SIMPLE FIELD SOLUTIONS FOR HEAVY OIL AND BITUMEN

October 2019
Forward Looking Statement and Disclaimer

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Fractal Systems Inc. is a heavy oil technology company who develops, patents, and deploys innovative, cost-effective solutions to improve producer margins, de-bottleneck infrastructure and provide flexibility associated with the transportation of heavy oil. The initial technology involves partial upgrading.

Fractal Systems Inc. is a private Canadian corporation with an office in Calgary, Alberta and lab in Sherbrooke, Quebec.
Experienced Team

DEEP INDUSTRY EXPERIENCE WITH A PROVEN TRACK RECORD

**Founders**

Michel Chornet  Director & Technology Advisor  
- Co-founder of Fractal Systems Inc. and 20 years of engineering and technology development experience in energy sector  
- Shell and H-Power  

Dr. Esteban Chornet  Founder  
- Inventor of JetShear technology & Professor of Chemical Engineering at Université de Sherbrooke (Québec, Canada)  
- Founder of Enerkem and Fractal Systems Inc.

**Joe Gasca** Chairman  
- 35+ years of industry experience, most recently as CEO of Ivanhoe Energy  
- 20+ years in major leadership positions at Texaco, including leading the upstream technology organization  
- Global Operations GM for BG Group

**Ed Veith** President & Chief Operating Officer  
- 35+ years of oil company and engineering company experience  
- 14 years at Ivanhoe Energy, most recently as EVP Upstream/SVP Canada Projects  
- Extensive heavy oil experience in California working with subsidiary of Shell & ExxonMobil

**Richard Masson** Chief Commercial Officer  
- 30+ years of industry experience  
- Former CEO, Alberta Petroleum Marketing Commission  
- Developed and cultivated key industry and governmental contacts  
- Held key senior roles in heavy oil divisions of Nexen, Shell, and others

**Committed Investors with energy experience**
Enhanced JetShear Highlights

IMPROVING OIL SANDS SUSTAINABILITY THROUGH INNOVATION

• Lower transportation costs
  • Reduced viscosity requires less diluent
• Increase infrastructure utilization
  • Less diluent frees up pipeline capacity
• Improve product value
  • Reduced discounts for product quality
• Reduce GHG emissions
  • Take diluent out of the system
• Lower capital investment
  • Viable in the current price environment

Fractal Systems Inc. — Creators of JetShear™ / Enhanced JetShear™ / ARP™
Enhanced JetShear
Value Proposition

JetShear™ | Enhanced JetShear™ | ARP™
Value-Add from Enhanced JetShear

AVOIDING COSTS IS PARTICULARLY ATTRACTIVE IN A LOW-PRICE ENVIRONMENT

7 bbls Bitumen

Enhanced JetShear

+ 1.5 bbls diluent

Conventional Blending

+ 3 bbls diluent

Lower diluent costs
Lower pipeline tariffs
Lower quality discounts
More efficient pipeline utilization

Net Value Addition = C$9.50 to C$14.00 per barrel of bitumen
EJS Net Value Forecast

ENABLES SIGNIFICANT COST REDUCTION AND HEDGE AGAINST VOLATILITY

- IHS Markit performed a market evaluation study on an EJS product produced in the field:
  - 51% reduction in diluent
  - Pipe transport to the USGC
- Improved cost structure due to lower diluent content and reduced quality discounts
  - Reduced purchase of diluent
  - Reduced tariffs to the USGC and from hub to field
  - Elimination of high TAN discounts
- Lower resid / diluent content / TAN improves market penetration
- Potential to further improve bitumen netbacks in select markets and refineries
- Hedge against volatility
  - Timing of new pipe
  - Diluent price and heavy oil differential

JetShear Environmental Benefit

POTENTIAL 11% REDUCTION IN GREENHOUSE GAS (GHG) INTENSITY

- Third-party firm conducted a wells-to-tank GHG assessment of Enhanced JetShear
- GHG impact of diluent production and transportation is significant
- Point source GHG emissions from JetShear are more than offset by reduced GHG from:
  - refinery processing of EJS product and diluent recovery
  - reducing the need for GHG intensive diluent
  - reducing transportation volumes

1. ClimateCHECK conducted a GHG assessment in February 2018 based on results achieved at the Commercial Demonstration Pipeline to USGC

<table>
<thead>
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<th>Case</th>
<th>Alberta Point Source</th>
<th>Transportation &amp; Refining</th>
<th>Total</th>
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<tbody>
<tr>
<td>SAGD</td>
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<td>141</td>
<td>205</td>
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<tr>
<td>JetShear + SAGD</td>
<td>70</td>
<td>113</td>
<td>183</td>
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</tbody>
</table>

