Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 90 (2016) 336 – 348

Energy Procedia

5th International Conference on Advances in Energy Research, ICAER 2015, 15-17 December 2015, Mumbai, India

# Fugitive methane emissions from Indian coal mining and handling activities: estimates, mitigation and opportunities for its utilization to generate clean energy

Ajay K. Singh*, Jaywardhan Kumar

*CSIR-Central Institute of Mining and Fuel Research, Dhanbad 826 015, India*

**Abstract**

Fugitive methane emissions from fossil fuel extraction account for significant contribution towards greenhouse gas (GHG) emissions in India. Out of total all-India GHG emissions of 1.88 million Gg-$CO_2$ equivalent in 2010 (with LULUCF), 48928.66 Gg-$CO_2$equivalent belonged to fugitive emissions from fossil fuel extraction. Methane emission from coal mining and handling activities has increased from 0.555 Tg in 1991 to 0.765 Tg in 2012, as per national emission factors developed by CSIR-CIMFR. These estimates have been prepared as part of India's Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) and the Biennial Update Report (BUR).

With increasing demand of coal, current production is likely to touch around a billion tonnes by 2020. In this paper a time series data of coal production and associated fugitive methane emissions from coal mining and handling activities have been presented up to the year 2012. The methane released from coal mining and also coalbed methane can supplement India's scarce natural gas reserves and act as a GHG mitigation opportunity. There are several technologies to achieve this in India, which include:

1. Coalbed methane (CBM): There exists an estimated potential of 400 BCM of CBM in three provinces viz. Jharkhand, West Bengal and Chhatisgarh. Commercial scale exploitation of CBM has already begun in Raniganj Coalfield in India.
2. Coal Mine Methane (CMM): Three coalfields in the Damodar River Basin (Raniganj, Jharia and Bokaro) were studied for feasibility of recovery and utilization of CMM. Kalidaspur and Ghusick collieries in the Raniganj Coalfield, Murulidih, Amlabad, Sudamdih and Parbatpur mines in the Jharia Coalfield and Jarangdih and Sawang collieries in the East Bokaro Coalfield appear to be favourable sites for CMM recovery.

*Corresponding author. Tel.: +91-326-2296007; fax: +91-326-2296025

*E-mail address:*ajay.cimfr@gmail.com


Peer-review under responsibility of the organizing committee of ICAER 2015
doi:10.1016/j.egypro.2016.11.201

3. Ventilation Air Methane (VAM): Methane diluted by ventilating air in underground coal mines is vented to the atmosphere and may be captured for its gainful utilization. Our studies have revealed that utilization of VAM at Moonidih Mine of BCCL can lead to a net emission reduction of 0.62 million tonnes of $CO_2$ equivalent per year.
4. Abandoned Mine Methane (AMM): There has been no effort to quantify the potential of AMM resource in India so far. It is imperative, therefore to initiate a study for evaluation of AMM resource potential in India.

Such mechanisms may serve as a valuable instrument to mitigate atmospheric methane emissions to the atmosphere and to find new pathways of clean energy deployment in India. This paper presents an analysis for policy-makers and the stake holders by providing a technological overview for augmenting clean energy resources in India.


Peer-review under responsibility of the organizing committee of ICAER 2015

*Keywords:*Coal mining and handling activities; Clean Coal Technology;Coalbed Methane; Coal Mine Methane

## 1. Introduction

In the last four decades, a substantial growth has been recorded in commercial primary energy consumption in India. Energy usage in India is expected to grow significantly due to India's developmental goals. Though the renewable energy consumption has grown from 9.2 MTOE in the year 2011 to 13.9 MTOE in the year 2014 [1], coal is likely to remain the main source of energy in India in the foreseeable future [2]. It has been reported that over 70% of electricity generated in India is from thermal power plants [3]. Coal is considered as vital to India's energy security [4]. The Geological Survey of India [5] has estimated proven coal reserves of the country at 131.61 billion tonnes. Estimates of total coal resources are much higher at 306.60 billion tonnes up to a depth of 1200 metres as on 1st April 2015. The coal resources reported above are coal *in-situ* and all of them are not extractable at the present status of economics and technology. The proved recoverable reserves of 60.6 billion tonnes [6] are capable to supply coal for over 100 years at current level of production and more than 50 years at double the existing rate of production. This appears to be a very comfortable situation and should enable coal mining industry in India to meet increasing demand despite some technological and financial barriers.

Methane is invariably found within coal seams and associated rocks. Coal normally stores substantial quantities of methane within its micro pores. Underground coal mining was plagued by the gas hazards and had been a continual source of anxiety and inconvenience to the miners throughout the long history of the industry [7]. The ventilation air along with the mine gases is released into the atmosphere. Although, the levels of methane in the vented air is frequently less than 0.02% in the Indian context, a significant amount of the gas is added to the atmosphere every year, as the quantity of vented air is quite large. Methane present in coal is not a safety problem in the case of surface mining. However, a considerable amount of the gas is emitted to the atmosphere during surface mining of coal also as the share of coal production from surface mines is more than 90% in India. Besides the emission during mining, coal still contains some remnant gas that is released slowly with time during handling activities such as processing in washeries and coal handling plants and subsequent utilization.

In this paper, current methane emissions from Indian coal mining and handling activities have been estimated. The basic calculations for estimating emissions have been carried out following the methodologies very similar to those recommended by the Intergovernmental Panel on Climate Change (IPCC) [8, 9]. Methane emission factors during mining and post mining for different categories of coal mines have been determined. Annual coal production data for different category of mine is collected, which is multiplied by the corresponding methane emission factor and the conversion coefficient of $0.67 \times 10^{-6}$ Gg $m^{-3}$ to obtain estimates of methane emission from coal mining. Estimates based on IPCC emission factors have also been obtained and are compared with the present results. Besides the estimates of methane emission from coal mining and handling activities, various mitigation options for extraction of this gas for its gainful utilization as a clean source of energy have been discussed.