BIOTHERMICA VAMOX® TECHNOLOGY
AN INNOVATIVE WAY TO MONETIZE CARBON CREDITS FROM VENTILATION AIR METHANE

by

Biothermica Coal Carbon Inc
in cooperation with Eco-Alliance

September 22, 2010
Outline

1. Biothermica group overview
2. Opportunity: Carbon revenues from VAM destruction
3. The VAMOX® technology: How it works
4. Biothermica demonstration project with JWR, Alabama, USA
5. Project feasibility studies at Ukrainian mines
6. Biothermica business approach in Ukraine
Founded in 1987, Biothermica’s mission is to develop, finance, build and operate projects which capture and valorize methane emitted by landfill sites and underground coal mines, and monetize the associated carbon credits, thermal energy and/or electricity on the national and international markets.
Integrated Development

**Full project cycle** is covered by Biothermica internal resources (technical, legal & financial)

- Feasibility Study
- VAM Partnership Agreement
- Detailed Engineering
- Construction & Commissioning
- Carbon Project Validation, Registration & Monetization
First VAM project in North America with JWR, Alabama, USA

Based on Biothermica’s proprietary VAMOX® technology

VAMOX® unit at JWR mine No.4, Alabama

Mine Ventilation shaft, JWR mine No.4
OPPORTUNITY:
CARBON REVENUES
FROM VAM DESTRUCTION
VAM is **methane** emitted by underground coal mine ventilation systems worldwide. VAM represents **more than 50%** of underground coal mine methane emissions.
Schematic overview
Coal Mine Methane Extraction

1) Horizontal Pre-Mining 2) Surface Pre-Mining 3) Post-Mining and 4) VAM
### VAM emissions worldwide (2010)

<table>
<thead>
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<th>Country</th>
<th>VAM emissions (MMtCO2e)</th>
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<td>Ukraine</td>
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<td><strong>World</strong></td>
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THE VAMOX® TECHNOLOGY
HOW IT WORKS
History and Origins
From BIOTOX® to VAMOX® (1991-2010)

- Biothermica has developed the VAMOX® System based on its expertise with the internally developed BIOTOX® RTO Technology (20+ Yr of R&D)
- BIOTOX® RTO Patented Technology is an International Award Winner from A&WMA (1999)
- The VAMOX® Technology Patent is underway...

Highly efficient Regenerative Thermal Oxidizer (RTO)

Inspired by BIOTOX® air pollution control technology
Regenerative Thermal Oxidation (RTO) principle is to break down contaminants with high temperature

- BIOTOX® process is to abate VOC, PAH & other pollutants...

- VAMOX® process is simply to abate methane...

- VAMOX® minimizes energy consumption
Principles of Operation
Dynamic Overview

Start-up only burner
(Methane being destroyed at 96%)

CO₂ + H₂O
+ Heat + Carbon credits

Heating energy and hot water at 70°C
3.9 MW @ 0.6% CH₄

Mine Ventilation
Air Methane (CH₄)
General Arrangement
No Flammable Gas Mixture Can Enter the VAMOX®

Methane Analyzer

inlet duct

Cut-Off Damper
Highlights

- No impact on mine fan
- From 0.2% to 1.2%+ CH₄
- Fully automated operation
- Remotely monitored/controlled
- No catalyst
- Possibility of heating energy
Biothermica – JWR
Demonstration Project in Alabama, USA
Achievement

1st VAM Project in North-America

- Partnership with Jim Walter resources, Inc.
- 1st & Only VAM Project in America - commissioned on January 26th, 2009
- Approved by U.S. Mine Safety & Health Administration
- Project Registered in June 2010 with the Climate Action Reserve
- **850 m³/min capacity**  
  (10% of available VAM flow)
- **13 m x 8 m footprint**
- **93 kW dedicated fan**
- **Up to 98% destruction**
- **0.8% CH₄ average at fan**
Mine Fan CH₄ Distribution
(Year 2: March 2010-March 11)

Distribution of VAM CH₄ Level

% CH₄

Nb. Of Days

0.55% 0.60% 0.65% 0.70% 0.75% 0.80% 0.85% 0.90% 0.95% 1.00% 1.05% 1.10% 1.15% 1.20% 1.25% 1.30% 1.35% 1.40% 1.55%

7 19 23 40 57 44 44 23 25 11 12 18 14 6 9 2 6 2 2
VAMOX® Project at JWR
93% Uptime in August 2011
Achievements
(As of August 31, 2011)

- Commissioned March 6, 2009
- 66,000 tCO₂e since start of project
- 54,153 credits verified by third-party
- 88% availability
- 17,344 hours

- Registered with California’s
Future Systems

- 3,120 m³/min capacity
- Multiple units in parallel
- Capture >75 % + of mine fan airflow
- ≈ 36 m x 13 m footprint
- ≈ 520 kW dedicated fan
- Thermal energy generation
VAM PROJECT FEASIBILITY STUDY
AT 3 UKRAINIAN COAL MINES
Project 1 - Close up on VAM shaft
Shaft Details

- Air Flow: average of 7,000 m³/min
- CH₄ concentration: 0.8 % (with CMM enrichment)

The VAM Project

- Install two (2) VAMOX® with total VAM capacity of 6,200 m³/min (85% of total flow)
- Special considerations for dust
- Production of hot water for mine needs (80°C)
- Total ERUs to be generated: up to 270,000 /Yr
Study Financial Results

Key Results

- The ERU price should be greater than € 9 for the project to be profitable
- Post Kyoto framework should be defined for price stability
- VAM CH₄ concentration and unit availability rate (up-time) are the most important factors for achieving predicted profitability
Framework for carbon credit generation in Ukraine

- Ukraine is eligible to generate carbon credits (ERUs) under Kyoto protocol JI mechanism until 2012

- Current price of ERUs: € 8-9/tCO$_2$e (Bluenext)

- Potential post 2012 scenarios
  - Continuation of Kyoto Protocol JI mechanism post 2012
  - Recognition by EU ETS 2013-2020 of credits generated in Ukraine post 2012
  - No recognition of carbon credits generated in Ukraine post 2012
Biothermica
Business Approach in Ukraine
**Shared Risks & Investment**

- Biothermica and mine finance the project
- **Profits are shared** between the parties

**No Risks For Mine**

- Biothermica finances the project
- Biothermica pays a **royalty to mine**
Thank You!
Spassibo!