

# Biothermica



**BIOTHERMICA VAMOX<sup>®</sup> 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<sup>®</sup> 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**



# BIO THERMICA GROUP OVERVIEW

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# Biothermica mission

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

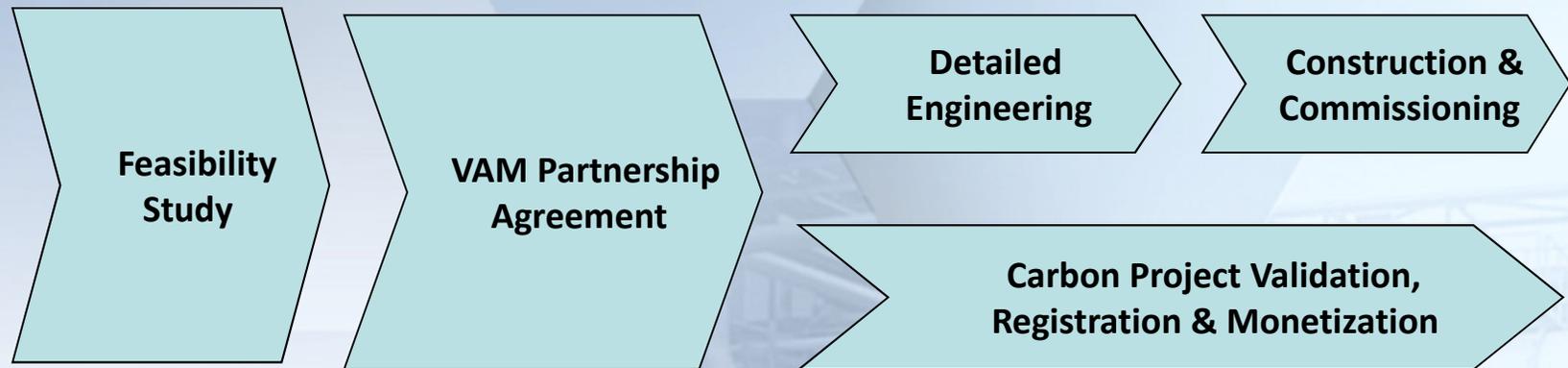


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# Integrated Development

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



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# First VAM project in North America with JWR, Alabama, USA

Based on Biothermica's proprietary  
**VAMOX<sup>®</sup>** technology



VAMOX<sup>®</sup> unit at JWR mine No.4, Alabama



Mine Ventilation shaft, JWR mine No.4

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# **OPPORTUNITY: CARBON REVENUES FROM VAM DESTRUCTION**

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# Ventilation Air Methane (VAM)

VAM is **methane** emitted by underground coal mine ventilation systems worldwide

