Virginia Center for Coal and Energy Research (VCCER) at Virginia Tech

COAL MINE METHANE PROJECT OPPORTUNITY

VAM Mitigation/Utilization Opportunities at Kozlu Mine
Turkish Hardcoal Enterprise (TTK)
Zonguldak Basin, Zonguldak, Turkey

OVERVIEW OF COAL MINE METHANE PROJECT:

THE COAL MINE IS LOCATED IN ZONGULDAK HARDCOAL BASIN IN TURKEY. THE ANNUAL CH_4 EMISSIONS FROM THE MINE WERE 246,610 t CO_2e AND THE AVERAGE VAM CONCENTRATION IN 2011 WAS 0.69% CH_4. CURRENTLY, THERE IS NO CMM BEING COLLECTED AND/OR UTILIZED AT THE MINE. THE MINE IS ONE OF THE FIVE MAIN COLLIERIES OF TURKISH HARDCOAL ENTERPRISE. THE CURRENT PRODUCTION LEVEL IS ABOUT 700,000 t/YEAR.

TECHNICALLY, MOST OF THE COMMERCIALLY AVAILABLE VENTILATION AIR METHANE (VAM) MITIGIATION/UTILIZATION TECHNOLOGIES CAN BE APPLICABLE FOR THE MINE SITE. AMONG THEM, THERMAL FLOW REVERSAL REACTOR (TFRR) AND CATALYTIC FLOW REVERSAL REACTOR (CFRR) TECHNOLOGIES APPEARS TO BE PROMISING. CARBON CREDIT IS NEEDED TO IMPLEMENT SUCH A PROJECT IN TURKEY SINCE VAM IS NOT REGARDED AS A RENEWABLE ENERGY SOURCE IN TURKISH LEGISLATION. TAX EXEMPTIONS AND INCENTIVES TO BE OFFERED BY THE TURKISH GOVERNMENT WOULD SIGNIFICANTLY AFFECT PROJECT ECONOMICS. FULL FINANCIAL RESPONSIBILITY IS EXPECTED FROM THE CONTRACTOR FOR THE IMPLEMENTATION OF SUCH A PROJECT AT THE MINE.

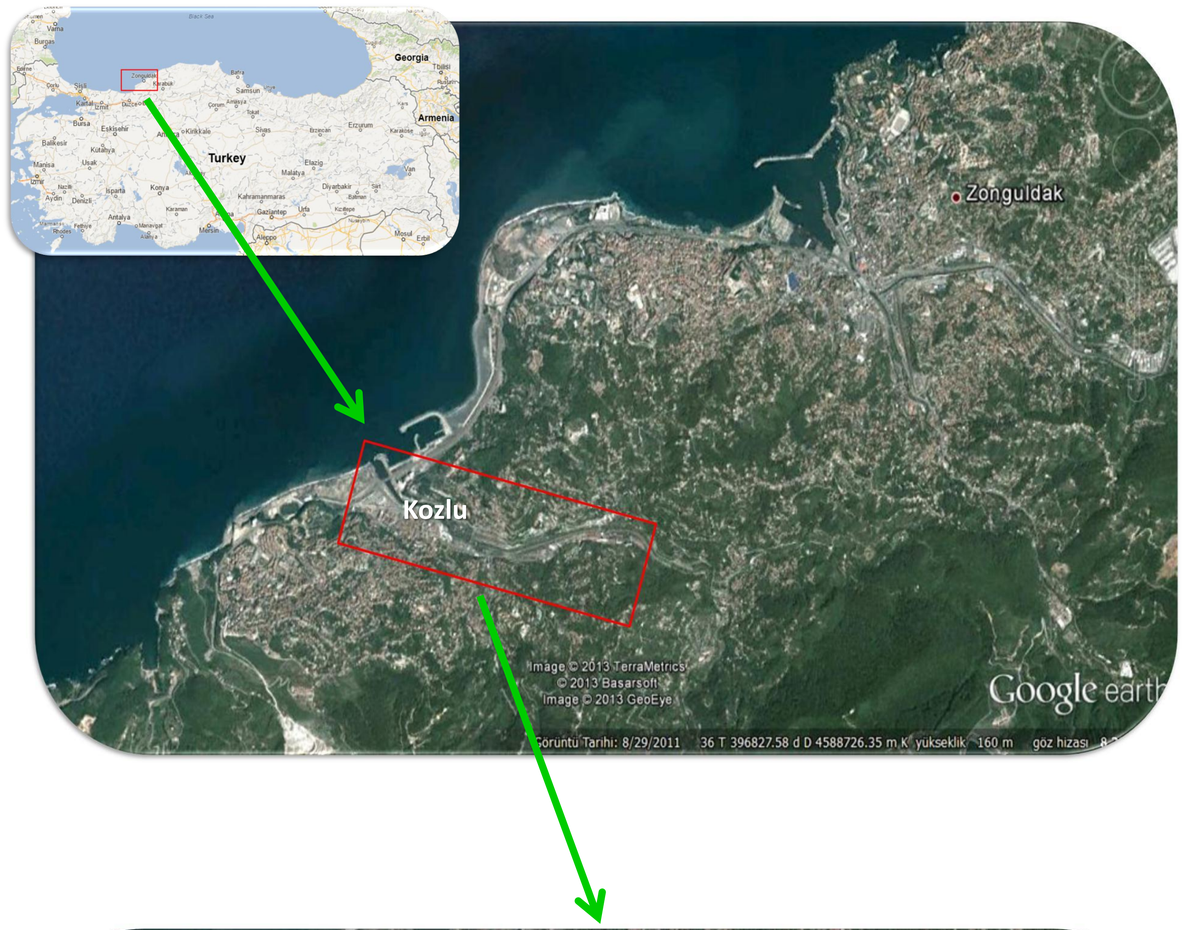
ESTIMATED ANNUAL EMISSION REDUCTIONS: 0.169 MMTCO$_2$E

