

# Biothermica

## VAMOX<sup>®</sup> Projects at Walter Energy's Coal Mines



U.S. Coal Mine Methane Conference  
Las Vegas | September 24, 2012



# Agenda

- 1. Biothermica**
- 2. VAMOX<sup>®</sup> project at Walter Energy Mine No.4, Alabama, USA**
- 3. Moving forward – upcoming projects**



# Biothermica

## What we do

- Canadian group founded in 1987
- Develop **patented technologies** applied to industrial emissions control and methane destruction/utilization
- Finance, build, own and operate **carbon credit** and **energy** production facilities
- Based on destruction/utilization of **methane** from **landfills** and **coal mine** ventilation systems







# Industrial Emissions Control



## **BIOTOX® Technology**

**Regenerative Thermal Oxidation (RTO)**

**Non-conventional industrial emissions**

**> 10 industrial processes since 1990**

**9 patents**

**Award winner from the U.S. AWMA**



**BIOTOX® unit**

**Presque Isle, Maine, USA**

**Food industry**

**100,000 cfm**

**COC emissions**

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# Landfill Methane Development Selected Projects



**Gazmont 25 MW Power Plant**  
Montreal landfill (Canada)  
Finance, Build, Own, Operate  
2 billion kWh of electricity since 1996



**El Salvador CDM Project**  
Nejava landfill  
Finance, Build, Own, Operate  
100% equity  
215,000 carbon credits over 2006-2008  
Major interest in project sold in 2008  
MIGA insurance



**Multilateral Investment  
Guarantee Agency**  
World Bank Group





# VAM Project Development Natural Evolution



**Industrial Emissions  
Expertise**

**Landfill Methane  
Project Development**



## VAM Project Development



**VAMOX<sup>®</sup> unit at Walter Energy No. 4 Mine  
Alabama, USA**

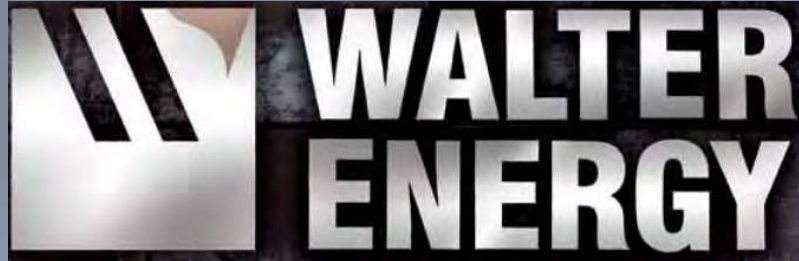
**Finance, Technology, Build, Own, Operate**

**Biothermica**



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- **Headquartered in Birmingham, Alabama**
- **2011 sales of \$2.6 billion, 4,400 employees**
- **Leading producer and exporter of metallurgical coal**
- **Operations in AL, WV (U.S.), BC (CAN) and UK**
- **Jim Walter Resources AL mines among gassiest in U.S.**
- **Active CBM and CMM extraction**
  - **Since 1981 Black Warrior Methane**

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# VAMOX<sup>®</sup> Project Overview

- JWR Bleeder shaft 4-9, No. 4 Mine, Brookwood, AL
- First of its kind (MSHA) at active U.S. coal mine
- Financed by Biothermica, 100% equity
- Objective: Demonstrate VAMOX<sup>®</sup> RTO technology
- Full operation since March 2009
- Registered with the Climate Action Reserve