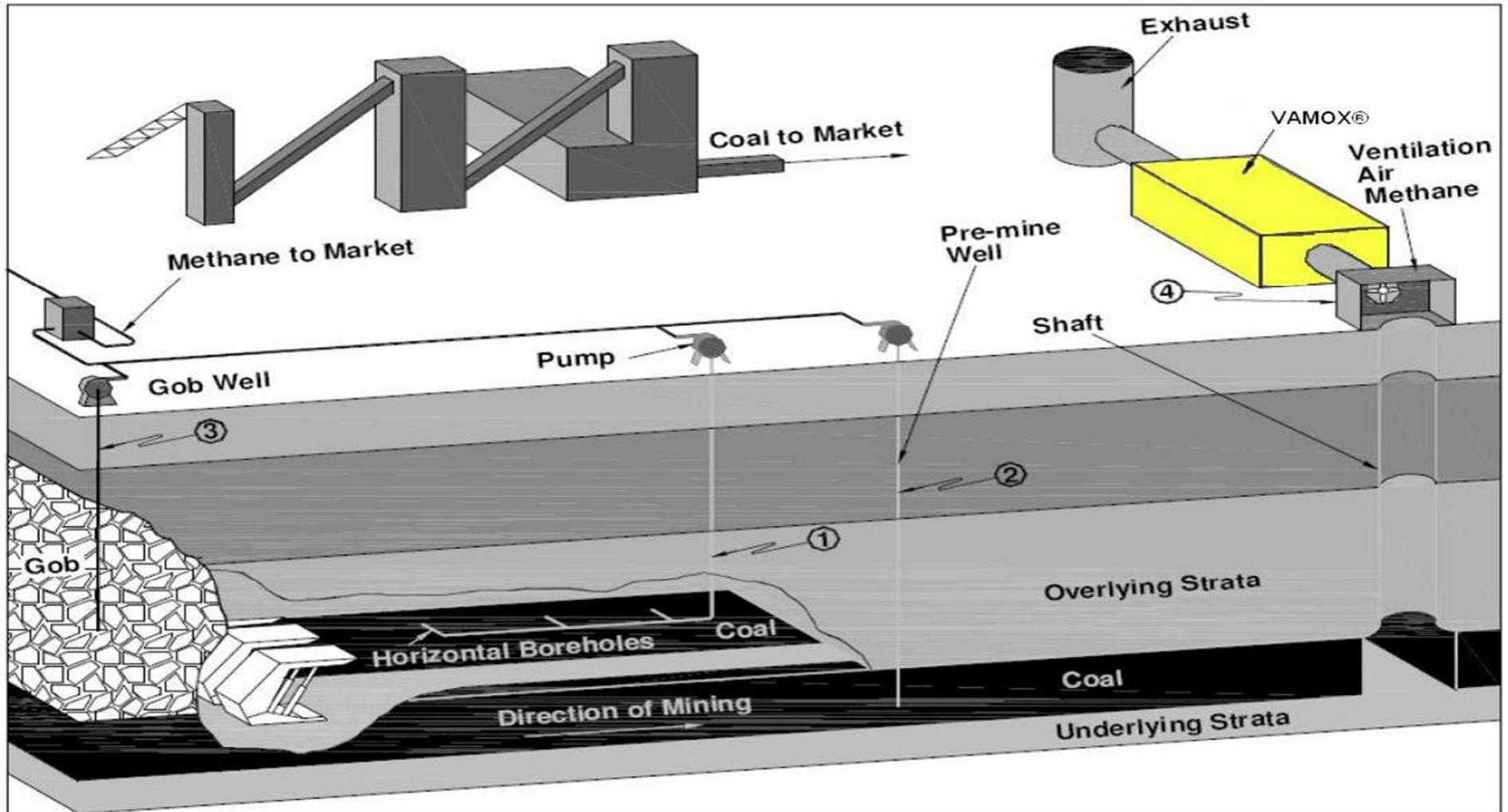
VAM represents **more than 50%** of underground coal mine methane emissions



Mine Ventilation Shaft (USA)



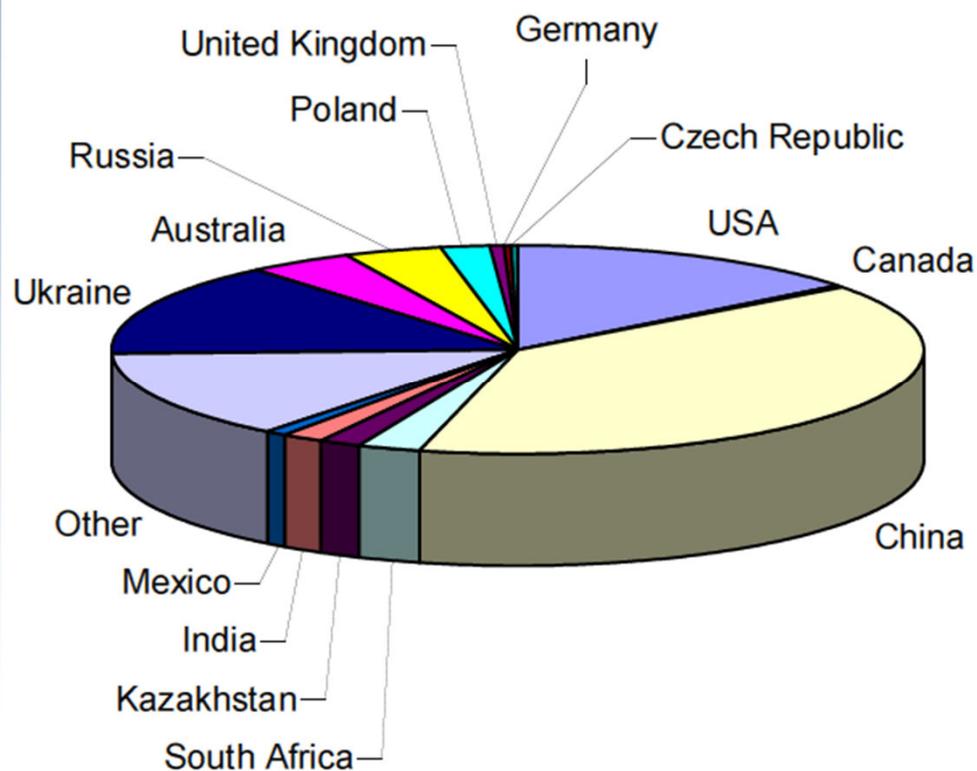
# Schematic overview Coal Mine Methane Extraction



