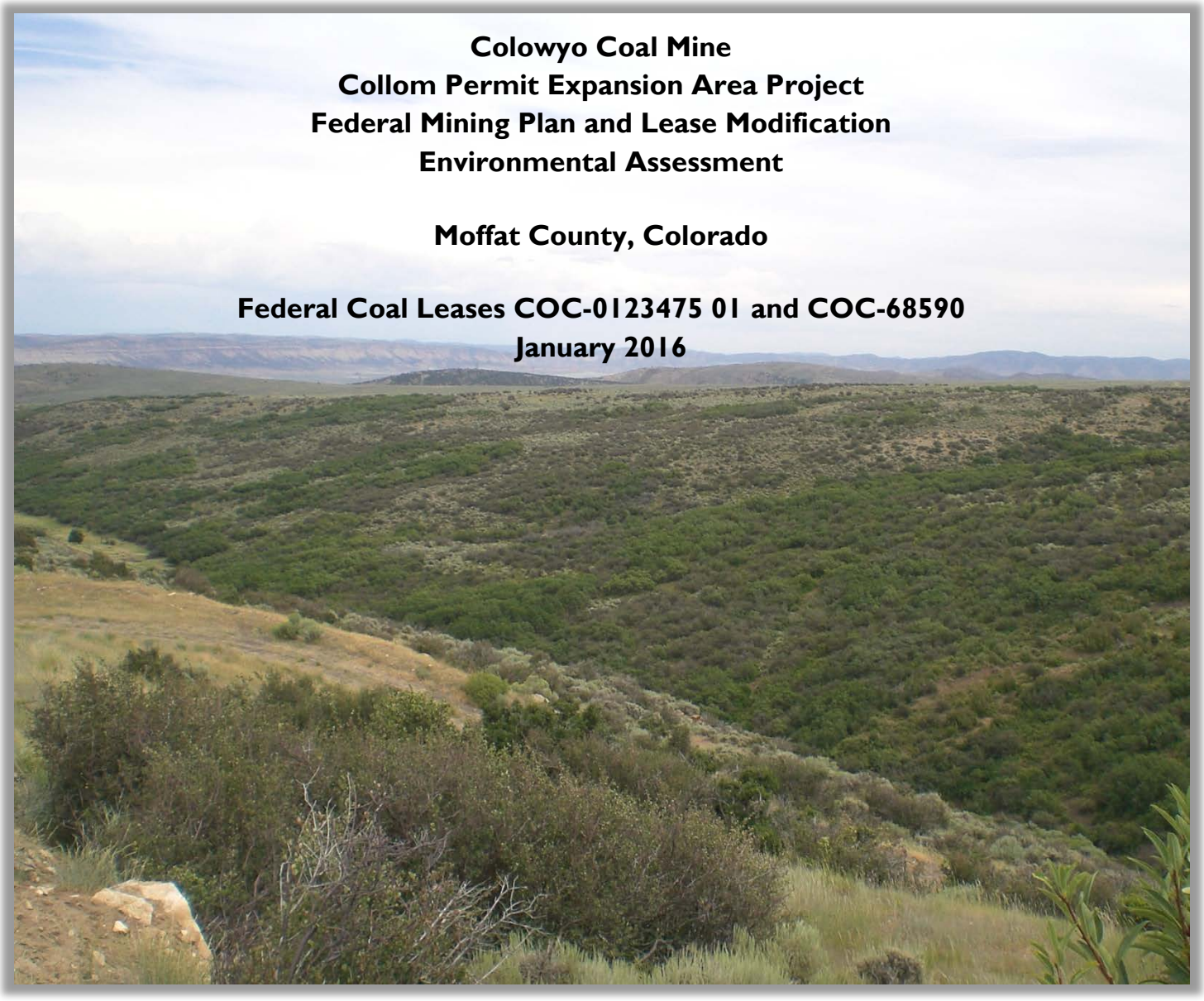
UNITED STATES DEPARTMENT OF THE INTERIOR
OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT
&
BUREAU OF LAND MANAGEMENT



Colowyo Coal Mine
Collom Permit Expansion Area Project
Federal Mining Plan and Lease Modification
Environmental Assessment

Moffat County, Colorado

Federal Coal Leases COC-0123475 01 and COC-68590
January 2016

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should be used when basin specific data is unavailable. Tier 2 is the "Country or Basin Specific Method". Both methods are recommended by the IPCC for surface mining estimates.

A Tier 2 methodology was used to determine methane emissions estimates from extraction for both Alternative A and Alternative B. In addition to methane estimates from coal extraction, post-mining estimates were also determined. Tier 2 methodologies were used because emission factors associated with Rocky Mountain coal were available.

Alternative A assumes 5.1 mtpy (4.63 million metric tons [mmt]). The IPCC has supplied default emission factors for surface mining with a range of 0.3 to 2.0 m^3 CH_4/metric ton (mt) of coal. Basin specific factors are derived from the in-situ factors, which are based on geologic regions of the U.S. The Colowyo Coal Mine falls into the Rocky Mountain region with an in-situ basin methane emission factor for coal of 0.4 m^3 CH_4/mt. The second component of total surface mining methane emissions is the methane content of the surrounding strata. Total surface mining emissions typically produce twice as much methane as in-situ coal (EPA 2006). The surrounding strata are assumed to also have an emission factor of 0.4 m^3 CH_4/mt resulting in a total factor of 0.8 m^3 CH_4/mt. A factor of 0.67 $Gg/10^6$ m^3 was implemented as part of the conversion from cubic meters to metric tonnes.

