



# HARBIR CHHINA

Date and place of birth (if available):

Date and place of interview: November 4, 2011, Harbir Chhina's office at Cenovus

Name of interviewer: Peter McKenzie-Brown

Name of videographer: Full names (spelled out) of all others present: N/A

Consent form signed: Yes

Initials of Interviewer: PMB

Last name of subject: CHHINA

---

PMB: I'm talking to Harbir Chhina, and I'm not supposed to pronounce it with the extra aspiration. It's the 4th of November and we're meeting at his office at Cenovus, where you are the Executive Vice President.

CHHINA: Of oil sands.

PMB: Of Oil Sands, so that's with Cenovus Energy. I like to put these interviews into historical context: in the last couple of days Europe has been in crisis because of a big, financial mess over the euro and Greece, and today that whole part of the world is in chaos. It's been one of the most awful things to follow. The crisis has been going on for two years. Do you have any thoughts or comments on that?

CHHINA: Not on that.

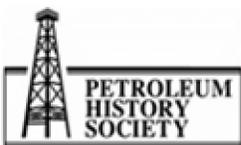
PMB: Fair enough.

CHHINA: It's not my area of expertise so I'd like to just stay focused on what I know well.

PMB: I've been obsessed with it for several months. It's been a great story. Harbir, I would like you to begin by just telling me about your, giving me a brief biography of yourself, where you were born, education and so on; as much as you can up to the present.

CHHINA: Okay, I was born in India, we came to Canada in 1970 and I was about ten years old.

PMB: What part of India?



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



CHHINA: It was Mulledpur, it's about a couple hours north of Delhi, small village. And then we landed in Kitimat, B.C. and then we grew up. I grew up mainly in Kamloops, Mom and Dad and three siblings. And after that, in '78, I graduated from high school and had to go to university. Calgary was an appropriate place to come and so I did my Bachelors of Petrochemical Engineering, graduated from Calgary in 1982. Then I joined AOSTRA. I stayed there for about seven years.

PMB: What year did you join?

CHHINA: I joined in '82.

PMB: So it was still a fairly young organization?

CHHINA: Yeah. They had started, I think, sometime in 1974. And I got a lot of good experience there. I worked on up to twenty-five different pilots. Got a chance to see UTF working, and once I saw that working I left. I left in December '88 to join, back then it was called Alberta Energy Company, which later became EnCana and then EnCana split up into Cenovus. So I've been with this company now since 1988 to 2011.

PMB: So you don't job hop?

CHHINA: No, no. I actually joined this company in '88 with one goal and that was to take Primrose to a hundred thousand barrels a day and we achieved that about two years ago. So that was my goal. That's what I originally started was to get Primrose up to that, so I've been very focused on that so far.

PMB: So how long has Cenovus or its predecessors owned the property at the Primrose?

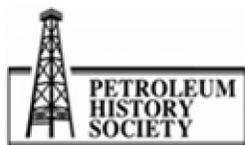
CHHINA: Okay, that one would be... I forget the exact year. It would probably go back into the 70s, somewhere around the mid-70s.

PMB: That isn't a property that you bought from Amoco is it?

CHHINA: No, no that was a...

PMB: Okay, because Amoco's is different.

CHHINA: Yeah. The Primrose Air Weapons Range was acquired by Alberta Energy Company, but then they didn't have the expertise to develop it, so what they did is partner up with different companies. So Amoco at that time was one of the companies, which later became BP and then also Imperial Oil is in there too. Husky's in there, and then we have companies like Suncor in there and CNQ, so a number of these... Conoco Phillips, so a number of these companies. Foster Creek, nobody talked that there was actually anything at Foster Creek at that time, because most of the development was in the Clearwater formation. Everybody was trying to duplicate Imperial Cold Lake, and so Foster Creek was retained as a hundred percent property with the AEC.



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



PMB: And that was the property where you first commercialized SAGD, is that correct?

CHHINA: That's right, we started at Foster Creek, and we started a pilot. We started building the pilot in '95, it became operational in '97 and then a year later we expanded it from one well pair to four well pairs, and then we started building in 1999, our first commercial project which became operational in 2001. Then we kept expanding it from twenty to thirty, thirty to sixty, and then sixty to a hundred and twenty thousand. Today that property's doing about a hundred and ten to fifteen thousand barrels a day. In my mind it's actually the first SAGD project to have paid out, which was last year. So something that Roger Butler invented at Imperial back in the late 70s and 35-40 years later was the first commercial major project to have paid out.

PMB: I'd like to come back to that in a little bit but first there are some specific questions I want to ask you about the early part of your career. When did you initially learn about the oil sands? I guess as soon as you arrived in Calgary?

CHHINA: No, actually while I was going through university I had a summer position with BP Canada, and that time they were going on to build Wolf Lake, so as a summer student I got exposed to actually working with a senior engineer to help him model what Wolf Lake production would look like and what will the gas composition, what the oil rates, water rates would be, so all of those things. So I got first exposure to the oil sands working on Wolf Lake.

PMB: So that was in the early 70s or mid-70s?

CHHINA: That would have been in '80... 1981.

PMB: Why did I think in the 70s? Did you start in university in '73?

CHHINA: No, '78. I started university in '78, I graduated in '82.

PMB: Oh, I beg your pardon.

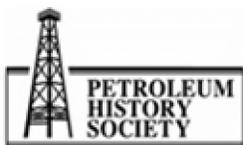
CHHINA: So my third year experience was with BP in 1981. Back then it was actually called Marguerite Lake, and that project did start a lot earlier than when I first joined them and then Marguerite Lake was a pilot which went on to building Wolf Lake which was the first commercial project.

PMB: And those properties were basically, they were sold didn't they? Didn't Sir John (Browne) sell those, and I forget who bought them after...

CHHINA: Yeah, it was Amoco that bought them from BP.

PMB: And so that was your first personal...

CHHINA: Actually they bought it for a buck too, which is interesting.



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



PMB: They bought it for what, one dollar?

CHHINA: One dollar because when BP built Wolf Lake... I learned a very important lesson during that summer time, and the lesson I learned was that you don't go around building oil sands projects if you haven't delineated the resource. You have to know what you have and what the quality is before you start spending big dollars and building these plants. And I remember that when Wolf Lake, the facilities were being built yet they started drilling the wells, and the oil saturations were substantially lower than what we thought they would be compared to Marguerite Lake which is the analogy that Wolf Lake was supposed to be built on, and so that was a very important lesson for me. And so that project really didn't work out back then and that's why BP sold it for a buck because they felt that the environmental liabilities were too high. So Amoco bought that and they saw the value in the facilities and then they built some pipelines up to Primrose, and now I think they're doing about ninety thousand – no, more than that – thousand barrels per day on huff-and-puff from horizontal wells and they use that facility to process the water and clean it up and then send the good water back to Primrose to do the steaming.

PMB: Now your first job as you explained to me was after you got out of university, was working with AOSTRA.

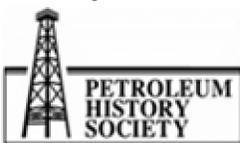
CHHINA: Right.

PMB: Why don't you tell me what you did and what your positions were within the company, or within the organization?

CHHINA: Okay so, I was basically most of time, during those six, seven years was a Reservoir Engineer, working on different pilots. Things like the gross amount of carbonates, we did a lot of piloting there with huff-and-puff, and earlier on before I got there they tried combustion and things like that. I was also involved with Kearl Lake in terms of doing a steam flood over there, and I was involved in Marguerite Lake. So a number of the huff-and-puff projects, altogether it was about twenty-five different projects that I worked on as a Reservoir Engineer for certain time periods and one of the last ones was really UTF, where I was really just responsible for the geotechnical properties and some of the reservoir properties to nail those down.

PMB: One of the people that I really wish we had the opportunity to interview was Roger Butler, but obviously we don't. Can you tell me how well you knew him and did he have an influence on you?

CHHINA: Roger didn't have an influence directly on me. Didn't know him personally, but he did leave Imperial because he came up with the SAGD technology, then Imperial patented it, and then he retired and then he worked at AOSTRA for, I don't know, maybe a year or two and then he took a position at the University of Calgary. And so during that year or two, of course AOSTRA was a small group back then so you kind of knew what everybody was doing back then. But I didn't have any direct, I guess, involvement with him, just as a peer. We kind of shared what all of us were working on. I did have the privilege of taking a course underneath Roger at the University of



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



Calgary. I still have his notes. And those notes back then went on to become his book that he wrote on Thermal Recovery.

PMB: What was the name of that book? I have seen a copy.

CHHINA: Yeah.

PMB: He wrote quite a number of things, didn't he?

CHHINA: I think, Thermal Recovery of Bitumen, something like that it's called.

PMB: And so you have the printed, photocopied notes that he handed out to all of his students?