PROJECT DETAILS

- Name of Project: VAM Mitigation/Utilization Opportunities at Kozlu Mine
- Name of Mine: Kozlu Mine
- Type of Ownership: Public
- Type(s) of assessments performed: Pre-feasibility
  - When performed: 2012
  - By whom: Dr. Kemal BARIS (VCCER)

MINE INFORMATION

- Mine owner: Turkish Hardcoal Enterprise (TTK)
- Percent ownership: 100%
- Status and type of mine: Active, Underground
- Mining Method: Longwall
- Service Life of Mine: > 100 years



PROJECT FINANCES

Assumptions		: TFRR, Project life: 10 years				
Carbon Credit		: 0.0	7.3	13.2	19.8	US$/tCO$_2$e
Estimated Revenue	Mitigation	: 0.0	1.2	2.2	3.4	MM US$/year
	Utilization	: 2.2	3.5	4.5	5.6	MM US$/year
Projected Capital Costs	Mitigation	: 5.4 MM US$				
	Utilization	: 15.4 MM US$				
Projected (O&M) Costs	Mitigation	: 1.5 MM US$				
	Utilization	: 0.4 MM US$				
Estimated Return on Investment (ROI)	Mitigation	: NA	NA	8.1	5.8 years	
	Utilization	: NA	NA	8.5	5.9 years	

HISTORICAL AND PROJECTED MINE DATA

HISTORICAL COAL PRODUCTION AND METHANE EMISSIONS

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Coal (thousand tonnes/yr)	638.5	665.2	657.7	601.6	540.8	509.7	506.8	555.4	518.2	653.7	683.2	**691.2**
Methane (MMm^3/yr)												
Emitted from ventilation system(s)	18.34*	19.11*	18.89*	17.28*	15.53*	14.64*	14.56*	15.95*	14.89*	18.77*	19.62*	**19.85**
Liberated from drainage systems	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vented to atmosphere	18.34	19.11	18.89	17.28	15.53	14.64	14.56	15.95	14.89	18.77	19.62	**19.85**
Total Methane Emissions	18.34	19.11	18.89	17.28	15.53	14.64	14.56	15.95	14.89	18.77	19.62	**19.85**

* Estimated

PROJECTED COAL PRODUCTION AND METHANE EMISSIONS

YEAR	2012	2013	2014	2015	2016	2017	2018	2019
Coal (thousand tonnes/yr)	700	700	700	700	700	700	700	700
Methane (MMm^3/yr)								
Emitted from ventilation system(s)	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1
Liberated from drainage systems	NA	NA	NA	NA	NA	NA	NA	NA
Vented to atmosphere	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1
Total Methane Emissions	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1