CLIMATE  
ACTION  
RESERVE

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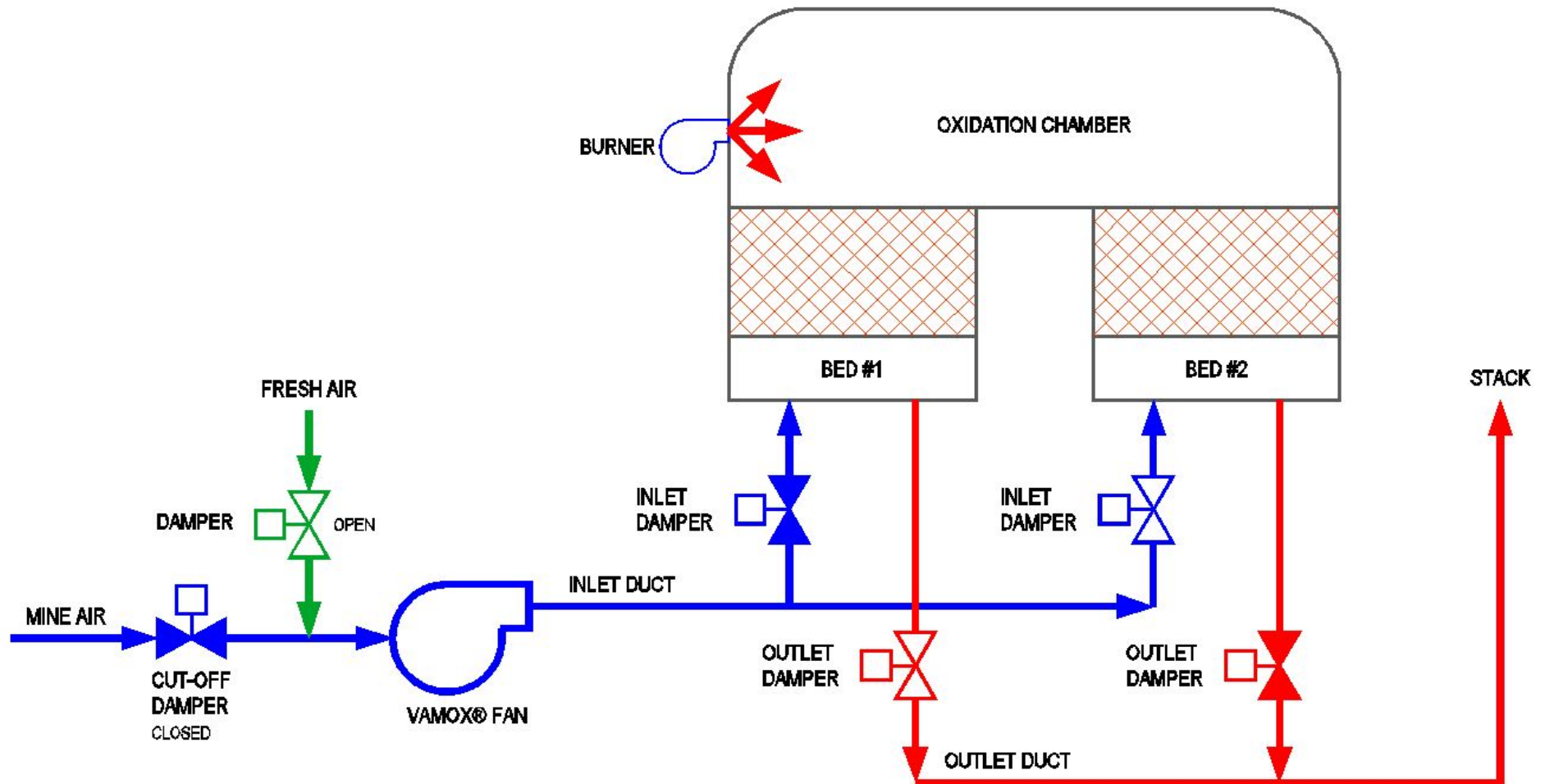


# VAMOX<sup>®</sup> Project Specifications

- 2 ceramic bed RTO
- Medium size unit - 1,400 ft<sup>2</sup> footprint (40\*35)
- 30,000 cfm nominal flow rate, 10% of VAM flow
- 0.3% - 1.2% range of CH<sub>4</sub> level accepted
  - Dilution with fresh air if incoming VAM > 1.2%
- VAM destruction only
  - Revenues from carbon credit generation