CHHINA: Yes because he was in the process of still getting good examples and getting the... just got a chance to see what sunk in with the students and what didn't and he kind of used it to perfect the book I think, which is I think is normal amongst our discipline.

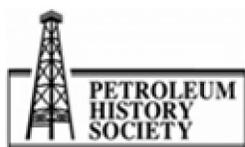
PMB: In academics especially.

CHHINA: Yeah, in academics, yeah.

PMB: You wrote a paper while you were at AOSTRA for the Journal for Canadian Petroleum Technology and in that you suggest that SAGD did not originate in Alberta. You suggested that it might have originated in California. Can you tell me a little bit about that?

CHHINA: Okay first I believe that paper was written while I was with Cenovus, or back then it was with Alberta Energy Company and the paper was written on low pressure SAGD, a lot of the companies really didn't believe in that back then so Neil and I wrote a paper on that.

So one of the things that I learned when I was working on the Kearl Lake Project, I worked with a guy by the name of Jack Vogel. And Jack was an old guy, very experienced guy; he spent most of his career with Shell. He's very well-known in the reservoir field, he came out with what we call inflow performance curves. So I had a real chance to work with him and while I was working with him, I learned a lot about gravity drainage, it wasn't SAGD, but it was gravity drainage with vertical wells. And Jack had a lot of experience with the California fields and he got me interested in those and so he taught me, that really, in the old days thought that they were doing steam drives, where the steam was going to push the oil to the production wells and he was one of the first guys to realize that's not what happens, that the steam actually goes from the injector to the producer but its gravity that drains the oil into the production well and so we started to apply some of Jack's techniques at Kearl Lake. And then later on, Roger Butler came about with SAGD which was really horizontal wells, parallel horizontal wells and using the top one to inject the steam. So the configuration with gravity drainage is very different with SAGD. In California it's still going on today, but they still continue to use vertical wells.



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



They have been doing horizontal wells in the last decade or so. But back then when SAGD was first... came to be known, I believe the biggest gravity drainage project was San Joaquin Valley in California, projects like Kern River and stuff, they were producing a lot and they still have significant oil production from those oil fields that were started back in the 1960s. And they have recovery factors of up to anywhere from fifty to seventy-three percent, very similar to what we produce with SAGD on the recovery factor side.

PMB: Well that's very interesting, when did they start doing this?

CHHINA: They started in the 60s and they started with huff-and-puff and so normally after huff-and-puff, it becomes inefficient after a number of cycles. So after a few years, three to five year type period, then they started to do... they thought they were doing a steam drive but it actually was a steam flood. And basically the difference is one is displacement with pressure, and a flood is gravity drainage, where you're using gravity to drain into the well. That's the difference. And that was very successful for them because horizontal wells weren't around back then.

PMB: Well that's a very interesting story. One of the things when I spoke to Chi-Tak Yee, he tells me that he has actually seen a document, and he couldn't find it after Roger Butler died. Chi-Tak Yee became Roger Butler's business at one point.

CHHINA: Right, that's right.

PMB: But he said he has seen as document that Roger Butler wrote in 1969 in which he actually presented some of his early ideas about SAGD. So it actually does go back at least...

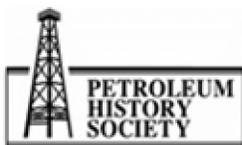
CHHINA: At least...I didn't realize that.

PMB: His notion goes back at least that far, because a number of other people, like Clem Bowman have said well, you know I really thought about this and so on. But I think the evidence is pretty clear, that theoretically at least, it was Roger Butler.

CHHINA: Yeah.

PMB: Now, I want to just finish off your commentaries on AOSTRA. Was there anybody in that organization that in your opinion made a particularly important decision or had a particularly important role?

CHHINA: Yes. When I look back, I think there was one moment that changed our business significantly, and that was back in about 1985. Just before I get to that, AOSTRA's mandate back then was to take some of the, it was a Crown corporation, their job was to develop technology, mining and in-situ, and so our mandate was to fund up to a maximum of fifty percent, so industry had to support at least fifty percent for the dollars that we were spending on capital and operating costs. And so back in '85 Roger Butler was with AOSTRA and then AOSTRA decided that UTF was, that was testing out SAGD at UTF was the thing to do, that this would be a game changer.



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



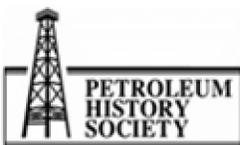
So in order for them to get started of course, they needed partners. So they invited, I believe, any oil company that would come and listen to them from North America. And I remember that meeting well with all these oil companies and we were trying to explain the SAGD, how it was going to work. And at the end of the meeting there wasn't one company that believed SAGD would work. Nobody was willing to fund it. And the total expenditures of UTF, I forget the exact numbers, but they would be around a couple of million dollars. And so at that time, so our mandate is to only fund up to fifty, nobody is interested.

Chevron was the only company at that time that wanted to try out their own scheme not SAGD. Their scheme was called Hasdrive, and they were doing it as a separate test, so they really weren't involved in the UTF test and Hasdrive of course was later tested at Kearl Lake where one of the pilots I worked on, and so that didn't work over there. So ultimately what Chevron tested never did get commercialized.

So now let's talk about UTF and SAGD. So that's where, because nobody was interested, I believe Maurice Carrigy made the gutsiest call in our industry and he said that, he was acting chairman I believe at that time, and he made the decision to fund it a hundred percent. And so we were building it and it was just a, I forget exactly what the timing was, but all this money had been spent and so there was still pressure that we didn't live up to our mandate of the fifty percent, so at that time AOSTRA offered the companies, at a very low price, I think it was like a million, million and a half bucks for like a sixteen percent interest so they get six to eight companies to join at that time for a nominal price. So that's... if Maurice Carrigy wouldn't have made the call, I'm not sure how many decades we would be behind if UTF did not test the SAGD recovery scheme, because after... after I saw basically that scheme working in 1988, that's why I joined Alberta Energy Company to actually, they tested it from the tunnels, the horizontal wells drilling up.

What we had to do now is prove that we could drill the wells from the surface down and then we could get in five metres of parting, hundred metres long and then we could run SAGD. One is draining into the tunnels, this one had to flow up to the surface and that was a big difference and so looking back on history I think Maurice Carrigy made a really key decision in where we are today with the SAGD technology.

PMB: Good, now I'm going to send you a little article I wrote about that, but I'd like your thoughts on this, the fellow who actually designed that mine, the shafts and tunnels his name is Gerry Stephenson argues that that might still be one of the very best ways to produce oil sands. You have less of an environmental footprint because all of your stuff is down in the tunnel, you don't have to have pumps in a lot of discreet wells to pump the oil out, you let it drain into the tunnel and then you pump it from wherever its collected to the surface. You have a fifty-eight degree Fahrenheit working temperature, three hundred and sixty-five days a year; you don't have to be waiting for the freeze up and that kind of thing. You might not be familiar with that idea but just generally what do you think about that notion?



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



CHHINA: That was looked at in the earlier days; it was really a cost issue. Even AOSTRA, the UTF facility that was nowhere close to being paid out, so maybe if it was in a richer part of the oil sands, maybe it would have paid out, but it was really a cost analysis. Today at something, for example at Foster Creek, you talked about the environmental footprint not being there and so, our footprint today is about five percent off where we recover all our oil. The major footprint is really in the plant itself, but once the plant is built we're just building pads from large areas up to, we believe we can go up to about twenty miles away from that sight to recover that oil so all in all our footprint is small. But really to answer your question, shafts and tunnels versus in-situ, the shaft and tunnels, the best, where they made sense possibly would be in the shallower depths, where the oil sands are within a hundred metres or so of the surface.

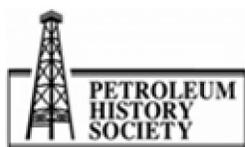
Well when you go to depths of something like Foster Creek, Foster Creek is a depth of about four hundred and fifty to five hundred metres, that's a significantly longer depth to go to versus the UTF site, or other shallower areas. One place where it would apply is where it's extremely shallow, that economics may work out in that scenario, but we don't have too much resource in that part so. And we continue to find ways to make in-situ SAGD with conventional horizontal wells, even try to make it cheaper and improve the returns.

PMB: Thank you very much. Do you have anything to say about the AOSTRA part of your life or shall we....

CHHINA: I think that was the best thing AOSTRA did. So, okay their mandate really was to develop technology and to sell it, but that never really worked. We never really made any significant dollars by selling technology. In my mind the real value of AOSTRA came in people like me and the academia, people like Roger Butler, the students that he had, for example Chi-Tak, right. It was people, students like that and people like me that went on to run and operate other oil sands projects in these other companies, I think that's where the real value came and the training and one thing AOSTRA did really well is fund universities across Canada and there was a lot of research being done and in some ways I think there was more research being done back then than there is today, we might be spending ten times the amount of dollars on research and development but we're doing it within the companies rather than jointly as an industry and also funding the academia world, so that part was, I think AOSTRA did really well. AOSTRA worked very well with the Alberta Research Council, back then they were called, so there was a lot of innovation going on back then.