1) Horizontal Pre-Mining 2) Surface Pre-Mining 3) Post-Mining and 4) VAM



# VAM emissions worldwide (2010)



Country	VAM emissions (MMtCO <sub>2</sub> e)
China	111
Ukraine	41
USA	41
Australia	12
Russia	11
South Africa	7
Kazakhstan	5
India	5
Poland	5
Mexico	2
United Kingdom	2
Canada	1
Germany	1
Czech Republic	1
Other	39
World	283



# THE VAMOX<sup>®</sup> TECHNOLOGY

## HOW IT WORKS

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# History and Origins

## From BIOTOX<sup>®</sup> to VAMOX<sup>®</sup> (1991-2010)

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



AIR & WASTE MANAGEMENT  
ASSOCIATION

Highly efficient **Regenerative Thermal Oxidizer (RTO)**

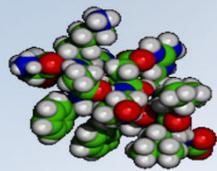
Inspired by **BIOTOX<sup>®</sup>** air pollution control technology





# Principles of Operation Chemical Process

- Regenerative Thermal Oxidation (RTO) principle is to break down contaminants with high temperature
  - BIOTOX<sup>®</sup> process is to abate VOC, PAH & other pollutants...



- VAMOX<sup>®</sup> process is simply to abate methane...