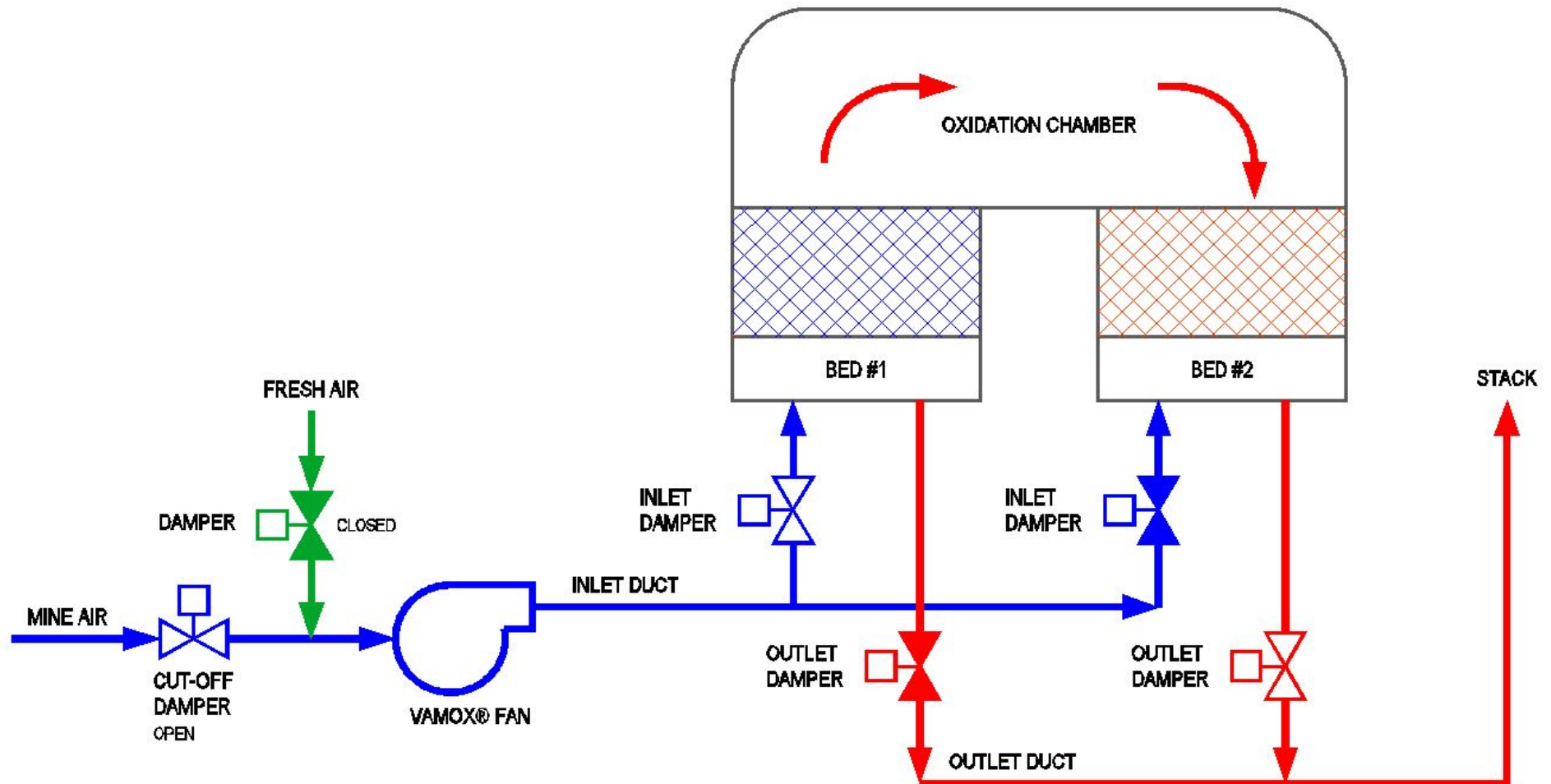
# Operating Principle Start-up





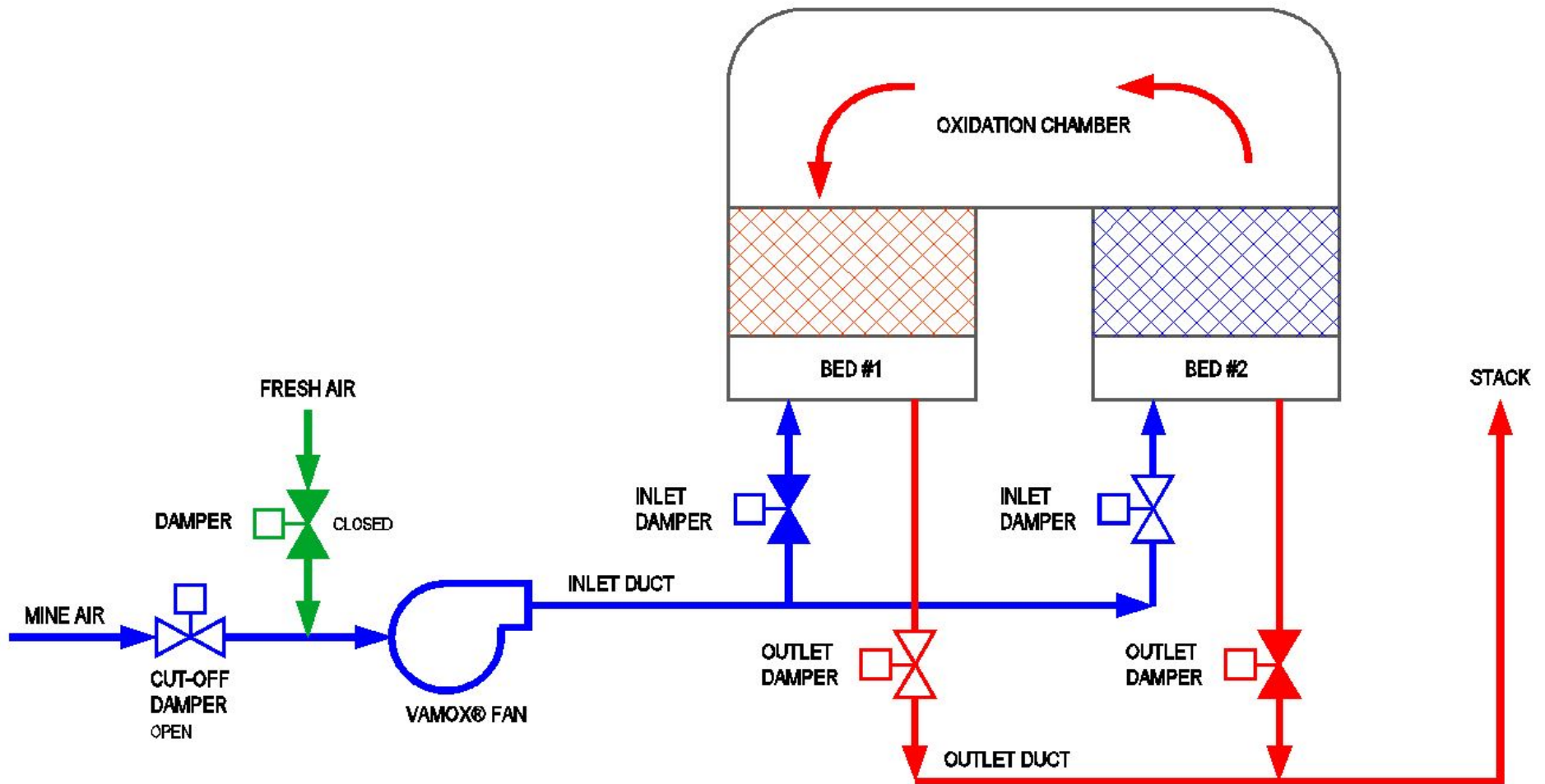


# Operating Principle Cycle 1





# Operating Principle Cycle 2











# Project Task Allocation

## Ongoing Operations

### Biothermica

- Remote monitoring: Satellite link with VAMOX<sup>®</sup> control room
- Verification of system operating parameters
- System optimization
- 24/7 technical support

### Jim Walter Resources

- Remote monitoring: Dashboard in No. 4 Mine control room
- Ability to stop unit from No.4 Mine control room



