

# COAL MINE METHANE PROJECT OPPORTUNITY IN-MINE DRAINAGE AND POWER PRODUCTION PROJECT AT THE FU HONG UNDERGROUND COAL MINE XISHUI COUNTY, GUIZHOU PROVINCE PEOPLE'S REPUBLIC OF CHINA

## OVERVIEW OF COAL MINE METHANE PROJECT:

Fuhong Coal Mine, located in southwest China within Guizhou Province, has coal reserves of 9.4 million metric tons and is currently mining at rate of 140,000 metric tons/year and will increase to 300,000 metric tons per year in the near future, with the addition of a mechanized continuous miner. Fuhong has a gas drainage station producing at a rate of 140 cubic meters per minute with a maximum methane concentration of 20 percent; however, the current drainage and ventilation systems will be insufficient for maintaining safety at the increased mining rate. A prefeasibility study was performed to examine the potential for implementing a methane recovery and utilization project. Fuhong's methane resource is estimated to be 122.7 million cubic meters. The project will consist of a cross-measure borehole drainage program, drilled from within the mine workings into the roof of the mineable coal seams to capture methane gas and reduce the potential for coal and gas outbursts. Drained methane can be used in one of two ways: Option 1, power generation for use at the mine or, Option 2, combined power generation and on-site use in a coal dryer. Increased electricity demand in Guizhou makes displacement of grid-purchased electricity attractive for the mine. The optimal use will be decided by mine management as dictated by the energy needs of the mine. In the power generation only option, Option 1, 56,279 MWh of electricity will be generated annually; and it is assumed that all power generated will be used by the mine. Capital costs are estimated at \$7.13 million USD with an IRR of 66.9 percent and a payback period of 2.5 years. Carbon emissions would be reduced by 246.2 thousand tons of CO<sub>2</sub>e over the project's 10 year life. In the combined power generation and coal drying option, Option 2, in addition to fueling the equipment to dry the low grade coal using 1.595 million cubic meters of the available gas, 46,798 MWh of electricity will be generated annually for use at the mine. Capital costs are estimated to be \$6.3 million USD with an IRR of 74.2 percent and payback period of 2.75 years. Carbon emissions would be reduced by 504.0 thousand tons of CO<sub>2</sub>e over the project's 10 year life. The mine requires technical assistance for a full-scale feasibility study to determine the viability of a drainage program and electricity production project.

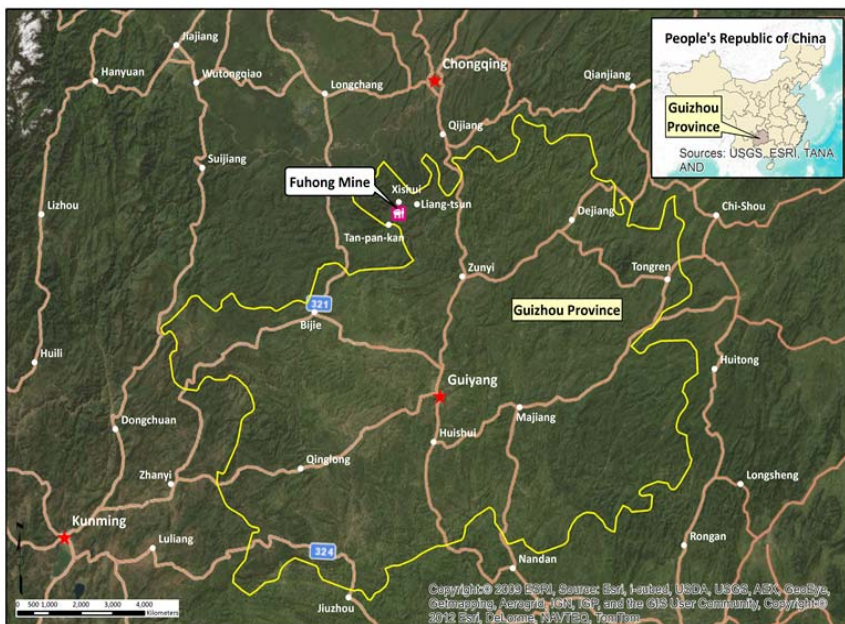
**ESTIMATED ANNUAL EMISSION REDUCTIONS: 0.25 MMTCO<sub>2</sub>E (POWER GENERATION ONLY) / 0.50 MMTCO<sub>2</sub>E (POWER GENERATION AND COAL DRYING)**