PMB: One of the people I interviewed was Eddy Isaacs, who is the President and CEO of Alberta Innovates and he basically tells me that the contracts for the technology were so badly written that if they tried to sell some of the technologies that were developed today...

CHHINA: Yeah.



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



PMB: ... The company that originated it would be suing them. You know, there were really no provisions even after thirty years or whatever it is to actually sell those technologies. So there was a maybe a legal or a drafting issue that nobody was able to get through.

CHHINA: I know we always had lawyers involved but I don't know the details of the contracts but...

PMB: Okay, now one of the things and in fact Bob Taylor mentioned this when I spoke to him a few days ago, he talked about the importance of the initial application of commercial application of SAGD at Foster Creek. Now you started this in the 90s, in the mid-90s. And as we all recall from those days, oil prices were going right down the toilet and then in, I think it was '98 they hit a recent, they hit the worst point in years, in years it had been. When you started looking at that, at what price point did you think that project, the Foster Creek Project could actually be profitable?

CHHINA: So when I presented Foster Creek to a board of directors, back in the '99 time period, oil was I believe close to about thirty bucks, gas prices were in the two dollars to two-fifty per MCF range, so those are the two biggest factors in economics. And our rate of return back then was about thirteen percent and so normally we don't fund projects that are under fifteen but this project had so much upside that the board gave us permission to get started and build the first commercial project. So it was a downturn, we were trying to be countercyclical but as we were building Foster Creek the activity did pick up. But for our first project we were about twenty-two percent over. So to answer your question on the economics, yeah thirty dollars, gas prices of two to two-fifty would have made these projects economical. Our cost of capital is normally about eight to nine percent so we do start to think about projects above nine even though we prefer at least a fifteen percent return.

PMB: So even though you saw prices, especially for bitumen and heavy oil, even though you saw those prices really collapse you were still full steam ahead.

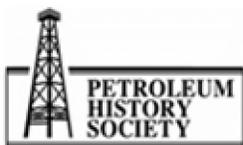
CHHINA: Yes. And prices actually improved while we were building Foster Creek, so the activity picked up.

PMB: The years were what? Did you say '96?

CHHINA: '99 to 2001 when we were building the first commercial project so we had it on production in 2001.

PMB: Okay. And the first experimental project was a little bit earlier?

CHHINA: It was in '95 we started building it and we started producing it in '97. And so today, Foster Creek has actually a twenty-five percent return and that's due to two reasons, one is commodity prices. The de-link between oil and gas, so prices have improved substantially on the oil side. Our net backs at the wellhead for bitumen have improved substantially. A decade ago we were getting only about forty percent of WTI for bitumen at the wellhead. Today Foster Creek is about sixty-six bucks in about an eighty to ninety WTI world, so we've come up to as close to about



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



seventy percent plus type number from the forty percent. So the more bitumen we've been producing over the last decade, the more the refineries in the south have been trying out our feed stock, and the more they're starting to realize they actually like this and can make pretty good amounts of gasoline and diesel through those refineries.

PMB: Now help me if I'm wrong here, but you've cut a deal with the refineries in Wood River, Cenovus has. Is that part of the reason that you are, that you're getting a better return on this or not?

CHHINA: No. First let's talk about the deal. The deal was really, we started looking at what do we do with this bitumen. Everybody else was building upgraders in Alberta and we felt that was too expensive, plus costs would go out of control plus we weren't going to end products with bitumen, the end product was really gasoline, diesel and jet fuel; and the U.S. is the biggest consumer of energy. Our refinery produces multiple product streams, like ten to fifteen different product streams. So you really want a refinery where the population is. So we felt that we're better off to send our bitumen down to the States, upgrade those refineries to handle the lower API crudes, the higher sulphur content, all of those things and so that's why we partnered up with ConocoPhillips, with the Wood River and boarder refinery. We're fifty percent interest in that and they are fifty percent interest in Foster Creek, in Christina Lake.

So basically we became integrated with those refineries, sometimes we make money on the upstream, sometimes on the downstream, and sometimes we make money on both. This year we'll be making money on both, last year was not a good year for downstream, the previous years were. So, our business is very cyclic, and this actually helps us stabilize our cash flow.

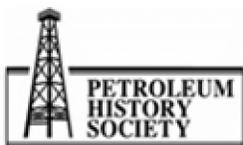
PMB: I'm trying to remember when you made that deal; it was about two or three years ago?

CHHINA: It's about 2006, yeah.

PMB: 2006, okay good. Were you directly involved in the National Oil Sands Task Force?

CHHINA: No. I didn't have any involvement in that, I was too busy trying to develop technology to make the oil sands work economically so, in some ways actually Foster Creek was actually pilot number twenty-six, the first twenty-five weren't economic. So Foster Creek was the first pilot project I worked on that actually went on to be economic. So that's how difficult it was, in the old says who was really making money on in-situ was Imperial. Imperial is still the leader today in terms of thermal production, at least for the next six months as we start to ramp-up Christina. But they've been the leaders up to now, they've been the company to beat in terms of steam/oil ratios and production rates, and so they're doing about a hundred and fifty thousand barrels a day at a steam/oil ratio of about three point three I think.

PMB: And what's your steam/oil ratio?



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



CHHINA: We're at about two point one at Foster. Christina was about one point seven earlier on this year. But as we're building, bringing on new phases, the steam/oil ratio is a little bit higher now but it will drop back next year to one point seven.

PMB: Okay, now, actually this segways very nicely from what you just told me. About a year ago, the Oil and Gas Journal had a little article which quoted you and said that you had fifty research and development projects in the wings. Can you talk to me a little bit about that?

CHHINA: Okay, so....

PMB: Just wide open.

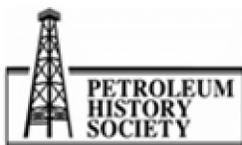
CHHINA: Firstly, we're up to a hundred and forty now and we're actually spending close to two hundred million dollars on, not just R&D, but technology development in general.

PMB: Sorry. In one year you've gone from fifty research and development projects to a hundred and forty research and development projects?

CHHINA: Those forty were basically R&D projects which are sometimes out of the sky and they may not work. Two-thirds of them may not work at all so we're actually pretty happy out of ten things that we work on, if we're successful with two or three and so that was the R&D, but at the same time, we were spending significant dollars on technology development. We were just trying things in the field, rather than research them in labs, then study them before trying them out. So that's what I differentiate between R&D, sometimes they're theoretical in the lab stage of that and then you go through a demonstration phase in the field. Sometimes we just go straight to demonstration when we're really confident about some of the technologies. So we were probably working on more than forty of those a few years ago, but definitely since Cenovus was formed back in December 2009, we have definitely over the last couple of years beefed up how much we're investing and how many things we're investigating on the technology development and the R&D side.

PMB: The decision to take Cenovus out of the larger EnCana Corporation, what has that done to your part of the business?

CHHINA: Oh, that's pretty simple. The first meeting that I was asked to present to our board of directors when Cenovus was formed, was on technology. And so historically before Cenovus we were within a big gas company and our shareholders didn't know whether they were buying a gas share or an oil share and so when we split up the companies, it became very clear what our mandate was. We had some conventional production, some natural gas and then we had a whole bunch of growth on the bitumen side and the bitumen needs a lot of gas. So with having some gas production, we're actually long gas right now, but we will be line with, over the next ten years, as the gas declines and we start to use more gas production we'll be physically hedged with gas. And so our growth story is really, "Continue to grow some conventional business, let the gas decline to how much we need but continue to grow the oil sands business."



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



So we're very focused now on what we're doing. And one thing that's done for us is that within a big organization, whether you fund international projects and gas projects and oil sands projects, it was very difficult to have firm funding for multiple projects over the next three or four years. With Cenovus getting formed our balance sheet was really good. Today we're actually building five projects simultaneously, and over the next three years we will be building eight projects simultaneously.

PMB: I'm sorry, how many?

CHHINA: Eight. So we consider ourselves in the manufacturing business. We are not, we're not making widgets, we've done this nine times before now. Our widgets are just bigger and by bigger I mean like forty thousand barrel a day phases, before we used to do from twenty to thirty and thirty to sixty and we did smaller chunks. Christina was nine, then it was eighteen and now it's going up to forty, fifty-eight, so the chunks are getting bigger. So we're just doing different phases simultaneously and that's really helped keep our cost down.

PMB: What's the cost of building a forty thousand barrel per day unit?