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Benefit 11% reduction in GHG
JetShear Frees Up Oil Export Capacity

APPROXIMATELY 20% MORE BITUMEN CAN BE TRANSPORTED IN EXISTING PIPELINES

Conventional Dilbit

Enhanced JetShear

Diluent volumes are reduced, lessening the need for imported diluent and improving infrastructure utilization – a significant benefit given current egress challenges
Enhanced JetShear Hub Project

JetShear™ | Enhanced JetShear™ | ARP™
EJS Hub Project
SECURING THE FUTURE THROUGH ENERGY DIVERSIFICATION

• Recently secured Provincial and Federal government support of $12.2 Million
  • Emissions Reduction Alberta (ERA) - $5 Million
  • Sustainable Development Technology Canada (SDTC) - $7.2 Million
  • Partial funding of pre-sanction activities (site, scale, regulatory approvals, commercial agreements for supply) to achieve project sanction

• Supply agreements secured/being developed with multiple producers
  • Targeting up to 50,000 bopd bitumen supply

• Partner agreements in place
  • Project ownership and financing

• New jobs created for engineering, construction and operations while improving the GHG intensity of oil sands
EJS Hub Project Scheme

TOLLING MODEL ALLOWS PRODUCERS TO ACHIEVE A VALUE UPLIFT WITHOUT COMMITTING CAPITAL

- Build Enhanced JetShear facility adjacent to a terminal that is both rail and pipeline connected
  - Maximum optionality as takeaway capacity changes over time
  - Facility could generate a pipeline spec product or a “neat” product (without diluent) for rail transport as non-hazardous commodity
- Tolling Model
  - Process dilbit owned by producer
  - Charge producer a fee for service (“toll”)
  - Strip out diluent and “return” excess to producer
  - Return EJS product to producers for transport to refiners via pipe or rail

[Diagram of the Tolling Model process]

Producer provides pipeline quality dilbit → EJS Hub (Enhanced JetShear, producer pays toll) → Transport (producer pays reduced pipeline / rail tariffs) → Refinery (producer sells partially diluted / neat bitumen)

Excess diluent returned to producer
Hub Project Commercial Structure

STRUCTURE IN PLACE TO DELIVER THE PROJECT

- Commercial structure in place to deliver the project; commercial agreements for supply being negotiated
- Producers benefit from the profit between incremental value for EJS product and avoided diluent and transportation costs, less the midstream toll under take or pay contract
- Canadian midstream partner will finance, build, own and operate the hub project
- Fractal earns a per barrel licensing fee and has option to participate in the project’s equity
JetShear
Market
Cost Structure
• Oil sands must be competitive with other investments around the globe to capture
development capital

Transportation Challenge
• Most oil sands bitumen goes to the U.S. for refining
• Pipelines are now operating at full capacity due to growth in oil sands production
• New pipeline projects are having difficulty getting approval from governments

Environmental Concerns
• Bitumen has high carbon content – deemed “dirty”
• Industry requires new solutions to improve efficiency and reduce GHGs
Oil Sands – “High Cost” Resource Base

DILUENT, TRANSPORT & PRICE DISCOUNTS GREATER THAN FIELD OPERATING COSTS REPORTED BY PRODUCERS

![Chart showing costs per barrel from 2013 to 2018]
Canadian Diluent Market

GROWING OIL SANDS PRODUCTION LEADS TO INCREASED DILUENT DEMAND - $23 BILLION IN 2018

- Oil sands production totaled ~3.1 million b/d bitumen in 2018
  - ~2.2 million bpd bitumen not upgraded
- Forecast to grow to ~4 million b/d (2030)

- Diluent demand forecast ~1.1 million b/d in 2030
- Domestic condensate supply is expected to peak at approximately 600 kbpd by 2030
- Price will continue to be set by imported diluent to meet demand
- Diluent market of ~C$30 billion in 2030

* Based on forecasts by CERI (July 2019), CAPP (June 2019) and IHS Markit
Export Limitations
NEW EXPORT PROJECTS SLOW TO DEVELOPMENT AND FACE SIGNIFICANT HEADWINDS

- Approximately 75% of all crude produced in Canada is exported to the U.S. (much of it heavy oil)
- 99% of all Canadian crude exports are to the U.S.
- Export capacity is essentially full; growth volumes moving to rail and pipelines under apportionment resulting in wide heavy oil discounts