## PROJECT DETAILS

- Name of Project: In-mine Drainage and Power Production Project
- Name of Mine: Fu Hong Coal Mine
- Type of Ownership: Private
- Type(s) of assessments performed: Pre-feasibility
  - When performed: February 2013
  - By whom: Raven Ridge Resources, with Global Methane Initiative funding

## MINE INFORMATION

- Mine owner: Li Xiaowei
- Percent ownership: 100%
- Parent company: N/A
- Status and type of mine: Active; underground
- Mining Method: Room-and-pillar, longwall
- Service Life of Mine: 30.5 years



## PROJECT FINANCES

- Assumptions: 94.6 million cubic meters methane over project life
- Estimated revenue: US\$53.33, Option 1 / US\$46.35 million, Option 2
- Projected capital costs: US\$7.13 million, Option 1 / US\$6.3 million, Option 2
- Projected operation and maintenance (O&M) costs for fully implemented project: US\$1.2 million/yr, Option 1 / US\$1.0 million/yr, Option 2
- Estimated Project Payback Period: 2.5 years, Option 1 / 2.75 years, Option 2

# HISTORICAL AND PROJECTED MINE DATA

## HISTORICAL COAL PRODUCTION AND METHANE EMISSIONS

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Coal (tonnes/yr)											130,000	140,000
<i>Methane (Million m<sup>3</sup>/yr)</i>												
Emitted from ventilation system(s)											3.00	2.35
Liberated from drainage systems											20.0	14.0
Vented to atmosphere											20.0	14.0
Total Methane Emissions											23.0	16.4

## PROJECTED COAL PRODUCTION AND METHANE EMISSIONS

YEAR	2013	2014	2015	2016	2017	2018	2019	2020
Coal (tonnes/yr)	270,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
<i>Methane (Million m<sup>3</sup>/yr)</i>								
Emitted from ventilation system(s)	30.0	34.3	34.3	34.3	34.3	34.3	34.3	34.3
Liberated from drainage systems	9.34	9.47	9.47	9.47	9.47	9.47	9.47	9.47
Vented to atmosphere	-	-	-	-	-	-	-	-
Total Methane Emissions	30.0	34.3	34.3	34.3	34.3	34.3	34.3	34.3

