THE 11th ANNUAL RICE GLOBAL E&C FORUM

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"AN OVERVIEW OF THE CANADIAN OIL SANDS"

PRESENTED BY

MR. JOSEPH G. MUNISTERI P.E.

PRESIDENT

THE JOSEPH G MUNISTERI COMPANY

4265 SAN FELIPE SUITE #1100

HOUSTON, TEXAS 77027

<u>OR</u>

"ALL YOU NEED TO KNOW ABOUT THE CANADIAN OIL SANDS-AND THEN SOME"

TWENTY QUESTIONS FORMAT

COVERING:



THE TWENTY QUESTIONS ARE:

<u>PART I</u>

- 1. What are unconventional hydrocarbon resources?
- 2. Where are they located?
- 3. How large are these resources?
- 4. How much is recoverable?

QUESTION 1: WHAT ARE UNCONVENTIONAL HYDROCARBON RESOURCES? PART I

- Shale Oils
 - Spain
 - Colorado
 - Wyoming 🔶 USA
 - Utah
 - Brazil
 - Estonia
- Tar Sands-Canada
- Extra Heavy oils- Orinoco, USA
- Medium Heavy oils- Canada, Europe
- Brea tar pits- California
- Migrant methane- Kirkuk, Iraq

etc.

PART I-QUESTION 2: WHERE ARE THEY LOCATED?

- •Global OOIP: (~5) Tbbls: Volume of resource
- Extra-Heavy & Oil Sands (~75%): Most of the Resources
- Majority of Resource in the Americas: Canada & Venezuela
- Oil Shale (~15+%): Very Specific (Kerogene)



Geographic Distribution

PART I- QUESTION 3: HOW LARGE ARE THESE RESOURCES?

Total estimated volume- 5.0 Trillion bbls Broken Down As:

Medium Heavy 600 Bbbls Extra Heavy- 1600 Bbbls Oil Sands- 1750 Bbbls Oil Shale- 1050 Bbbls Total 5000 Bbbls

PART I-QUESTION 3: HOW LARGE ARE THESE RESOURCES? (Continued)

Oil Sands In Canada

<u>P</u>	roven Res	serves	<u>Ave. pay thickness</u>	<u>Mass%</u>	<u>Porosity%</u>
Athabasca- 5 areas- Mining & Insitu-	- 1369.6	Bbbls	24-100ft	4.7-10.2	16-30
Cold Lake- 3 Areas- Insitu only -	195.1	Bbbls	18-39ft	7.3-9.5	27-31
Peace River- 3 Areas- Insitu only-	135.6	Bbbls	20-78ft	5.1-8.1	18-27
Oil Sands Total Extra Heavy And Medium Heavy oils	1700.3 <u>50.0</u>	Bbbls			
Grand Total	<u>1750.3</u>	Bbbls P	roven Reserves		

PART I-QUESTION 4: HOW MUCH IS RECOVERABLE?



<u>Mining:</u> Current recoverable reserves- 36 Bbbls <u>Insitu:</u> Current recoverable reserves- <u>140 Bbbls</u> Total recoverable reserves- 176 Bbbls

<u>PART II</u>

- 5. What are their characteristics?
- 6. How do we compare major unconventional resources?
- 7. Where are the Canadian unconventional resources located?
- 8. How do we extract bitumen?



Source: Herold's Energy Conference

°API Gravity

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PART II-QUESTION 5: WHAT ARE THEIR CHARACTERISTICS? (Continued)

Three Basic Liquid Classifications:

- Tar Sands Viscosity Range from 10,000 Cpo to 10 million
 Gravity Range 6.0° API to 12.0°API
- Extra Heavy Oil- Viscosity Range 100 Cpo to 10,000 Cpo Gravity Range 6.0°API to 19.0°API
- Medium Heavy Viscosity Range 10 Cpo to 100 Cpo Gravity Range 16^{o API} to 25^{oAPI}

<u>All Are:</u>

- Non homogeneous in composition
- Dirty mixtures/Sand, Water, Sulphur, inorganics
- Hard to extract in winter whether mine or in situ

PART II-QUESTION 6: HOW DO WE COMPARE MAJOR UNCONVENTIONAL RESOURCES?