Source - CAPP 2018 Crude Oil Forecast, Markets and Transportation
JetShear Technology Background

JetShear™ | Enhanced JetShear™ | ARP™
The Science

THE KEY INNOVATION IS LOW-SEVERITY PROCESSING TO ACHIEVE HIGH YIELDS AND BENEFICIAL PRODUCT PROPERTIES AT LOW COST

- JetShear uses low-severity, hydrodynamic cavitation and mild thermal cracking to structurally modify asphaltene molecules by separating resin groups attached to the asphaltene core
- The rapid change in pressure allows microbubbles to form around nucleation sites
- Kinetic energy from cavitation, converts to chemical energy and modifies heavy oil microstructures and the state of aggregation
- The resulting de-structuring lowers viscosity and bulk density with essentially no change in the volumetric yield
- Approximately 50% less diluent is required to meet pipeline specifications
Enhanced JetShear Process Flow

UTILIZES FRACTIONATION, HEAT, PRESSURE & OFF-THE-SHELF TECHNOLOGIES

1. Initial processing step separates diluent from bitumen
2. Bitumen is sent to the JetShear module, heated to thermal cracking temperatures and pumped through proprietary jet-nozzles where cavitation and mechanical shearing occurs
3. Olefins concentrated in the lighter cuts are removed by processing in a low-pressure, catalytic polishing unit with hydrogen
4. Hydrogen is supplied using a licenced hydrogen package or purchased from local hydrogen supplier
5. Sulfur is recovered from by-product gases using a licenced sulfur recovery unit
JetShear
Commercialization
JetShear Development Timeline

DEMONSTRATED TECHNOLOGY DEVELOPMENT

Pilot
Pre-2009
1-30 bopd

Proof of Concept

Field Demonstration
2009-2010
300 bopd

Nozzle Scale up

Commercial Demonstration
2012-2015
1,000 bopd

Commercial Nozzles

Commercial Demonstration
2016-2017
1,000 bopd

Processed >110,000 bbls

Major EPC Class 4+ engineering

Canadian and USGC capital cost studies

August 2017

Patent Applications (PCT) 2008
Patent granted: Process for treating heavy oils
Patent granted: Treated oils having reduced densities and viscosities
Patents Granted 2011-2012

Large Scale Commercialization
2018
50,000 bopd

Hub Concept Development

Processed >110,000 bbls

SDTC/ERA Support

Market studies
Hub feasibility studies
Engagement of midstream and pipeline companies
Applications for government support

Regional Hub Facility Project
2019
50,000 bopd

Progressing commercial scale hub project with producer(s), hub host and engineering/financial partners

Commercial Demonstration
Commercial
Pilot
Field
Large Scale
Regional Hub
Pilot
Commercial
Large Scale
Regional Hub
Field
Scale-Up Risk Addressed

FIELD PROVEN NOZZLE-LIFE PERFORMANCE

- Scale-up risk has been effectively addressed
- Three commercial-size nozzles successfully demonstrated in the field with processing over 225,000 bbls of bitumen blend
- Commercial design utilizes parallel banks of 500 bpd nozzles
- Commercial runtime > 6 months

SCALE-UP SEQUENCE

1 bpd/nozzle
3 bpd/nozzle
30 bpd/nozzle
150 bpd/nozzle
500 bpd/nozzle

27,000 BPD COMMERCIAL CONFIGURATION

6 BANKS OF 9 NOZZLES (500 BPD / NOZZLE)
Enhanced JetShear Commercial Demonstration Completed in 2017
READY FOR LARGE SCALE COMMERCIAL DEVELOPMENT

• Technology validation is complete; all milestones for commercial demonstration were met
• Over 225,000 barrels of diluted bitumen blend processed at demonstration facility
• Technology is scalable; commercial-sized nozzles met performance objective
Enhanced JetShear Benefits

TECHNOLOGY DE-RISKED AFTER LONG-TERM COMMERCIAL DEMONSTRATION

- Improve competitiveness of Canada’s bitumen production by reducing diluent needs by about 50%
- Reduce GHGs by ~11% from wells to tank
- Increase capacity of existing pipeline infrastructure by more than 20% by reducing need to ship diluent in two directions
- Economically attractive with low capital intensity and operating costs
- Deployable on a meaningful scale through EJS Regional Hub Facility
Fractal’s JetShear Technology Platform

IMPROVES OILSANDS SUSTAINABILITY

- Lower transportation costs
- Increase infrastructure utilization
- Improve product value in Province
- Reduce GHG emissions
- Lower capital investment
- Ready for commercial deployment