# GREENHOUSE GAS EMISSION REDUCTIONS

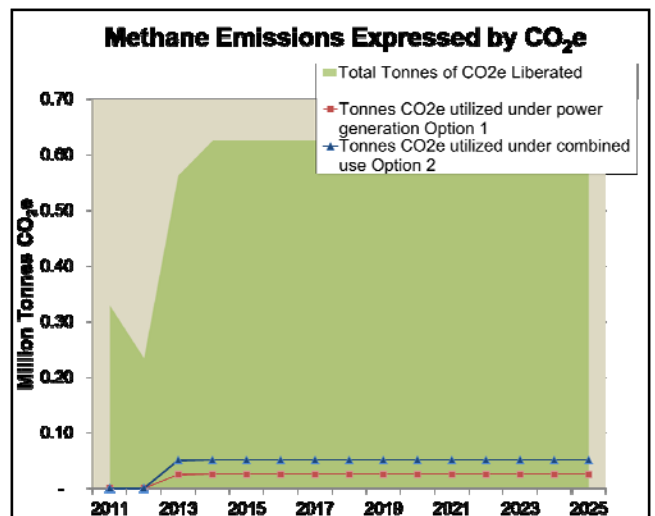
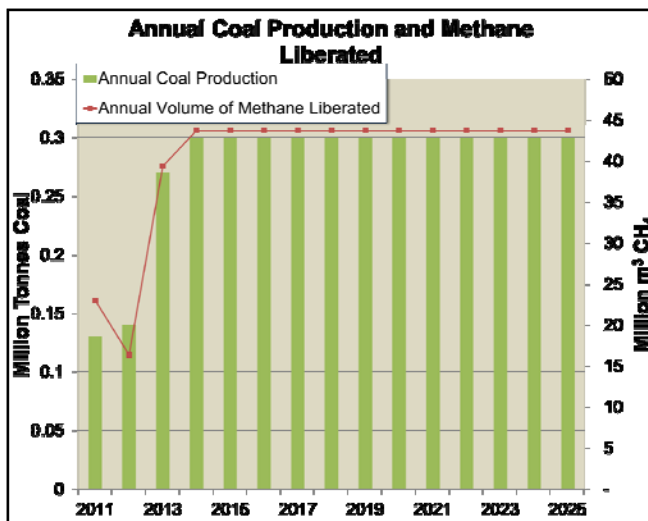
## ESTIMATED GHG EMISSION REDUCTIONS AND TOTAL VOLUME OF METHANE ALREADY RECOVERED/UTILIZED

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total CH <sub>4</sub> vented (ave. m <sup>3</sup> /min)											43.8	31.2
Average CH <sub>4</sub> concentration											20%	20%
Total CH <sub>4</sub> recovered and utilized (m <sup>3</sup> /year)											-	-

## TOTAL VOLUME OF METHANE EXPECTED TO BE RECOVERED/UTILIZED

YEAR	2013	2014	2015	2016	2017	2018	2019	2020
Total CH <sub>4</sub> recovered and utilized (Tonnes CO <sub>2</sub> e/year) End use Option 1	24,330.6	24,654.1	24,654.1	24,654.1	24,654.1	24,654.1	24,654.1	24,654.1
Total CH <sub>4</sub> recovered and utilized (Tonnes CO <sub>2</sub> e/year) End use Option 2	50,107.7	50,428.3	50,428.3	50,428.3	50,428.3	50,428.3	50,428.3	50,428.3

# COAL PRODUCTION AND METHANE EMISSION CHARTS



## MARKET ANALYSIS / DEMAND ANALYSIS

Although Guizhou is one of China's smallest and least urbanized provinces, its interconnections with the rest of the country have grown stronger in recent years, and its economic growth has closely tracked that of China as a whole. Electricity consumption within Guizhou has likewise followed the national/regional pattern, with strong double digit growth during 2005-2007. This growth gave way to a temporary decline in the second half of 2008 and the first half of 2009, under the impact of the global economic slowdown, followed by a rebound into 2010. It is reasonable to assume that Guizhou's economy and its electricity consumption will grow within the projected eight to ten percent range for the country as a whole in the medium term. The province's disproportionate economic dependence on energy-intensive extraction and manufacture of commodities such as coal, chemical fertilizers and their inputs/associated products, and aluminum, however, creates the potential for some volatility in local electricity demand. Industry as a whole has consistently accounted for close to 80 percent of Guizhou's electricity consumption, the above-mentioned commodities for an estimated 55 percent, and a single massive aluminum smelter near Guiyang for about 15 percent.

## TYPE(S) OF ASSISTANCE SOUGHT

The mine requires technical assistance for a full-scale feasibility study to determine the viability of a drainage program and electricity production project. The mine requires additional technology and equipment as well as expertise in using long reach drilling equipment in order to plan and execute an in-mine drilling program, as prescribed by the borehole array selected in the pre-feasibility study.

## PROPOSED TECHNOLOGIES



Jenbacher Gensets, Yanjing Mine, China



In-mine Drilling, West Elk Mine, USA

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