Typical Examples

	Type of Crude	Location	<u>Viscosity (Cpo)</u>	Gravity (API°)
•	Zuata	Orinoco	1050	8.5
•	Belridge	California	4000	9.0
•	Boscan	South America	9000	9.2
•	Maya	Mexico	9500	14.0
•	Kern River	California	8500	14.3
•	Peace River	Canada	110.000	8.6
•	Cold Lake	Canada	95.000	10.1
•	Athabasca	Canada	4,000,000	8.8
•	Lacq	France	50	22.0
•	Bachaquero	South America	95	18.0

PART II-QUESTION 7: WHERE ARE THE CANADIAN UNCONVENTIONAL RESOURCES LOCATED?



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PART II- QUESTION 8: HOW DO WE EXTRACT BITUMEN?

CANADA: Mining Process

Mainly: Athabasca – Fort Mc Murray Area

- Maximum depth: 75 m or 250ft (overburden plus oil sands)
- Recovery rate: ~ 82%
- Gas Required: ~ 450 cf / bbl
- Current Production-2007 equals: 1.32 MMb/d Raw Bitumen yields 1,080,000 B/D SCO (Synthetic Crude Oil)

PART II: QUESTION 8: HOW DO WE EXTRACT BITUMEN?

ATHABASCA- TAR SANDS

(Continued)

STEPS:

- <u>Stripping-</u> Buckel wheel excavators up to 125 ft
- Mining- Open pit- Back hoe or drag lines up to 250 ft
- <u>Hauling</u>- By off-road trucks up to 100 ton capacity
- <u>Upgraders-</u> Carbon out/Hydrogen in processes to produce (SCO) synthetic crude oil
- SRU Sulphur recovery units- Augmented by O2 injection
- <u>Restoration-</u> From spoil rows

PART II: QUESTION 8: HOW DO WE EXTRACT BITUMEN?

(Continued)

SAGD: Steam Assisted Gravity Drainage

Most Promising Option for Deep Horizons

Continuous Process via multi wells

- Steam injection wells
- Producing wells (gravity)

Steam assisted gravity drainage

High Recovery Rate~25%-50%

- High thermal diffusion
- Compare to conventional drilling~ 15%

Good Experience

- Production in 2007: 535,000 b/d

Requirements

- A lot of energy (1 Mcf/bbl + 150 cf/bbl for Upgrader)
- Production Technologies at High Temperature
 - Hydro Cracker, Etc. 16
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PART II: QUESTION 8: HOW DO WE EXTRACT BITUMEN?

(Continued)

It's A Driller's Paradise

Three Types of Extraction-Tar Sands Area:

- <u>Cold Lake-</u> 3 Basic Areas- Only Insitu- Deep Deposits. Thermal Primary wells plus SAGD Systems
- Peace River- 3 Basic Areas- Only Insitu- Thermal Primary plus SAGD Systems
- <u>Athabasca-</u> 5 Basic Areas- Mainly mining- Open pit plus both thermalprimary and Insitu SAGD Systems

Drilling History

Number of Producing Wells- Insitu Production

Year 1990- 2000 wells

Year 2000- 6000 wells

Year 2008- 8500 wells

Wells drilling 1985-2006	Exploration	<u>Developmental</u>	<u>Pilot</u>	<u>Total</u>
	13,765	15,182	611	29,558

<u>PART III</u>

- 9. What has been the production record?
- 10. What are the costs of production?
- 11. What has been the investment record?
- 12. How many projects are underway or planned?



PART III- QUESTION 9: WHAT HAS BEEN THE PRODUCTION RECORD? (Continued)

Average 2007 Raw Bitumen Production- Surface Mining-

- Syncrude Canada- 310,000 B/D
- Suncor Energy- 303,000 B/D
- Albian Sands Energy- 146,000 B/D
- Misc- <u>26,000</u> B/D

785,000 B/D

Average 2007 Raw Bitumen Production-Thermal Insitu

535,000 All Areas

2007 total production **1,320,000 B/D Raw Bitumen**

PART III- QUESTION 10: WHAT ARE THE COSTS OF PRODUCTION?