# Main Dashboard in Mine Control Room

10:35AM

Vamox™ System Apr.03, 2009



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VAMOX SHUT-DOWN

SYSTEM OPERATION

FIRE PROTECTION

AIR PRESSURE

METHANE ANALYSER

MANUAL SHUT-DOWN

RADIO LINK



INLET METHANE LEVEL



OXIDATION TEMPERATURE



STACK TEMPERATURE



MAIN FAN SPEED

ALARMS

DIAGRAM





# Project Task Allocation

## Ongoing Operations

### Biothermica

- Annual maintenance: VAMOX<sup>®</sup> unit and instrumentation
- Spare parts management
- Carbon management: monitoring, reporting, verification

### Jim Walter Resources

- Routine maintenance: weekly, monthly, quarterly
- Routine maintenance integrated within shaft maintenance rounds



# Carbon Credit Generation

- **CAR CMM Project Protocol**



CLIMATE  
ACTION  
RESERVE

- **Monitoring requirements**

- **Emission reduction calculation methodology**

- **Monitoring of emission reductions**

- **Flow rate and Methane concentrations (inlet and outlet)**

- **Continuous monitoring - specific instrumentation**
- **Recording of values every 2 minutes**

- **Energy consumption**

- **Instrument QA/QC**

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# Carbon Credit Generation

- **Verification**
  - Independent review of monitoring reports & data
  - Performed by CAR accredited entity
  - Annual or more frequent, includes on-site visit
- **Issuance of carbon credits (CRTs)**
  - CAR approval of Verification report and opinion
  - Issuance of CRTs in project developer account



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# Operational results Since March 2009

**> 25,000 hrs**  
Operation hrs

**92%**  
availability<sup>1</sup>

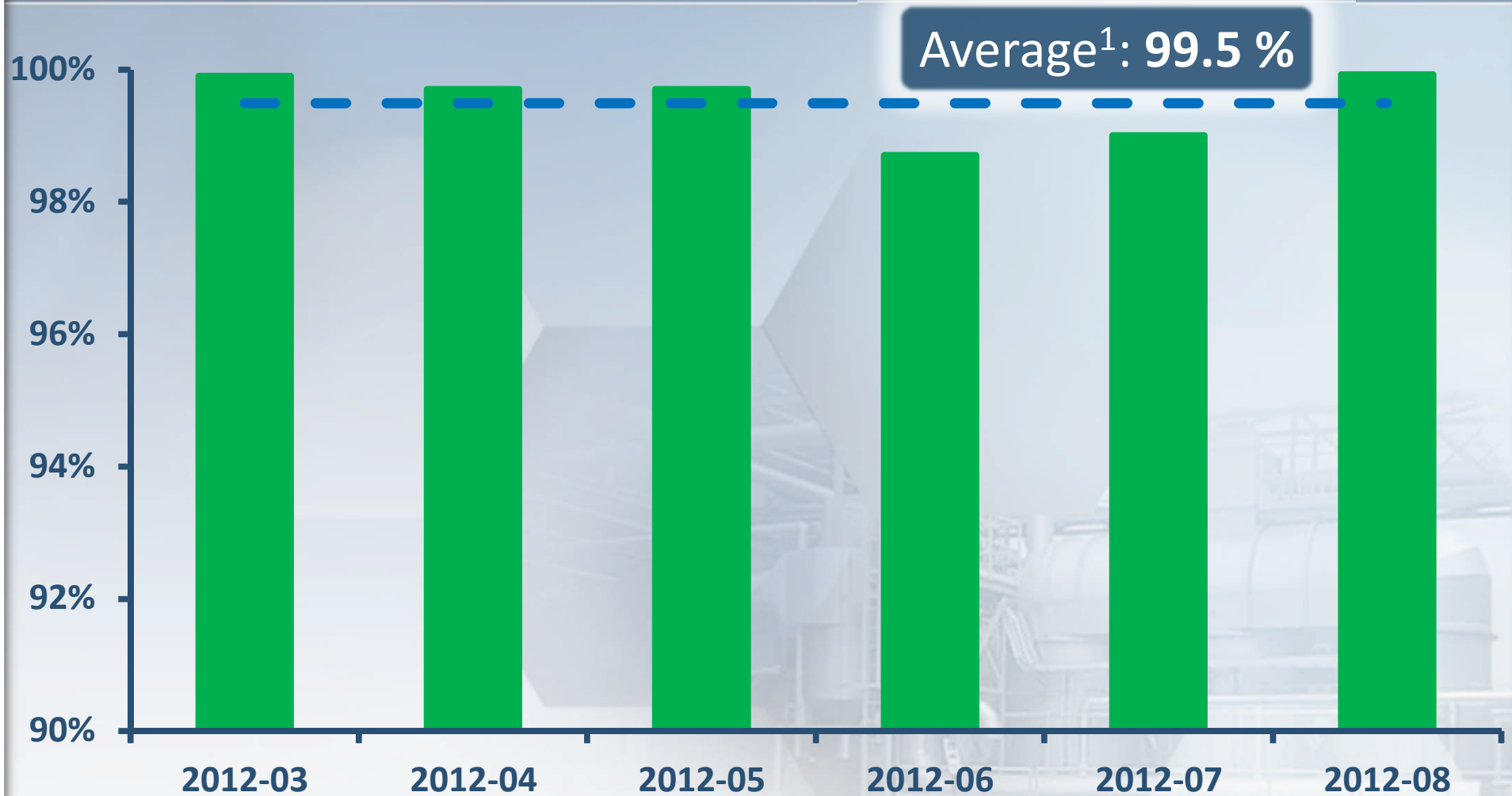
**> 78,000**  
tCO<sub>2</sub>e emission  
reductions