CHHINA: It costs us normally, at Christina we're building from about twenty-two thousand dollars per flowing barrel. Foster Creek was billed at about eighteen thousand dollars per flowing barrel. So really take that number, the twenty-two times the forty, so that's what you're spending on building that.

PMB: But then that continues to produce for a very long period of time.

CHHINA: If you don't build anymore phases, you'll be here for eighty years plus.

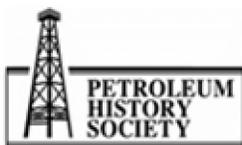
PMB: Really?

CHHINA: So what we try to do is build more phases at Christina and Foster, so the production at Foster, our goal is to take it from one-twenty to two hundred and forty over the next five years and then we'll probably add another hundred thousand on top of that after that. Christina we're going to take that similarly to about two hundred and forty thousand and then we'll add on another hundred thousand barrel a day chunks on top of that too. So we'll bring our eighty year reserve life to something much more reasonable which is about twenty-seven years.

PMB: Gee. I'm glad I own some Cenovus stock.

CHHINA: Yeah.

PMB: In the article, I'm going back to the one in the Oil and Gas Journal, you talked about ideas that I've never heard of, wedge wells for example. You talked a little while ago about low pressure SAGD, solvent-aided processes, in-situ combustion. These are not very commonly practiced in the industry I believe. Is this leading edge stuff?



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



CHHINA: So let's talk about low pressure first. Industry, when we started Foster Creek we were using gas lifting to produce our wells. So to produce the fluids by lifting it with gas, it's kind of like Old Faithful in Yellowstone Park, you know, as it unloads its liquid and that's kind of what gas lifting is. But the problem with gas lifting is you have to operate at a high pressure, which means higher temperatures which means higher SORs and so with low pressure SAGD we needed to develop electric...

PMB: SORs is the steam/oil ratio.

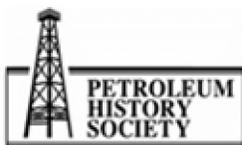
CHHINA: Yeah, steam/oil ratio. It is the most important metric in our business. It controls not only the economics, it controls your footprints, it controls your emissions, your water usage. It has an impact on everything in your business the steam/oil ratio does. Because we're basically building water plants, water recycling plants. Oil is actually a calculated number, it's a very small percentage of our plants is actually oil production, the rest is all related to water recycling, and generating steam and then cleaning up the water that comes back. So at that time people weren't really fussed and didn't believe that ESP's were required but over time I think industries caught on that ESPs are the way to go and they have to get away from gas lifting for other reasons that, there were times when there were lean zones and water zones in these oil sands formations, so people start to lose a lot of steam. And so but you won't get any oil back from that so the one way to counteract that was to put in electrical submersible pumps, start operating at a lower pressure and then they had control of where the steam was going and you were more efficient on how much steam you were using for every barrel of oil that you produced.

PMB: And the Electrical Submersible Pump is the ESP.

CHHINA: ESP is Electrical Submersible Pump, so back in 2001 was probably when we first tried them. The temperatures back then were about a hundred and sixty to a hundred and eighty maximum. You could not buy an ESP that was higher than those temperatures and of course we needed to go as high as two twenty-five, two-fifty. Today we're there. Today we can run anywhere from two-fifty or less on Electrical Submersible Pumps, so we've come a long ways in the development of that. And in industry, I think in the future you will see a trend in industry, trying to go to low pressure SAGD because it does actually help bring the SOR down and that was that JCPT paper that Neil Edmonds and I wrote. We felt that the optimum pressure to operate SAGD is more, should be in the thousand to fifteen hundred range, but that can vary depending on commodity prices. Currently a lot of the projects are run in the twenty-five hundred to three thousand KPA range and so with time we got to continue to bring that down. So that's one of the things we still have to continue to implement at Foster Lake and Christina Lake in terms of bringing our pressures down.

PMB: KPA is a Kilopascal.

CHHINA: Kilopascal, so atmospheric pressure is a hundred Kilopascals which is about fifteen PSI. So some of the other technologies that are really, that we looked at was first of all the liners,



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



producing sand was a big issue, so we had to redesign and come up with different ways to control the sand production. We also came up with what we called SAP, making our projects more efficient. SAP stands for solvent aided process, so basically we put butane and steam together, but now we're currently looking at anywhere from C1, which is methane, propane, butane, pentane, hexane, heptane. So basically anywhere from C1 to C7, we believe...

PMB: And you're just testing these hydrocarbons as a...

CHHINA: As jointly injecting them with steam and we find that something like steam and butane injection helps improve our steam/oil ratios by thirty percent. So we'll take wells that were "X" and they're point seven X once you start bringing butane, because butane is really a thinner for the oil. You can drop the viscosity by either heating it, normally in-situ is about a million centipoise and once you heat it to about two hundred and fifty degrees it comes to about six or seven centipoise. One centipoise is water, so it's still about seven times more viscous than water but still it moves pretty good, or you could put solvents in. It's like putting paint thinner with paint.

PMB: How much of these hydrocarbons can you pull out, how much of the butane, for example, can you extract after production?

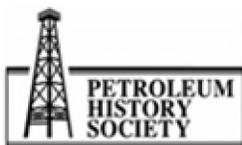
CHHINA: We believe that we will be able to recover ninety to ninety-five percent or whatever we inject. So only five percent will remain in the reservoir and that's a very important parameter. If you're leaving too much behind, these solvents are expensive. Then the economics wouldn't be accretive to SAGD, so you do have to recover in that range. You need to be at least eighty percent or higher in terms of recovery, otherwise you won't be accretive in your economics to SAGD.

PMB: Anything else on that?

CHHINA: On the other stuff, we have also pursued combustion. We call that, we did that on a gas cap, so basically when the gas over bitumen hearings were occurring in the Province, the gas, the government shut-in a lot of the gas production on top of the bitumen. So one of the ways we found is that we can still recover the gas and put heat into the reservoirs, we started a fire in the gas zone and we call that process Encaid...

PMB: You call that process what?

CHHINA: Encaid, E-N-C-A-I-D, and that has been going on for four years, basically all we did is heat up the wellbore a little bit and started putting in air. And what happened? The little bit of oil saturation that exists in the gas caps was enough, once it got contact with the air, and once we sparked it, that it started combustion. We started generating four hundred to four hundred and fifty degrees Celsius in the reservoir, by just putting in air, and on the production wells around it we were producing our methane. So the pressure in the reservoir really wasn't changing, we were getting our methane out and then we were putting four hundred degree Celsius heat into the reservoir, normally with SAGD we only go up to about two hundred and fifty degrees Celsius, so now that we've heated



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



up the reservoir, just this last week or two, we've actually drilled a well in the oil zone and now we'll see...

PMB: I'm sorry: which formation is this?

CHHINA: That's the Wabasca formation in Primrose. And so far that scheme has worked really well but now we need to see, can we produce that oil without putting any steam in and we think we can because we've already heated up the reservoir. Normally our formations, our oil sands formations are sitting at about ten to twelve degrees Celsius, so even going up to adding a hundred degrees, a hundred and twenty, thirty degrees is a big deal in terms of the mobility of the oil.

PMB: So you are in effect buying the gas cap, you're in effect buying that from the Province, the gas that you actually burn you would be paying?

CHHINA: No, no we're not burning the gas.

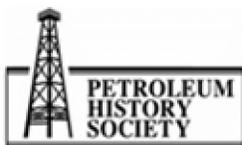
PMB: Oh? what did I misunderstand?

CHHINA: The air is displacing the gas, so gas that we weren't allowed to produce because they didn't want the pressure to drop, by injecting air we're not letting the pressure drop anymore, but yet because we're putting in air we can take out some methane now, and so the air is displacing the methane. What the air is really burning is actually the oil in the gas cap, so normally in a gas cap you would have about, maybe in the order of like thirty percent, sorry seventy percent, and seventy to seventy-five percent gas saturation of methane. You would have about ten percent of water saturation and you would have about ten to fifteen percent of oil. We are burning that ten to fifteen percent of oil which we couldn't recover anyways.

PMB: So how would this compare to the old notion of fire flood for example?

CHHINA: So the difference, in the old days and I personally was involved with a few of them, what we were trying to do is start a fire and displace the bitumen. And that didn't work for a simple reason, is that the bitumen wasn't mobile between, you're putting air in an injector and you're producing, with production wells around it. Unless you get the whole thing hot, you can't produce it. So all we did was just start a fire and we just kept re-pressuring up the reservoirs but we really couldn't get it to work. And we also tried it after doing huff-and-puff. There the air would go where the depletion has occurred but then it was hard to control it. So I've personally seen wells reach up to eleven hundred degrees Celsius and then you lose the well basically. So combustion in those days didn't work because of a lack of mobility.