- VAMOX<sup>®</sup> minimizes energy consumption



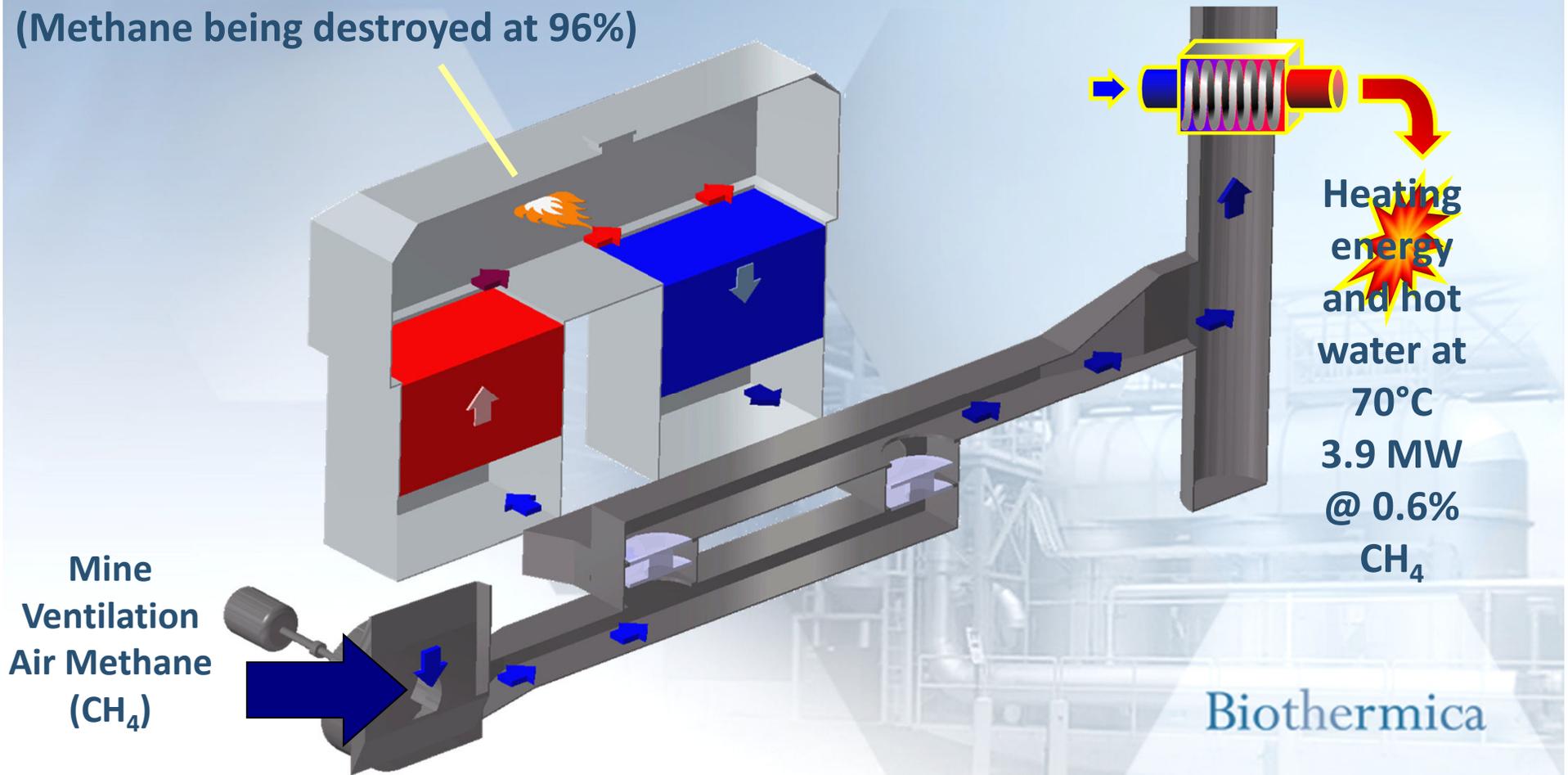
# Principles of Operation