**70,387**  
CRTs issued

<sup>1</sup> Excluding external events such as shaft maintenance or electricity supply outages



# Monthly Availability Reporting period # 4



<sup>1</sup> Excluding external events – most essentially electricity supply outages



# Methane Level At Shaft Since March 2009

Min: 0.3 %

Max: 1.5 %

Operational experience over wide range of  
fluctuating concentrations





# Project outcome: Refined expertise

- **How energy from VAM oxidation is released within the unit**
  - Influence of process conditions ( $[\text{CH}_4]$ , flow rate) on temperature distribution
- **Control optimization over wide range of  $[\text{CH}_4]$** 
  - High concentrations: management of heat
  - Low concentrations: maintain self-sustaining reaction and maximize credit production
- **Proprietary simulation model**
  - Optimization of design of future VAMOX<sup>®</sup> projects



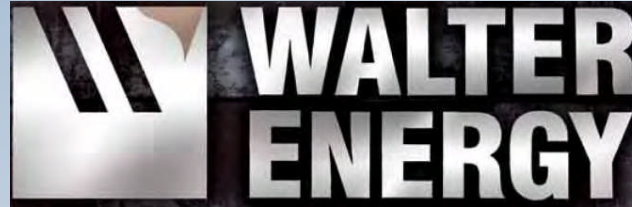
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# Moving Forward

- Partnership with



- Long term commitment to VAM
- Mitigate VAM from all economically suitable shafts
- Pipeline of  $\pm 3$  million tCO<sub>2</sub>e/year





# VAMOX<sup>®</sup> standard unit

- **130,000 cfm nominal flow rate**
- **5,000 ft<sup>2</sup> footprint (100\*50)**
- **Design optimized based on proprietary model**
- **Designed for facilitated relocation**
- **0.3% - 1.2% range of CH<sub>4</sub> level accepted**
- **Fully automated operation**
  - Auto-adjustment of operating conditions



# Upcoming Project

- **Bleeder shaft of Mine No. 7**
- **Shaft: 300,000 cfm, >1% CH<sub>4</sub>**
- **VAMOX<sup>®</sup> systems**
  - **2 large scale standard units**
  - **Air flow processed: 260,000 cfm**
  - **± 400,000 tCO<sub>2</sub>e/yr**