Where combustion has worked around the world is when you're dealing with a heavy oil, so you're dealing with fifteen to twenty, twenty-five API, it works really well if the APIs are even thirty or higher, so it's worked very well but as soon as you get to fifteen degrees API, and at reasonable temperatures the oil is mobile and that's what you needed for normal combustion to work. Here



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



we're doing it in a gas cap, and so there is mobility because gas is displacing gas, that's why it works really well in a gas zone.

PMB: So you might actually be able, or you believe that you can actually produce this field, but it leaves this portion of the field without steam, is that what I understand?

CHHINA: That's what we're trying right now.

PMB: Wow.

CHHINA: So we did the combustion, we heated the reservoir up, now we drilled one well to see can we produce this oil.

PMB: Okay....

CHHINA: We actually recovered it, so we did recover. So everything worked just as we expected just like the text books say combustion should work, it worked extremely well, but now we have to go to the next step and then we'll see how successful it will be overall in recovering the bitumen.

PMB: And if it does work, it actually, it could help resolve for a lot of companies this idea of not being able to produce the gas cap.

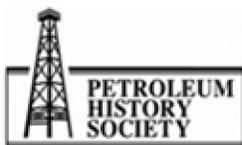
CHHINA: Yeah, but again, when you look at... approximately there's about two trillion barrels just short of that between the carbonates and the different oil sands zones and so the gas cap is actually over a very small percentage of that resource, so luckily we have it and so that's why it makes a lot of sense for us, but it's not something that I believe every operator in the oil sands will be able to employ.

PMB: Thank you very much. Anything else you want to talk about on your technologies?

CHHINA: So on the technologies, one of the other things we tried is what we call our **bloat-on-boiler**. Everybody generates, when you generate steam you don't want to convert every molecule of water into vapour because you always have some solids in there and you don't want to gung up your boilers if you go to hundred percent quality steam. So normally our boilers are set up to generate eighty percent quality steam and what we're doing is that twenty percent that's left, we actually run it through another boiler. So effectively now we're generating for every barrel of water that goes into our boilers, we're generating ninety-three percent quality steam versus a seventy-eight to eighty percent which the rest of the industry still generates. So that's been a pretty big breakthrough for us.

A simple concept but it adds a lot of value. Reduces emissions, it reduces your operating costs, things like that.

The other thing is wedge wells, basically we found that if you steam two SAGD well pairs over a three-year period the chambers coalesce, once they coalesce you're left with this wedge of oil, which



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



takes a long time to drain. We started drilling wells into that wedge and we've had very good success. Basically that oil is almost free, our cumulative steam/oil ratio for the wedge wells is like zero point one, so that's basically nothing. We put a little bit of heat to get the well started and then it's off and running. So those have been extremely successful; these wells pay out in ninety days. So I've never in my career drilled a well in the oil sands that could pay out that fast, to tell you the truth, so that's been a huge success story. We're also looking for other solvents, like I said C1 to C7s; we are also looking at steam plus CO<sub>2</sub>. That project just started up this week actually. So we're looking at that to see, could we put some of our CO<sub>2</sub> in with steam and kind of store it where the oil has been depleted, so we're looking at those types of things too.

PMB: Where are you doing that?

CHHINA: That's at Foster Creek, so that's a pilot right now, and if everything proves up we would put it as part of our commercial phase when the wells start to get depleted and we've ramped down on the steam, and you start to put in some steam and CO<sub>2</sub> and at the end you just put in some CO<sub>2</sub>. So we'll see how that works, but there are a number of initiatives like that, we're looking at different ways to generate steam also and lots of other pilots going on in terms of solvents, ESPs, generating steam. Also down-hole instrumentation, that's been pretty critical to us in understanding what's going on to the reservoirs. We're doing a lot of designing of our wells; we're starting to drill our wells longer so we have issues in actually sending the steam down twelve hundred metres evenly. So we're looking at different configurations down-hole to make some of that stuff work.

PMB: Do you apply micro-seismic to any of these projects?

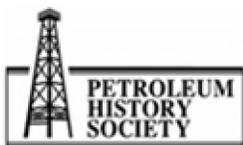
CHHINA: We have tried it historically, micro-seismic, we did not benefit a whole lot historically but that technology does change every decade I find, but recently we have not tried it. We do just normal forty seismic; we also do what's called Crosswell Seismic to understand where steam chambers are.

PMB: What is it called, cross...?

CHHINA: Crosswell Seismic so, a forty seismic is just a normal 3-D from the surface, forty just means we do it at different times later on. At Crosswell Seismic you put the source and the receivers down hole and that gives you a lot more detailed picture of what's going on in the reservoir down hole and how the variability in the reservoir is controlling the SAGD process.

PMB: Okay, science and technology. Really since the UTF and since SAGD, the science and technology has developed very rapidly and you've just given me some great examples of that. Do you think that it should be going in other directions, fundamentally different directions?

CHHINA: I believe that, I've always felt that, you know, we come across game changers every few decades. For example when I was talking about the California oil fields, what Imperial implemented was huff-and-puff but they did it with fracturing, they were actually doing mega fractures when they



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



were putting their steam in, and that was a very unique process in the world at that time, and that helped them get their steam/oil ratios down.

PMB: This was at Cold Lake?

CHHINA: This was at Cold Lake Imperial.

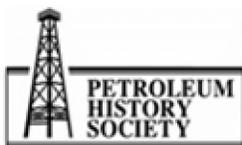
PMB: And that was around nineteen...it's in the late 70s?

CHHINA: They experimented in the 60s with May and 70s with Lemming and Ethel, and those types of projects, and then they commercialized in about '78, so they went through a couple of decades of experimenting, but that was a very unique technology. Today, an average oil well in the San Joaquin Valley in California is probably about five steam/oil ratio. Imperial, that's three point three. With the SAGD technology, now I just told you about Foster and Christina, are sitting somewhere around one point seven and two point one, so that was a game changer, and so I believe in the future we're going to continue to optimize SAGD and improve it by twenty/thirty percent by adding solvents in it. But I think the future is going down, I think combustion based recovery schemes have a good chance of working, and warm solvents or even cold solvents, we have to go down that path.

We did try what we called a Vapex Vapour Extraction pilot at Foster Creek and we put in propane, we did not heat it and so we were trying to recover oil without actually heating it and just using pure solvents and we felt that we still had lessons to learn. That was a big step going from all steam to all solvents without heating them, so that's why we started taking a gradual approach by doing SAP first with high temperatures and would slowly start to drop the temperatures and hopefully we can start to find ways to get this oil out without putting any heat or any substantial amount of heat into the reservoir.

PMB: Now if you look at the heavy oil deposits around the world. Obviously they're in Venezuela, which is a basket case, within the Soviet Union and many other places – sorry, Russia as it's now known. There is something like five or six trillion barrels of heavy oil/oil sands in existence around the world. Canada maybe has the biggest concentration of those. How much do you suppose this technology will be going across the oceans? And will it make those parts of the world competitors to Canada?

CHHINA: First of all whether it's, I think, thermal recovery or enhanced oil recovery, I believe Alberta is definitely the leader in enhanced oil recovery. In terms of, an example I will give you is our Weyburn Project. That's a light oil reservoir, conventional reservoir, which went through primary water flooding, and then we went to CO<sub>2</sub> injection after that. And so that's a miscible CO<sub>2</sub> flood, very unique, the biggest CO<sub>2</sub> sequestration project in the world. The other thing that's unique, that one of the things we're doing is horizontal wells in a heavy oil reservoir in Pelican. That zone is only two to three metres thick of twelve API oil, at about two to three hundred metres and that project is just... Originally it used to be six percent recovery factor, water flooding, we went to



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



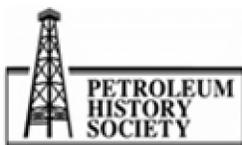
like fifteen, polymer flooding we went to about twenty-five, and then infield drilling we think we can get up to thirty-five percent of the oil in place on a reservoir that's only two to three metres thick.

The rest of the world does not know how to recover oil out of three metres. There's lots of learning on enhanced oil recovery on the normal stuff, definitely on the thermal side, countries like Venezuela, they also have oil sands, but the biggest difference, the biggest plus that Venezuela has over Canada is really the fact that they're close to the equator. And what does that mean the fact that they're close to the equator? We have a reservoir temperature in our oil sands of ten to twelve degrees Celsius; they have fifty to seventy-five degrees Celsius. So they may have the same API, same quality of oil, but their oil is mobile and so their oil should be relatively easier to recover than the oils out here. So definitely whatever technology is being employed could easily get employed in other heavy oil or oil sand reservoirs around the world. So this is, not just thermal recovery, a lot of the enhanced thermal recovery techniques will get employed and right now, you know, polymer injection is starting to become big. It's still relatively small scale in Alberta, but it will have major application around the world.