## Dynamic Overview

Start-up only burner

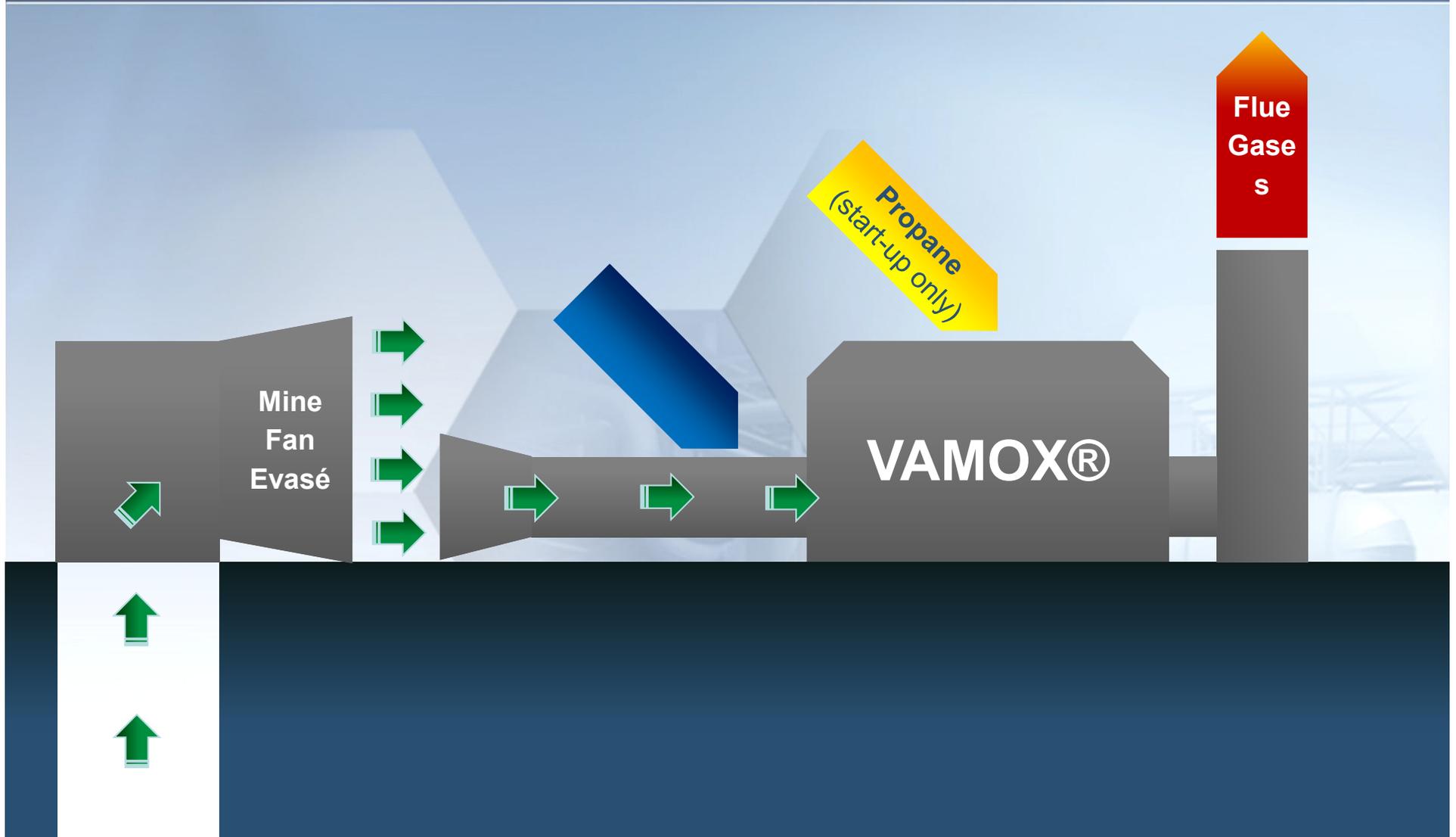
(Methane being destroyed at 96%)