GREENHOUSE GAS EMISSION REDUCTIONS

ESTIMATED GHG EMISSION REDUCTIONS AND TOTAL VOLUME OF METHANE ALREADY RECOVERED/UTILIZED

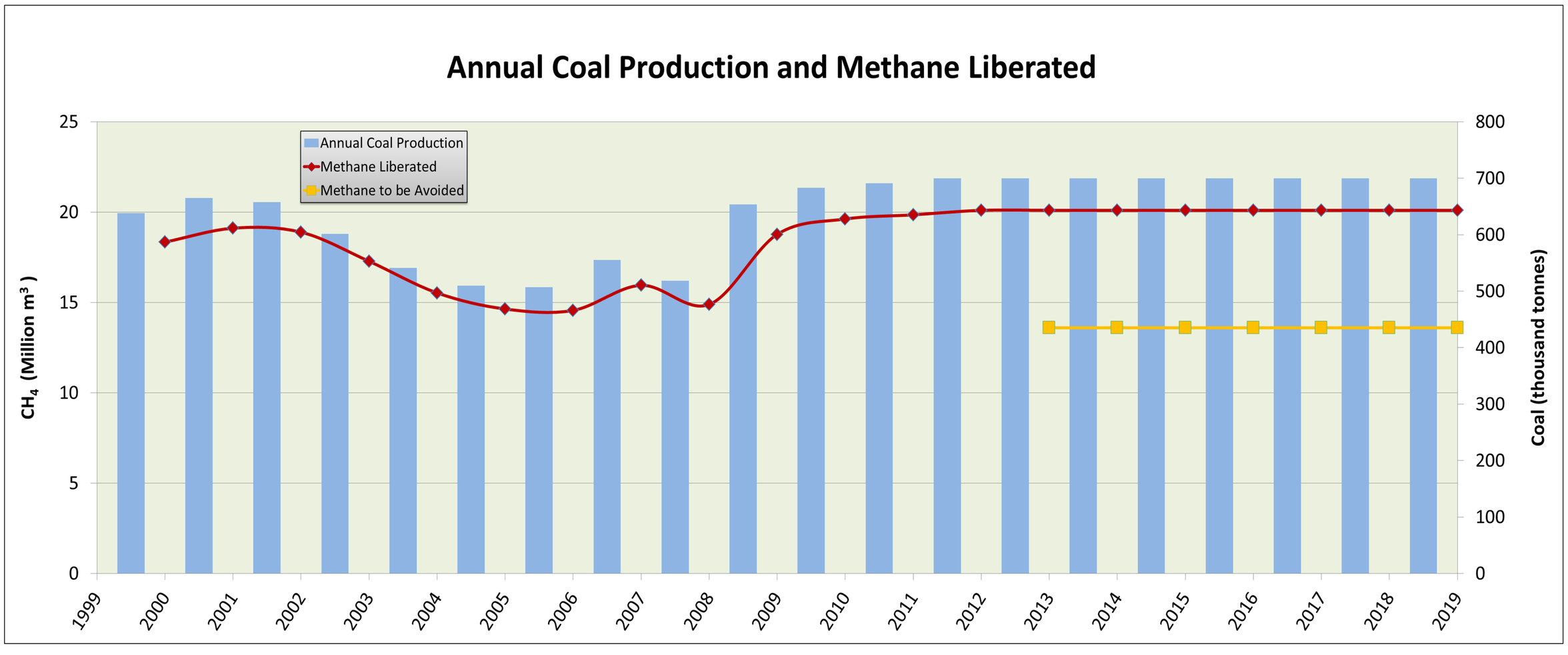
YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total CH_4 vented (ave. m^3/min)	35.1	36.2	35.7	32.9	29.6	27.8	27.8	30.2	28.5	35.7	37.3	**37.9**
Average CH_4 concentration (%)	0.64	0.66	0.65	0.60	0.54	0.51	0.51	0.55	0.52	0.65	0.68	**0.69**
Total CH_4 recovered and utilized (m^3/year)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

* Estimated

TOTAL VOLUME OF METHANE EXPECTED TO BE RECOVERED/UTILIZED

YEAR	2012	2013	2014	2015	2016	2017	2018	2019
Total CH_4 recovered and utilized (m^3/year)	13,660,000	13,660,000	13,660,000	13,660,000	13,660,000	13,660,000	13,660,000	13,660,000