PMB: Now an argument I've heard and people seem to have very strong opinions on the two sides of this argument. In the oil sands, the real competition is for the leases and once you've got the leases why not just share the technologies? Because you've got your land to get another piece you're going to have to buy it from it someone or do some kind of horse trading. But the technologies, surely the industry should be exchanging its ideas and technologies to increase productivity.

CHHINA: I agree with you that we should be collaborating more than we are and I know there are CAPP initiatives underway that we will start to do more of that. Definitely we need to do more of that, but there's also a part that's competitive. Our job is also to add value to our shareholders and so sometimes it's... to add that value you need to stay ahead and one of the reasons you need to stay ahead and be a little bit competitive, we're not sure where all our oil sands are going to go yet. An example is the Keystone Excel Pipeline. We never thought it would be a big issue, building a pipeline to the Gulf Coast, which is the biggest heavy oil processing hub in the world. The Mexican crude, the Mayan crude, one of the four largest oil fields in the world is the Cantarell Field. That field seven years ago was doing about one point two million barrels a day, today it's down to like three/four hundred thousand barrels and it's still dropping.

Venezuela is starting to send its oil to other places like China. So the Gulf of Mexico is starting to worry about where they're, how they're going to fill their refineries, so to us it made a lot of sense given that the U.S. was consuming twenty to twenty-five percent of the world's energy, that we were a perfect fit to send our oil sands down, but that's not how its turning out. And so the Gateway Pipeline, there's resistance to that too, in sending oil to the West Coast. We don't know if it gets built or when it gets built. And so there are limits to where our oil is going today. If that wasn't a constraint, it was a no-pipeline constraint, there's demand for an unlimited amount of oil sands then the competition is not essential. But right now it does add value if you're ahead of the curve because of these midstream and downstream limitations.



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



PMB: If neither of those pipelines occurred, were built, that would be quite a crisis for this Province, wouldn't it?

CHHINA: It would slow down some of the development, but we do have other alternatives, for example, the Trans Mountain Pipeline. We have been sending, actually, our Pelican production as well as some of our oil sands production down to Vancouver, Burnaby. And from there basically, once you're at the water, you can send your crude anywhere in the world and so we do send it, sometimes to PADD 5, which is the California market. We've also started to test the east part of the world to see if there is need for places like China and stuff, to see how well they like our crude there.

PMB: So you have already sent shipments to...?

CHHINA: Yes.

PMB: What parts of China?

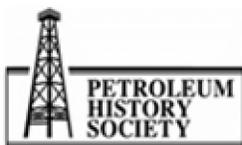
CHHINA: I don't know the details. We market it through a third party, we don't directly sell it. It's basically the take ownership of it at the Burnaby dock and so that's how we deal with it. So, we basically lose, we basically do the trading right at the dock and somebody else will handle it from there on.

PMB: For an AOSTRA guy, this will be easy to answer. What do you think is the role of government? What should the role of government be in oil sands development?

CHHINA: I think AOSTRA was actually a crown corporation, so basically government controlled. I think going down in the future, I think as an industry we should be working collaboratively and government should be working with industry. If I would change the AOSTRA model that's probably the only thing I would change. It should be industry led, rather than government led. But government, both provincial and the federal should be involved in helping us fund and develop new and better technologies that are more efficient environmentally. There are a lot of smart people in Canada. We've got to put them to work to solve and minimize the footprints, minimize the emissions and minimize the water usage and prove the economics of this resource so that we can go after even thinner and more complex reservoirs. Today we're only going after the good stuff right now.

PMB: But of course, if it had been up to industry, if AOSTRA had been industry led twenty years ago, or twenty-five years ago, you would never have had the UTF.

CHHINA: You're absolutely right with that, so there is a...that is the biggest weakness in what I just said, but still I do believe that it should be industry run. But I think we need to bring back the AOSTA type model, in terms of governments, industry working together and then academia. Not only just to universities, I think it's very important to involve the SAITs, NAITs and the colleges because when we look down with all this oil sands production that's coming, we're short of trades, short of people that operate steam plants and water plants. So we need to work with the institutions,



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



the technical institutions as well. Back in the AOSTRA days it was just limited to the universities, but now I think we need to expand that to not just university but all the technical institutions and the colleges and the trades. That's going to be a big part, and the training and development. I feel when I look forward that that's going to be a big issue in training all these people that we need in the oil sands. Today I believe we're employing about seventy-five to eighty thousand people. If all these projects come to fruition over the next twenty-five years, you will be employing about a million people. So how are we going to educate all these people? There's a lot of work left that we need to do if the oil sands are going to continue to grow.

PMB: Well I'm gobsmacked. A million people in how many years?

CHHINA: In twenty-five years. So right now we're sitting at about seventy-five thousand.

PMB: Unbelievable. Regulation, should it be more stringent? Has it been effective?

CHHINA: I think Alberta has the most stringent regulations I believe in the world, if not the most, it's on the top quartile, definitely. Could they be more stringent? I think there's one part that's become loud and clear, is that the average public wants third party assessments and also wants to know the accumulative effects of all these projects. And I think rightfully so. We support that initiative and we think we don't see anything wrong, and that's a government or a third party doing that, we're okay with all of that stuff, so we actually welcome that.

PMB: Social effects of oil sands development, a lot of controversy around this. And you have towns like Fort McMurray and some of the villages and towns in the northeast which are really going, growing at huge rates and all kinds of negative social effects. A lot of concern from two sides. Some aboriginals are saying, well we're not being treated fairly and then of course there's all the evidence that aboriginal business is developing at a very rapid pace. Would you comment on that please? I'm particularly interested in how this will effect and is affecting aboriginal peoples?

CHHINA: Okay on this issue, this would have been back in about 1997 when I first started the pilot. There's one part that sticks out in my mind with respect to the aboriginals that actually changed my whole view in what we're doing today. That was when I went to Cold Lake First Nations, and I saw in their offices they had a big map of the Primrose Air Weapons Range where they used to live, but they had these words, three words, and those three words were "livelihood for livelihood" and I understood that. I understood what that meant and what they're looking for. They have treaty rights, that's with the federal governments and stuff, but we want to develop this resource so we have to do it and work together, at the benefit of both. "Livelihood for livelihood", that's what they're looking for, respect. And so after looking at those words we started working with the aboriginal groups so what we started to do is started to create opportunities for them to form alliances with other companies. So one of the things we did was to give them catering, the catering business.

That's a steady business, you don't want to give them business that's just there for just one or two years, first of all it's hard to set up, and train, and develop and then it's done, so those models didn't



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



work. But the long-term sustainability jobs in camps was perfect for that. To one of the other aboriginal groups we said, we do a lot of earth work, we have to move dirt around when we're building these plants, or we have to build roads, or we have to build pads and we said, that's steady work, that goes on for the next thirty/forty years. And so we gave them a letter, we guaranteed them work for the next five years, they took that letter, went to the bank and were able to get equipment for hauling gravel and dirt around, and so they started a business. That business has been growing year after year, so our model is to, as our projects grow, not just the First Nations, the local communities to continue to work with them and in the Foster Creek area it's also the military. The military has control over the Air Weapons Range, they bring in planes from all over the world and we have to work with all of them and so, especially the First Nations. I think so far we've had a pretty good track record with them. We don't wait for them to jump up and down and complain that we're not giving them work, we actually assume as our activity starts to pick up, our involvement with the First Nations and the communities goes hand-in-hand. We're in this business for the long haul.

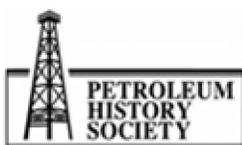
So we don't think short-term about the stakeholders at all. And one of the things that I'm pretty proud of is that ever since I've been in this company, all the projects that we've had to get approval for, we've never had to go to hearing, which means that we've never had a conflict to the point where we had to go to a hearing to get it resolved. We usually reach consensus on what the stakeholders want and what we're trying to do and so far that relationship's worked really well, but it's one of those things that I think we need to continue to work at and improve year after year. Again, it's "livelihood for livelihood". You've got to continue with that.

PMB: Surely there is a fit here in another sense. A few minutes ago you were talking about the probability of basically a shortage of manpower in the Province, and yet here you have to a certain extent unemployed people in the very areas where you're doing business.

CHHINA: Right, so on two notes, first let's talk about the aboriginals then I'll talk about the whole rural community. So example: I'll take is the Cold Lake First Nations. Before we were doing Foster Creek their unemployment was about eighty percent. Their own chief some years back said that that's dropped to twenty percent, so basically everybody that wants to work is working. Sometimes when we're giving them work they're having to go outside their bands to other bands, so I think we've done a pretty good job at keeping the people employed, whoever wants to work.