# Walter Energy Mine No. 7 Bleeder Shaft





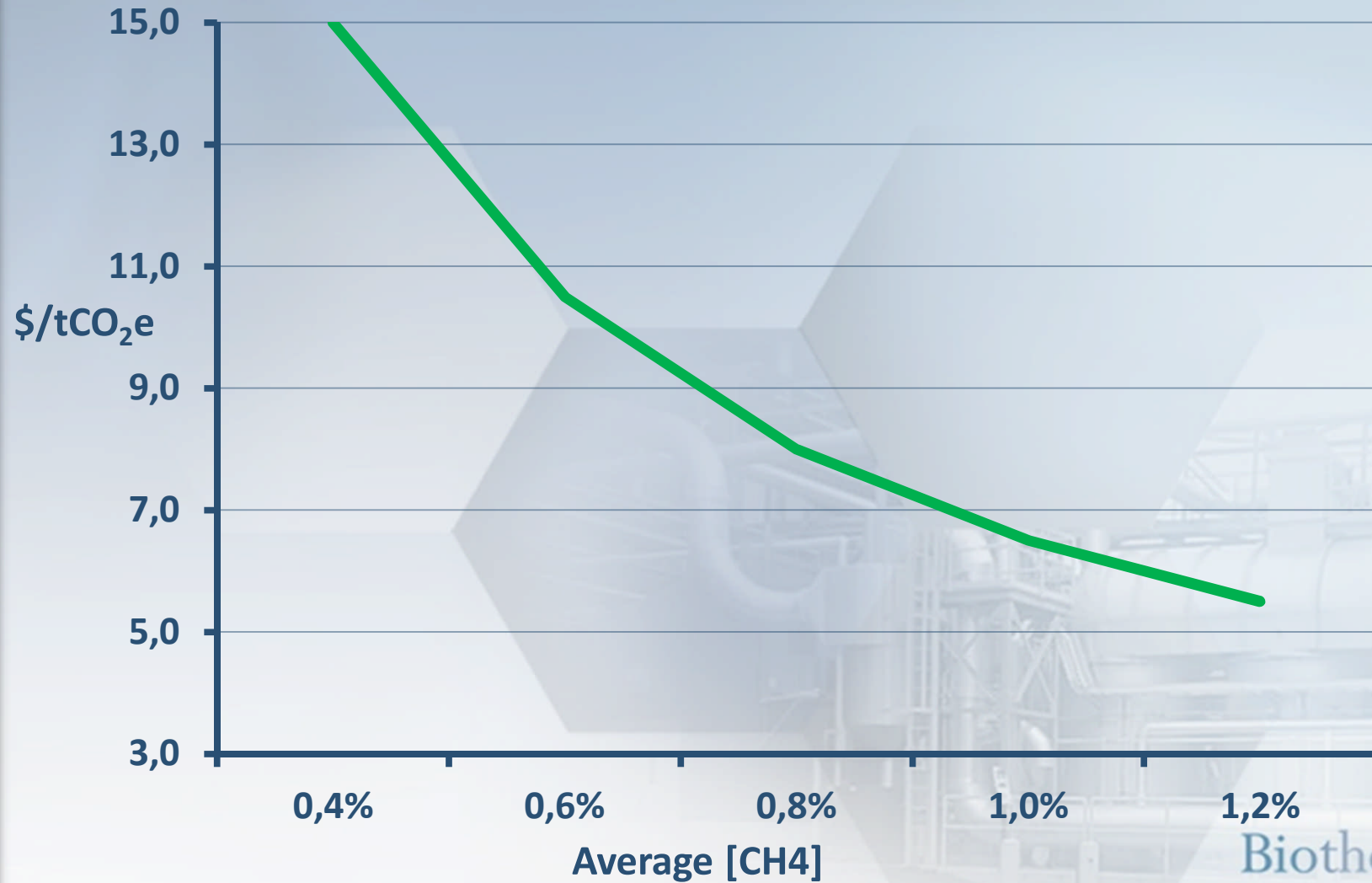


# Project Status Summary

- **Design completed**
- **Approved by MSHA District 11 (May 2012)**
  - As addendum to mine ventilation plan
- **Green light when framework certainty**
  - California working on CMM Project Protocol (June 2012 announcement)



# Carbon price triggers



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# Thank You

**Raphaël Bruneau, M.Sc.**

Director – Carbon Markets

+1.514.488.3881 x226

[raphael.bruneau@biothermica.com](mailto:raphael.bruneau@biothermica.com)