Post-mining coal handling also contributes to overall methane emissions. Again, the in-situ emission factor is applied, but, to avoid overestimates, only the percentage of gas released is included in the calculation. On average, western U.S. coal retains 72 percent of the methane (Kirchgessner et al. 1996). Therefore, 28 percent is released during the post-mining handling process.

After aggregating the two processes (extraction and post-mining) and assuming 4.63 mmt/year coal extraction, the total methane emitted is 2,827 metric tonnes annually. Additionally, the extraction of all 74.1 mmt (81.7 million short tons) would generate approximately 49,922 metric tonnes of methane.

Mining Combustion Gaseous GHG Emissions

The EPA regulates several GHGs, which primarily include carbon dioxide (CO_2), CH_4, and nitrous oxide (N_2O). There are several other regulated GHGs, such as refrigerants, that are not emitted by the mine. CO_2, CH_4, and N_2O are byproducts of incomplete combustion and are emitted via tailpipe, blasting, and drilling. Each regulated GHG has an associated global warming potential (GWP). GWP was developed to allow for direct comparisons of global warming impacts of different gases. CO_2 is used as the reference gas and therefore has a GWP of 1. According to the EPA, CH_4, and N_2O have GWPs over 100 years of 25 and 298, respectively. All associated GHG emissions are multiplied by each applicable GWP and aggregated together to obtain a final value of carbon dioxide equivalent (CO_2e) in units of metric tons.

Utilizing EPA emissions factors and the maximum mining rate of 5.1 mtpy, the direct GHG emissions associated with Alternative A are detailed **Table 4.3-5**. In 2011, 2,245 mmt of CO_2e were emitted throughout the U.S. according to the EPA NEI database. Also, 130 mmt were emitted within Colorado as stated by the 2014 Colorado Greenhouse Gas Inventory Update. Alternative A would contribute 0.40 percent of the statewide total and 0.023 percent nationwide. In comparison, the amount associated with Alternative A would be insignificant. The emissions contributable to Alternative A would be much smaller when compared to the statewide and national GHG emissions.

Black Carbon Emission Estimates

Black carbon is a significant component of particulate emissions related to incomplete combustion. Haul trucks and locomotive use of diesel fuel are sources of black carbon. As of 2005, 93 percent of all mobile source black carbon emissions came from diesel engines (EPA 2012). Black carbon directly absorbs light and reduces the reflection of heat off snow and ice as it gets deposited. Black carbon has been linked to climate impacts such as increased temperatures and accelerated ice and snow melt.

All haul truck types were evaluated for their contribution of black carbon as a percentage of overall particulate (**Table 4.3-6**). All 240T trucks were assumed 830E Komatsu haul trucks, which all have a "2007-plus" engine. The 50T haul trucks are "pre-2007" engines. The EPA has determined black carbon to be a higher percentage of particulate matter when emitted from engines constructed prior to 2007. There is a drastic reduction for newer engines because of better design and use of diesel particulate filters (DPFs). The carbon black percentage of pre-2007 trucks is 78.97 percent compared to 9.98 percent for post-2007 trucks (MOVE 2014). Passenger vehicles also contribute to black carbon emissions, but it is approximately an order of magnitude less.

Table 4.3-5 Direct GHG Emissions (metric tons/yr), Alternative A

Activity	CO_2	CH_4	N_2O	CO_2e
Scrapers[5]	2,993	0.17	0.08	3,020
Drills[8]	26,103	1.05	0.20	26,191
Dozers[3]	25,171	1.41	0.64	25,398
Graders[4]	131,812	7.37	3.36	132,999
Haul Trucks (240T)[6]	50,375	1.26E-02	0.01	50,379
STA Haul Trucks (50T)[7]	2,484	2.6E-03	2.4E-03	2,485
Collom Haul Trucks (50T)[7]	6,312	6.6E-03	6.2E-03	6,314
Water Trucks[1]	14,916	0.015	0.01	14,921
Blasting[2]	185,053	6.54	1.63	185,704
Access Road	62	3.58E-03	7.30E-03	64
Rail Maintenance	602	0.04	6.85E-03	605
Methane Release	--	2,827	--	70,675
Total	**445,885**	**2,844**	**6.0**	**518,754**

[1] All water trucks use the same engine as the 793C haul trucks; assumes 10 mph speed
[2] Blasting assume 400 tons of ANFO per blast
[3] Assumes an average of 25 gal/hr fuel consumption from Caterpillar Performance Handbook edition 42 - D-11 T tractors medium consumption rate
[4] Assumes an average of 15 gal/hr fuel consumption from Caterpillar Performance Handbook edition 42 - 24 M graders medium consumption rate
[5] Assumes an average of 24 gal/hr fuel consumption from Caterpillar Performance Handbook edition 29 - 637E scrapers medium consumption rate; also average speed of 8 mph
[6] Assumes an average of 50 gal/hr fuel consumption from Komatsu Application Handbook Edition 30 - 830E haul truck high consumption rate; also average speed of 25 mph (real time fleet data)
[7] Weststar 6900XD; average speed of 25 mph; 120 gallon tank assumed to be filled after each 10 hr shift - 12 gal/hr fuel consumption
[8] Assumes 1,200 gal diesel consumed per day

Table 4.3-6 Black Carbon Emissions (tpy) from Haul Trucks, Alternative A

Haul Truck	Black Carbon $PM_{2.5}$	Black Carbon PM_{10}
50 Ton	0.056	0.066
240 Ton	0.302	0.329
Access Road	5.39E-04	5.82E-04