COAL PRODUCTION AND METHANE EMISSION CHARTS



MARKET ANALYSIS / DEMAND ANALYSIS

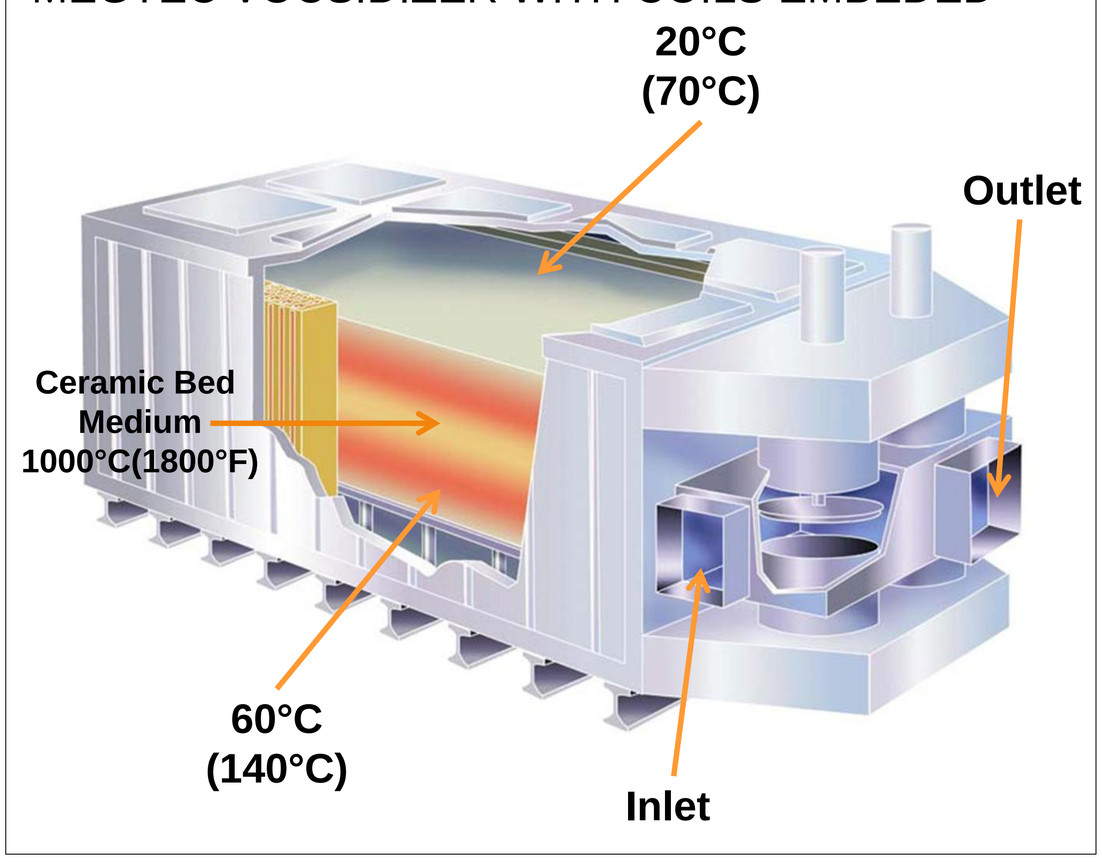
THE PROPOSED FACILITY WOULD GENERATE 3 MW OF POWER AND IS IN THE IMMEDIATE VICINITY OF KOZLU, A TOWN WITH A POPULATION OF 35,000. THE GENERATED ELECTRICITY CAN EITHER BE USED IN KOZLU MINE OR SOLD TO RESIDENTIAL CUSTOMERS LIVING IN KOZLU, WHICH IN THIS CASE WOULD BE ENOUGH FOR 7500 FAMILIES/YEAR.

TYPE(S) OF ASSISTANCE SOUGHT

- AN AGREEMENT WITH TTK IS NEEDED AND THE PROJECT MUST BE FULLY FINANCED BY THE CONTRACTOR. (THE DATA OBTAINED IN THIS STUDY HAS ALREADY BENEFITED A PRIVATE TURKISH COMPANY)
- THE CONTRACTOR WILL BE RESPONSIBLE FROM ALL TECHNICAL ASPECTS OF THE PROJECT.

PROPOSED TECHNOLOGIES

MEGTEC VOCSIDIZER WITH COILS EMBEDED



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FOR MORE INFORMATION, CONTACT:

Dr. Kemal Baris,
Research Scientist
Virginia Center for Coal and Energy Research
460 Turner Street NW, Suite 304
Blacksburg, VA
USA, 24060
Tel: +1 (540) 231 81 08
E-mail: kemal@vt.edu

*More information on the study can be found in: Baris, K. (2013) Assessing ventilation air methane (VAM) mitigation and utilization opportunities: A case study at Kozlu Mine, Turkey, *Energy for Sustainable Development*, 17:13-23.