$\text{CO}_2 + \text{H}_2\text{O}$   
+ Heat + Carbon credits





# General Arrangement





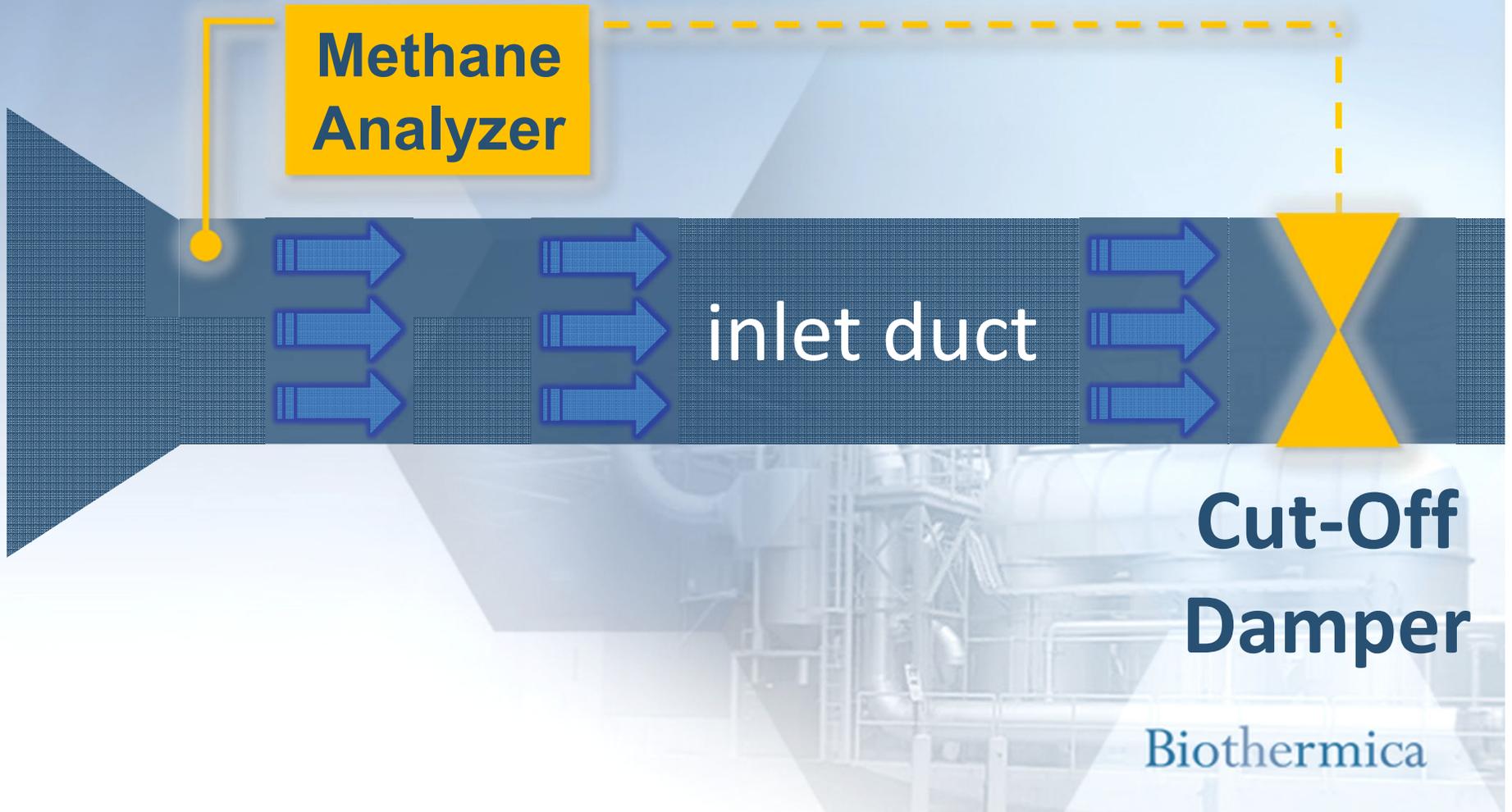
# No Flammable Gas Mixture Can Enter the VAMOX®

**Methane  
Analyzer**

inlet duct

**Cut-Off  
Damper**

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# Highlights

- **No impact** on mine fan
- From **0.2% to 1.2%+ CH<sub>4</sub>**
- **Fully automated** operation
- **Remotely** monitored/controlled
- **No catalyst**
- **Possibility of heating energy**



# **Biothermica – JWR Demonstration Project in Alabama, USA**

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# Achievement

## 1<sup>st</sup> VAM Project in North-America

- Partnership with  **Jim Walter resources, inc.**  
BLUE CREEK COAL - BROOKWOOD, ALABAMA
- **1<sup>st</sup> & Only** VAM Project in America - commissioned on January 26<sup>th</sup>, 2009
- **Approved** by U.S. Mine Safety & Health Administration
- Project **Registered** in June 2010 with the Climate Action Reserve





