Combined Miscible Drive (CMD)
“Recovering the Unrecoverable Barrel”

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Jackson Hole, Wyoming
Corporate Summary

- Public Company Listed in Toronto (TSX: NNN)
- Q2 Production Exit Rate – 1,200 BOEPD
- Reserves – 17.4 MMBOE Proved; 28.6 MMBOE Proved + Probable
- Acquire producing oil and gas properties with substantial conventional and enhanced oil recovery development
- Technical staff has specific expertise in evaluation, acquisition, re-development and Enhanced Oil Recovery (EOR) technologies.
High Quality Asset Portfolio

Concentrated portfolio of oil and gas properties with an attractive reserve base leveraged 98% to crude oil.
History of In-Situ Combustion

• In-situ combustion technology has existed for over 100 years - what’s old is new again.

• In the US there have been 228 in-situ combustion projects ~ 60% failed:
  ➢ Poor Reservoir Characterization
  ➢ Unanticipated Operational Challenges
  ➢ Management Commitment

• All projects that utilized oxygen enriched air were technical successes but uneconomic due to declining oil prices.
Combined Miscible Drive – CMD

A patented in-situ combustion process in which foamed oxygen is injected at the top of an oil reservoir to generate $\text{CO}_2$, heat and steam.

- **Oxygen, Carbon Dioxide, and Steam**
- **Combustion Zone**
- **Oil**
- **Water**
• Foamed $O_2$ is used to generate $CO_2$ and steam in-situ

• Steam heats and displaces oil toward the production wells

• $CO_2$ and light oil form a miscible layer in front of the steam

• $CO_2$ saturates the oil ahead of the miscible light oil layer

• The process is unique because the benefits of a $CO_2$ flood, gravity drainage, and a steam flood are combined to enhance production.
CMD Project Screening Parameters

- Reservoir Depth – 2,000 to 5,000 ft
- Porosity > 22%
- Initial Oil Saturation > 50%
- API Oil Gravity < 32°
- Reservoir Oil Viscosity < 500 cp
- Sloping Structure for Top Down Injection
NiMin California Property
Pleito Creek Field – Santa Margarita Reservoir

- **OOIP = 38.7 million bbl**
- **Reservoir & Crude Oil Properties**
  - Depth = 3,600 to 4,600 ft
  - Avg. $k = 90$ md
  - Avg. $\Phi = 28\%$
  - $SO_R = 65\%$
  - $16^\circ$ API Crude & 185 cp @ 105° F
  - Temperature = 105° F
  - Avg. net pay = 115 feet
- **Current production 300 BOPD**
- **CMD response in 3 horizontal wells**
- **Primary expected recovery up to 12%**
- **CMD expected recovery up to 60%**
Pleito Creek Injection Facility

1. Produced Water Treating
2. Liquid $O_2$ Storage & Pumping
3. $O_2$ Vaporization
4. Water & $O_2$ Mixed to $O_2$ Foam
5. Injection Well Design
6. Safety System
Pleito Creek Conditions for CMD

- Top Down Injection
- Gravity Stable
- Reservoir Temperature  = 105° F
- Injection Pressure  = 1,700 psi
- Significant CO₂ Absorption
Pleito Creek - CO₂ Density @105° F
Pleito Creek - Oil Swelling @105° F

![Graph showing the relationship between pressure and oil swelling factor.](image-url)

- **X-axis**: Pressure, psi
- **Y-axis**: Bo, rb/stb
- **Legend**:
  - CO2-105
  - CO2-225
  - CH4-105
  - N2-105

**Key Points**:
- **Supercritical Region**
- **Gas Region**
- **Liquid Phase**

**Notes**:
- The graph illustrates the effect of pressure on oil swelling for different gases at 105° F.

Pleito Creek - Gas Saturated Oil Viscosity @105°C F

![Graph showing the effect of pressure on viscosity for different gases (N₂, CH₄, CO₂)]
H3 Production Plot

- Oil Rate - bopd
- CO₂ Concentration

CO₂ Concentration
Actual Production
CMD Initiation
Benefits of CO$_2$ Generation

- Supercritical CO$_2$ properties of gas and liquid
- Significant absorption of CO$_2$
- Oil swells up to 34%
- Oil viscosity reduction up to 91% (100 to 10 cp)
Top-down Burn, Oil Recovery Factor

![Diagram showing the relationship between volume burned and oil recovery factor. The x-axis represents the volume burned (%), and the y-axis represents the oil recovery (% of oil at start less fuel). The graph includes lines for initial gas saturation probabilities: 0%, 10%, 20%, 30%, and 40%. The diagram also highlights possible reserves and probable reserves.](image-url)
Pleito Creek - Audited Reserves

Without CMD (Ultimate Recovery 12%)

- 2.5 MMBO
- $50.0 MM PV_{10}

With CMD (Ultimate Recovery 36%)

- 11.8 MMBO
- $225.9 MM PV_{10}

Primary + CMD Recovery 30%

* NiMin reserves from Huddleston & Co, Inc. NI 51-101 reserve report effective January 1, 2011. All reserve volumes net to company working interest unless stated otherwise.
Pleito Creek – Development Plan

- Continue primary development - 15 drilling locations
- Increase oxygen injection rate
- On-site oxygen plant
- Re-inject carbon dioxide rich produced gas
Enhanced Oil Recovery – Cost Comparison

**Developed CMD Cost**
- Lease Operating Expense: $12/BBL
- Capital Costs: $4/BBL
- Total Development Costs: $16/BBL

*Limited to existing facilities and 1500 BOPD; Ultimate 36% recovery OOIP; Unrisked

**Alberta Energy and Utilities Board (2009)
CMD Summary

• CMD process allows for the efficient recovery of oil at greater depths than steam methods

• CMD process generates only 10-15% of the greenhouse gases as in conventional steam generation and no local footprint

• In the US, there are approximately 165 heavy oil fields with 14 billion barrels OOIP that could benefit from this process

• In the US, there are approximately 276 light oil fields with 32 billion barrels OOIP that could benefit from this process
Contact Information

Address: 1160 Eugenia Place, Suite 100
          Carpinteria, CA 93013
Office:  (805) 566-2900
Fax:     (805) 566-2917
Website: www.niminenergy.com

Sven Hagen, PhD
President
shagen@niminenergy.com

Scott Dobson
Chief Operating Officer
sdobson@niminenergy.com