In terms of the other stakeholders in the communities, about five years ago, we changed our whole execution plan. Before what we used to do is have these big general contractors building our plants, they'd bring in a thousand people from wherever they could find them, whether it was Edmonton or Calgary or wherever. And so we found that these big general contractors didn't really work for us, that as a company we didn't have any control over our costs.

So what we started to do was establish our own construction management team, our own people actually run the construction now, any contractors, subcontractors, they're all dealt through Cenovus people. And so as a result of that, the other thing we learned was that we found that a lot of



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



companies during the 2000-2008 period, could manage about thirty to fifty people, but the same company, if we gave them more work and they staffed up to three hundred that they couldn't do the work efficiently.

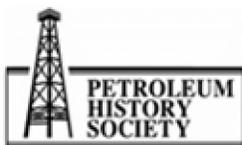
There are times when I've had to write a cheque for up to seven million dollars without an invoice and that's because the subcontractors weren't getting paid. And so this was a company that managed really well thirty to fifty people, but got to the point where they weren't even paying their subcontractors and weren't even giving us invoices in an efficient time period so the subcontractors would get paid.

So what we did then is we said okay, forget the general contractor. We'll manage our own and now we're going to have ten different small contractors with thirty to fifty people and as a result, those companies started to end up being more local. So there was about three/four years ago the mayor of Cold Lake actually came up and said, "What are you doing differently? We can tell that you're doing something different." And that's what we were doing different. He started to see more employment and growth around their communities in the Bonnyville and Cold Lake area because we changed our strategy of small contractors. And for us that was really good because our number one thing that we look at when we build these plants, the most important thing to us is safety, number two most important thing to us is compliance, following the laws of the land. When we get these applications approved, there are lots of things we need to comply with by the regulations, and the third thing is, we have our own policies for compliance. So compliance means Alberta, federal and also our company rules which is basically no drugs and alcohol.

If somebody gets caught with a bottle of beer, they're kicked out, drugs obviously gone, so and that has worked really well. The number three most important thing for us is adding value to our shareholders. We do not add value at the sacrifice of safety or compliance. One of the things that... Over the last five years, I have received letters from the local RCMP officers that we see some of these other projects where there's alcohol and drugs that there's lots of issues that they need to go address. And they said keep your, we like the way you guys are running your camps, leave them dry, there's a huge benefit to that. So that's the local RCMP officers telling us that this, you may not be seeing what's going on in the other camps, but your camps are very different, keep them that way because you guys are doing the right thing.

PMB: Does Cenovus have its properties mostly in the Cold Lake region? Or are there any in the Athabasca?

CHHINA: So at Foster Creek... really the Athabasca, when we talk about the Athabasca region its everything from north of Fort McMurray all the way down to Foster Creek is actually the most southern project in the Athabasca deposit. That's where the McMurray ends and that's where the Clearwater takes off down to where Cold Lake is. That's the other big... so for Foster Creek we've always been historically in the Cold Lake area, Lloydminster, that type of area. Christina, most of our people are still, basically we're using the same contractors that we use at Foster. They do piling work at Foster, then they'll go do it at Christina and cement jobs, same thing, so we're trying to use that.



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



So far we have been away from the big mining projects and competing for utilities, rather than roads or people and all of that, so that's been very good in terms of controlling our cost structure because we are going different. The contractor strategy is small so we can hire small companies and we're away from the Fort McMurray area which really helps us control our costs.

PMB: Environmental effects of development, land reclamation, biodiversity, air, carbon dioxide, ground water, surface water: Issues? Thoughts?

CHHINA: Okay first of all, it's all of the hundred and forty projects that we're working on in the R&D and technology side, two-third of them, first of all, are addressing environmental issues. So I'm not saying that they're purely for environmental. They make good business sense but they also improve the environment. For example, something like SAP, when you reduce the steam to oil ratio you reduce the emissions. It actually improves our recovery factor, so it makes good business sense but at the same time we're using less water, the recycled water, and we're also putting out less emissions. So we have to continue to go down that path of improving our environmental footprint and when you look at the first pads at Foster Creek to what exists today, we have dropped the amount of trees that we cut down for each pad from what we did back in 2001 to what we're doing now.

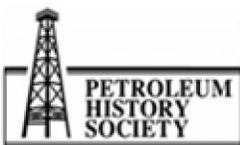
I forget the exact number but it's probably dropped by somewhere around forty percent on the footprint of a pad. Water usage, basically the only fresh water we actually use now is really, we have thousands of people in our camps, so you do need water usage for that, you need water for making ice bridges during the winter time and things like that. Most of the water gets recycled and if you need surplus water, we use what's called brackish water. Brackish water is anything more than four thousand total dissolved solids. So it's really not fit for human consumption, so we're trying to use our water, so that water is normally deeper than the fresh water sources, so that's there. In terms of our reclamation...

PMB: That is ground water?

CHHINA: The ground water is up to about two hundred, about two hundred to three hundred feet type number, after that it will become more saline, saline and then after at certain depths it will become four thousand TDS.

PMB: Okay.

CHHINA: So the other one is reclamation, so when we're putting in a pad one of the things that they're required to do is take the top soil from that land and store it. You actually, if you go to any of our pads you will see a big pile sitting there and there will actually be a label on it saying top soil. And so that's... Nobody's supposed to touch that. So once we've recovered our oil and then we're starting to reclaim it, we get rid of all the equipment, we put back that top soil, we start planting the trees and then that process goes on for about three years. The environmental folks will check once a year to see how that's progressing, then after a three to four year period we'll get a certification that



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



you reclaimed this land to the specs that it was before we went there, so that's what we're doing on that part.

Now I want to continue to drop the emissions and even reduce the brackish water usage, all those things and we are working on different recovery schemes like I said, on solvent based or combustion based recovery schemes that will drop that with time. Now one of the other things I think we need to look at it, it's really easy to pick on the oil companies in terms of all these emissions and all of that. So I ran through an example of Foster Creek.

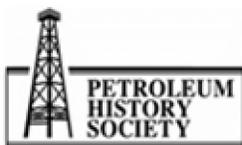
Foster Creek today is about a hundred and twenty thousand barrels a day. So we actually produce enough energy at Foster Creek to supply two Calgarys; so right now Calgary uses electrical, gasoline, natural gas, and all these different sources. I'm saying if all the sources were just oil, we're producing enough energy for two Calgarys. So how much does two Calgarys put up in emissions compared to a Foster Creek that provides the energy? We put up twenty percent; eighty percent is the end consumer; so both of us have to continue to work to reduce our environmental footprint. I think the average person, you and me, have to find ways to cut our energy needs, whether it's in our household or driving and so on, because that's eighty percent. But we need to continue to fund even more R&D projects to cut our emissions, find different ways to do CO<sub>2</sub> sequestration, reduce our need for natural gas. We need to go down that path of continuing to improve our recovery schemes and reduce our environmental footprint on the upstream where the oil is produced, and we have to do it on the downstream where the end user is using this energy.

PMB: A lot of people use that statistic about twenty percent being the CO<sub>2</sub>s produced by the industry as it produces and then processes gasoline for your car, and the other eighty percent is yours, so stop complaining to me. You're basically saying "No, we're not taking that position. We're saying we should reduce our twenty percent, but you should as well."

CHHINA: Yeah, we can only do what's under our control. So as an oil company we only control our twenty percent, that's why we'll continue to fund, like I said, we're investing two hundred million dollars out of our budget every year on these R&D research technology development projects. We're going to continue to go down that path. A simple thing like the wedge wells improved our steam/oil ratio by about fifteen percent. So that's fifteen percent less emissions, basically over a two, three year period with that one technology. SAP is thirty percent. So we have to continue to invest dollars in developing these technologies with the twenty percent that we're putting up in the air, and we're committed to doing that.

PMB: I'm going to ask you one last general question and then I'm going to let you say anything that you feel is appropriate. How is the industry going to evolve? We've talked a little bit about your position in it, and how it developed. What do you see happening over the next twenty-five years while it grows to be a million people strong?

CHHINA: I think I see technology changing here. I think we will find other new ways of extracting this, you know. People are looking at electrical heating, there's pilots going on there, we're using it



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



just for start-up purposes, not actually heating the whole oil sands. There was talk about using nuclear energy, I don't know where that's going to go, but I think bacteria. We actually have a project that we always work on, how did this bitumen actually come to be about?

This was conventional oil that started to migrate and as it came up close to the surface, the fresh water, the bacteria in the fresh water chewed up the light ends; there was a lot of methane released. And so because there's no real trap for the oil sands, except that they became so viscous that they couldn't move anymore. And bacteria today are still biodegrading that oil. So there might be other ways to recover and improve, whether it's the quality of the oil that can be improved, or make into something which is less, which is more environmentally friendly, like methane, methane is a clean burning fuel.