Economic Comparisons- 2008 Costs Raw Bitumen per Bbbl produced



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PART III- QUESTION 11- WHAT HAS BEEN THE INVESTMENT

PART III- QUESTION 12: HOW MANY PROJECTS ARE UNDERWAY OR PLANNED?

As of January 1, 2008

Major Mining and Upgrading Projects

-Total number of major projects being constructed-

5 new major projects

-Total number of major projects approved-

7 new major approved projects

-Total number of major projects in application-

14 new major projects

-Total number of new major projects announced or disclosed

23 new major projects

Total number- 49 new major projects in mining and upgrading

PART III- QUESTION 12: HOW MANY PROJECTS ARE UNDERWAY OR PLANNED? (Continued)

As of January 1, 2008 Major Insitu Projects

-Total number of major projects under construction-

8 new major projects

-Total number of major projects approved-

16 new major projects

-Total number of major projects in application-

2 new major projects

-Total number of major projects announced or disclosed-

45 new major projects

- Total number **71** new projects Insitu projects
- Total number <u>49 new mining and upgrading projects</u>
- Grand Total **120** new projects underway or planned

<u>PART IV</u>

13. How many upgrading plants are in operation?

14. What is the upgrading conversion efficiency?

15. How do you transport the Bitumen?

16. What major processes are used to upgrade Bitumen?

PART IV- QUESTION 13: HOW MANY UPGRADING PLANTS ARE IN OPERATION?

As of January 1, 2008

-6 major upgrading plants are in operation

With a total upgrading processing capacity of 872,000 B/D

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PART IV- QUESTION 14: WHAT IS THE UPGRADING CONVERSION EFFICENCY?

As of January 1, 2008

• What was the total amount of Bitumen upgraded in 2007?

- 286 Million bbls

• What was the total amount of Synthetic Crude Oil (SCO) produced in 2007?

- 251 Million bbls

•What is the overall conversion efficiency or yield?

- 87%

• What percentage of the total Bitumen produced in 2007 was upgraded?

- 60%

PART IV- QUESTION 15: HOW DO YOU TRANSPORT BITUMEN?

- From the mine- by draglines to haul trucks
- From initial preparation unit-by diluent blending
- For pumping- blended Bitumen- 50%/SCO 50%
- Or blending with 30% pentane or light Crude Oil or C4 Naphtha
- -From mine area to upgraders-by pipeline with blended mixtures
- -From Alberta to United States refineries-by blended mixtures in pipelines

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PART IV-QUESTION 16: WHAT MAJOR PROCESSES ARE USED TO UPGRADE BITUMENS?



<u>PART V</u>

- 17. What is synthetic crude oil?
- 18. How is it processed?
- 19. What are the major limitations to future growth?
- 20. What has been the impact on the region?

PART V- QUESTION 17: WHAT IS SYNTHETIC CRUDE OIL?

A Diagram Tells It All



-Varies by refinery type and OOIP composition

- -Most upgrading is done in Canada
- Most refining is done in the United States
- Sold at discount to Global Oil Industry prices

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PART V-QUESTION 18: HOW IS IT PROCESSED? INTEGRATED SCO COMPLEX



Source: McGinnis, J. and E. Confrotte, Hydrocarbon Processing



PART V- QUESTION 19: WHAT ARE THE MAJOR LIMITATIONS TO FUTURE GROWTH?

- -Many different factors-both technical and environmental are important
- Infrastructure sustaining capacity is limiting growth
- Pipeline capacity to new market areas is limiting
- Refinery redesign modification must grow commensurately
- Technical and skilled labor force size is limited
- Global crude oil availability and price stability is needed
- Total energy availability at elevated requirement is limiting
- Environmental issues- i.e. Sulfur, coke surpluses- and water usage may be limiting factors.

PART V- QUESTION 20: WHAT HAS BEEN THE IMPACT ON THE REGION?

- -Oil sands juggernaut goes on
- Tremendous impact on the region's economy
- Boom times are here- 1.5% unemployment level
- Housing cost in Calgary and Edmonton have sky rocketed
- Public services are strained- Schools, Roads, etc.
- Job site locations are in remote areas
- Inflation of all services costs is the result

When will it all end?

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