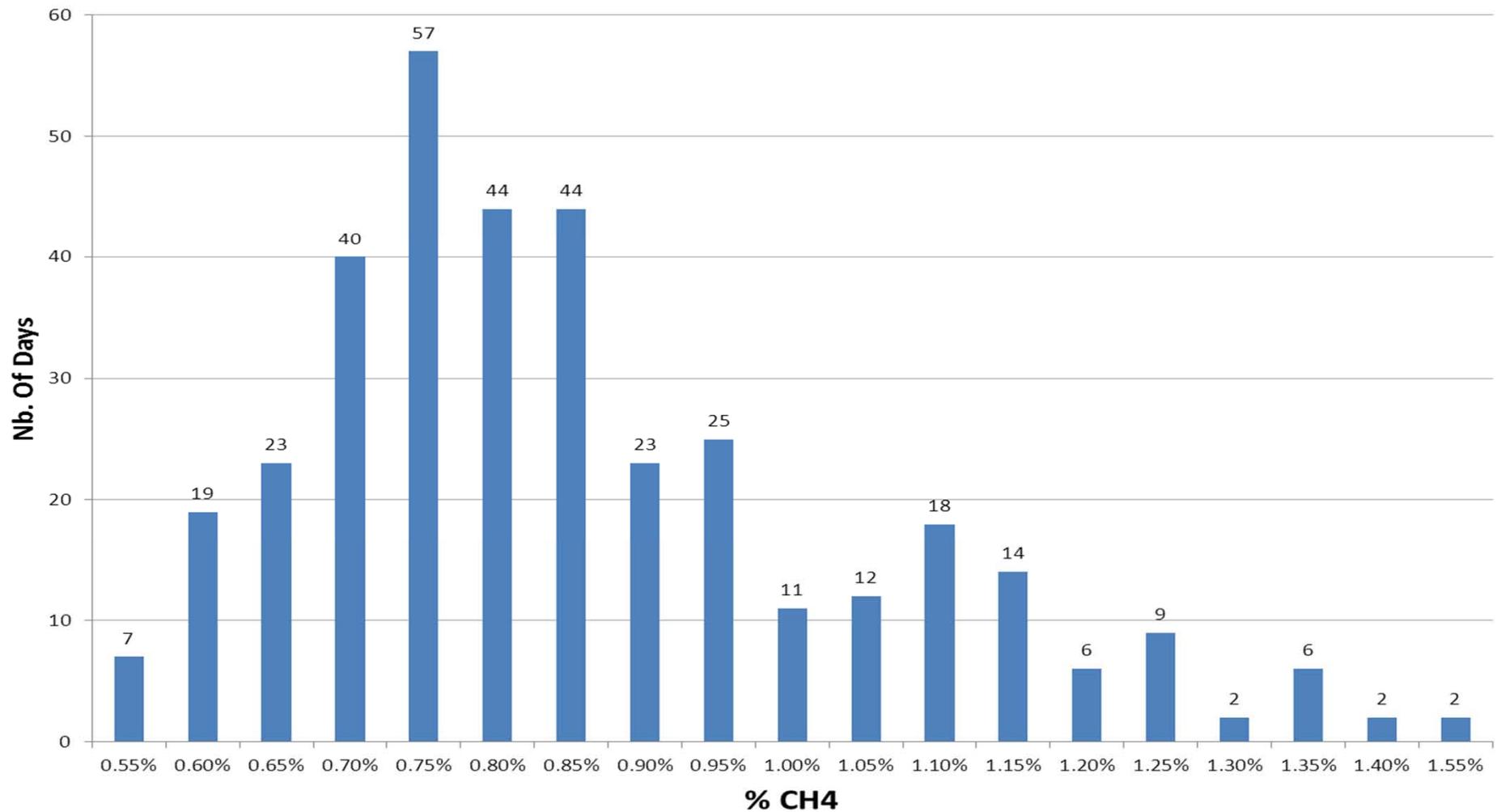
# System Characteristics

- **850 m<sup>3</sup>/min** capacity  
(10% of available VAM flow)
- **13 m x 8 m** footprint
- **93 kW** dedicated fan
- Up to **98% destruction**
- **0.8% CH<sub>4</sub>** average at fan