So I believe technology is going to be a changer and I believe that as the infrastructure in the oil sands changes, it's going to result in other industries. Whether its petrochemical type industries evolving and so I think that's going to start to happen, so I don't think what we're doing today is what we're going to be doing twenty-five years from now. Just like Imperial Cold Lake changed what was happening in California to huff-and-puff with fracturing, then we went to SAGD, I think you're going to see the next generation of recovery schemes start to evolve.

PMB: There's an argument that a lot of industrial waste can be sold. An example is at Syncrude, you know. There's a lot of waste ammonia, so a few years ago, ten years ago, they basically began selling to a company which built a little plant on the site and is now turning that ammonia into an ammonia fertilizer. And so the notion is that if you want to really get rid of a waste product, appoint a manager to sell it, to find a market for that waste. What's your thinking of that idea?

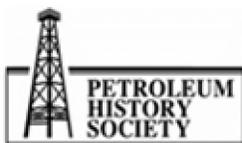
CHHINA: Okay, I'm not that familiar with the mining side but I understand how you could take advantage of that because you're upgrading there. In our projects we're not really upgrading and we don't have any refineries near our plants. We're basically producing bitumen, blending it and sending it down to where the refineries exist in the States. So those refineries are the ones that are producing, not just the three main products, gasoline, diesel and jet fuel, they're producing other materials as part of that refinery. So those opportunities would exist around those refineries.

PMB: For example, your steam processing facilities could be used to generate electricity which you could sell into the grid.

CHHINA: Which is what we do today at Foster Creek.

PMB: An example of that.

CHHINA: Yeah, so we generate steam and electricity simultaneously so we do sell. We're only consuming about half the electricity, so we do sell that. Now one of the other wastes, probably that we should try to harness and we're looking at ways to do that, we have a lot of low temperature heat, so in our plants when we produce our fluids we'll transfer a lot of the high temperature heat to the water that's going to get converted into steam, but the stuff less than seventy, ninety degrees Celsius,



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



we've got to find a way to harness and take advantage of that. Whether it's more electrical generation or we're even thinking whether we should be growing stuff, greenhouses type thing, what do we need to do to take advantage of that. So that is one thing that I believe that we could help hopefully find a solution to and one of the other things we're looking at is really using that low temperature heat along with solvents, as I was talking about it earlier. So there's different ways we can use some of that. But our situation, like you said, is a little bit different than the mining projects; they seem to have more end projects than we do.

PMB: Well I'm pretty well... my mind is a little bit numb here; anything else that you think that you'd like to say or like to offer to this project?

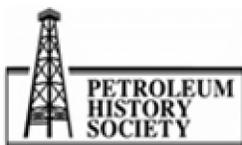
CHHINA: I think the other thing I'd like to say, that when I talk about technology, I guess an analogy might be a baseball game. If you asked me, Harbir, what inning do you think you're in when it comes to in-situ oil sands, and my answer is really, we just finished the first inning. Foster Creek, first project that paid out, but we've got a long ways to go. I think we've got a lot of smart people in Alberta and Canada, that if we put them loose in helping us to try to solve these problems and work together, I think we'll make a lot of headway in the second to the ninth inning in terms of improving what we're doing here in this province.

PMB: So going back to my suggestion earlier on that there may be five trillion, or six trillion barrels of heavy oil and bitumen around the world in various deposits, basically the prospect of peak oil, basically you know the world running out of oil production, reaching a plateau around the world becomes less likely, doesn't it, for the near future?

CHHINA: I don't know about that, all I know is rather than to run to other countries around the world, we are focused at home. We're focused on trying to improve our business here in Alberta right now. So it's not like we have teams looking everywhere around the world to see how we can transfer this thing, we're just trying to become even better at what we're doing here in Alberta.

PMB: But surely the people in Russia, for example, might be coming to Alberta and saying well what are they doing and how can we apply it.

CHHINA: Absolutely. I think the one thing we can teach the world, is not just about thermal recovery and enhanced oil recovery but about our manufacturing approach. The rest of the world is still drilling highly prolific wells, for example, like Brazil. They don't drill too many wells, but the ones they drill are very prolific, produce at very high rates. What we're good at is when something is marginal, we're good at putting a manufacturing execution strategy, so you're not just drilling two or three well wonders. You're drilling pads, specifically designed rigs – designed for drilling and walking on a pad and drilling well by well, but doing hundreds and thousands of these things. And I think that's, as the world gets heavier, which it is, we're running out of light oil, if you look at the API it's been steadily increasing and the sulphur content has been increasing as the API goes up. And so I think the rest of the world will be looking to Alberta to see what are these guys doing and what can



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



we apply and learn from and do it in their countries. But those opportunities will be coming in the future.

PMB: It's called the blackening of the barrel, isn't it?

CHHINA: Blackening of the...never heard that term.

PMB: Over thirty years ago oil was very light, and the barrels were clear oil and then it has gradually gotten blacker and blacker and blacker, in global oil.

CHHINA: We just say the overall API of world production has been dropping with time.

PMB: I prefer the blackening of the barrel.

CHHINA: I don't know about that.

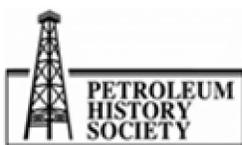
PMB: Anything else?

CHHINA: The other thing I'd like to say, it's a term that I use regularly in our company is really that the status quo is unacceptable. We've got to get everybody moving and thinking about this, and that's going to be the key. Get everybody in Alberta and Canada, and our company thinking about how do we make this business better. So one of the things that we did a couple of months ago is that we took fourteen hundred people from our company and said, you're not going to work for the next two days. We want you to learn. So those fourteen hundred people came and saw like a hundred plus posters about innovation that was going on, people that were finding a better way to do things, reduce emissions, become more energy efficient, reduce costs, all those things and so on. I think that really sparked, those types of things are very important for our culture. Is that when you show the employees that, for two days, all we want you to do is focus on innovation and technology, and look at what other people are doing, look for other opportunities around the company, now that gave us, goes a long way in terms of improving our culture and for the fact that we see a status quo that's unacceptable, that's what we want people to do and I think that helped a lot.

PMB: Were those the employees here in Calgary or did that include the field?

CHHINA: Both field and Calgary. And so we believe that, you can have a great business strategy, a wrong culture will leave the business strategy for lunch any day. So you have to work on both, and so it's very important to continue to build that culture and that culture shouldn't be just in our company, it should be in our industry, it should be the people that aren't even in our industry, so we've got to motivate that culture of innovation and becoming better.

PMB: I heard an interesting statistic and this just occurred to me. when Cenovus and EnCana were one company, I believe two-thirds of the assets of the combined company were in Canada and one-third essentially in the United States and now that Cenovus is split out, EnCana has two-thirds of its



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.



assets in the United States and one-third in Canada. Cenovus has two-thirds of its assets in Canada and one-third in the U.S. Are those statistics roughly correct?

CHHINA: No. Except for two refineries, we don't have any other operations in the United States.

PMB: Ah. This just referred to EnCana which all of a sudden lost its predominantly Canadian status.

CHHINA: Yeah, I'm not familiar with the statistics on the EnCana side, but on our side it's really our two refineries, so relative to what the upstream is worth, it's far more compared to our downstream and as we're growing our upstream it's going to dwarf the U.S. asset value even further. So we are a home grown and growing local company; so most of our eggs are in one basket here in Alberta.

PMB: In terms of your stature in Calgary, where would you rank among the oil sands companies, a number in terms of production?

CHHINA: I think on the in-situ side, really Imperial is still the leader, like I said there's about a hundred and fifty, we're doing about a hundred and thirty, forty right now, so we're very close to that number. And I think CNRL would be very close to our number too. So there are three companies now in in-situ, which are very close to each other in terms of oil sands production.

PMB: Then of course Suncor would be the clear leader in the oil sand world.

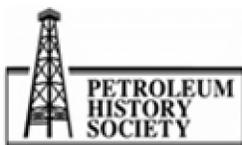
CHHINA: In overall mining, yes, because I believe they're like five hundred in total. So they're definitely once you include the mining, but in terms of the in-situ players, three of us are very close.

PMB: Thank you very much. Anything else?

CHHINA: I don't know. Did I miss anything? I don't think so, and I talked for a long time.

PMB: Well thank you very much, that was a good interview.

[END OF INTERVIEW]



Sponsors of The Oil Sands Oral History Project include the Alberta Historical Resources Foundation, Athabasca Oil Sands Corp., Canadian Natural Resources Limited, Canadian Oil Sands Limited, Connacher Oil and Gas Limited, Imperial Oil Limited, MEG Energy Corp., Nexen Inc., Suncor Energy and Syncrude Canada.