level.

7365. It is clear to us that inclusion of a complete second order level of analysis would have further reduced the EROI for the proposed project.

7366. In 2012, almost 40 years since the oil embargo of ’73, it seems that history repeats itself. We return to the choices Lovins, Odum, Georgescu Roegen and other pioneers in net energy analysis told us of the opportunity for a softer energy path.

7367. We have a second chance. It is our view that the proposed pipeline will facilitate development of what is certainly another hard path. We must ask ourselves whether this is the legacy we wish to leave to our children.

7368. We respectfully request that the Joint Review Panel of the Canadian Environmental Assessment Agency and the National Energy Board give substantial weight to the outcome of an EROI analysis in any arbitration of the viability of a major energy transport system.

7369. Thank you very much.

--- (Applause/Applaudissements)

7370. **THE CHAIRPERSON:** Mr. Bateman...?

7371. **MEMBER BATEMAN:** Mr. Peter, Mr. Jacob, the EROI discussion you presented this evening has been interesting and I have no questions on the presentation.

7372. I would be remiss, though, if I did not express on the record tonight that the presentation has not been oral evidence. The purpose for this gathering and for having individuals attend and resources to be expended has been for oral evidence.

7373. That does not mean that there is not a time and a place for what you have presented, but that would more correctly be for cross-examination and argument, and I do wish to point that out to you given the amount of resources and commitment that has been expended to gather this evening.

7374. Thank you.

7375. **THE CHAIRPERSON:** And I have no questions of clarification, and Mr. Bateman has accurately reflected the views of this Panel regarding the oral evidence aspect of things.

7376. With that, we will close tonight's session, and I thank everyone for your attendance.

--- Upon adjourning at 7:32 p.m./L'audience est levée à 19h32