# Mine Fan CH<sub>4</sub> Distribution (Year 2: March 2010-March 11)

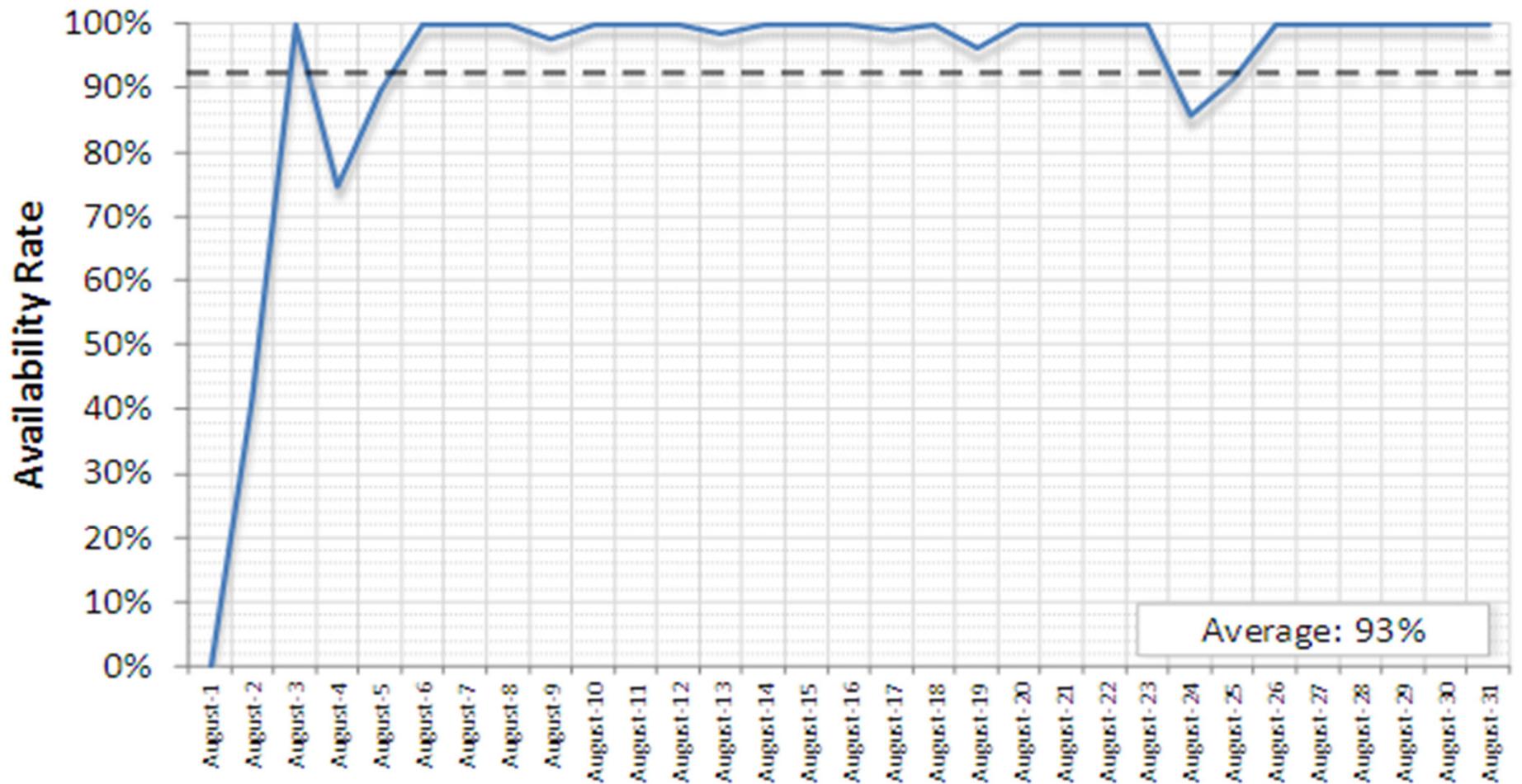
**Distribution of VAM CH<sub>4</sub> Level**





# VAMOX<sup>®</sup> Project at JWR

## 93% Uptime in August 2011







# Achievements

## (As of August 31, 2011)

- Commissioned March 6, 2009
- **66,000 tCO<sub>2</sub>e** since start of project
- 54,153 credits **verified by third-party**
- **88% availability**
- **17 344 hours**
- **Registered with California's**



CLIMATE  
ACTION  
RESERVE

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# Future Systems

- **3,120 m<sup>3</sup>/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**

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# Project 1 - Close up on VAM shaft



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# Project 1 - Technical details

## Shaft Details

- Air Flow : average of 7,000 m<sup>3</sup>/min
- CH<sub>4</sub> concentration : 0.8 % (**with CMM enrichment**)

## The VAM Project

- Install two (2) VAMOX<sup>®</sup> with total VAM capacity of 6 200 m<sup>3</sup>/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 CH<sub>4</sub> 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<sub>2</sub>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

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# Biothermica Business Approach in Ukraine

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# Business Models

## 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 !

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