U.S. Department of the Interior
Bureau of Land Management

Supplemental Environmental Assessment for the May 2015-August 2016 Sold and Issued Leases DOI-BLM-WY-0000-2019-0007-EA

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The BLM's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

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BLM Wyoming
Supplemental EA for the May 2015, August 2015, December 2015,
May 2016, and August 2016 Lease Sales
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1. Introduction

1.1 Introduction

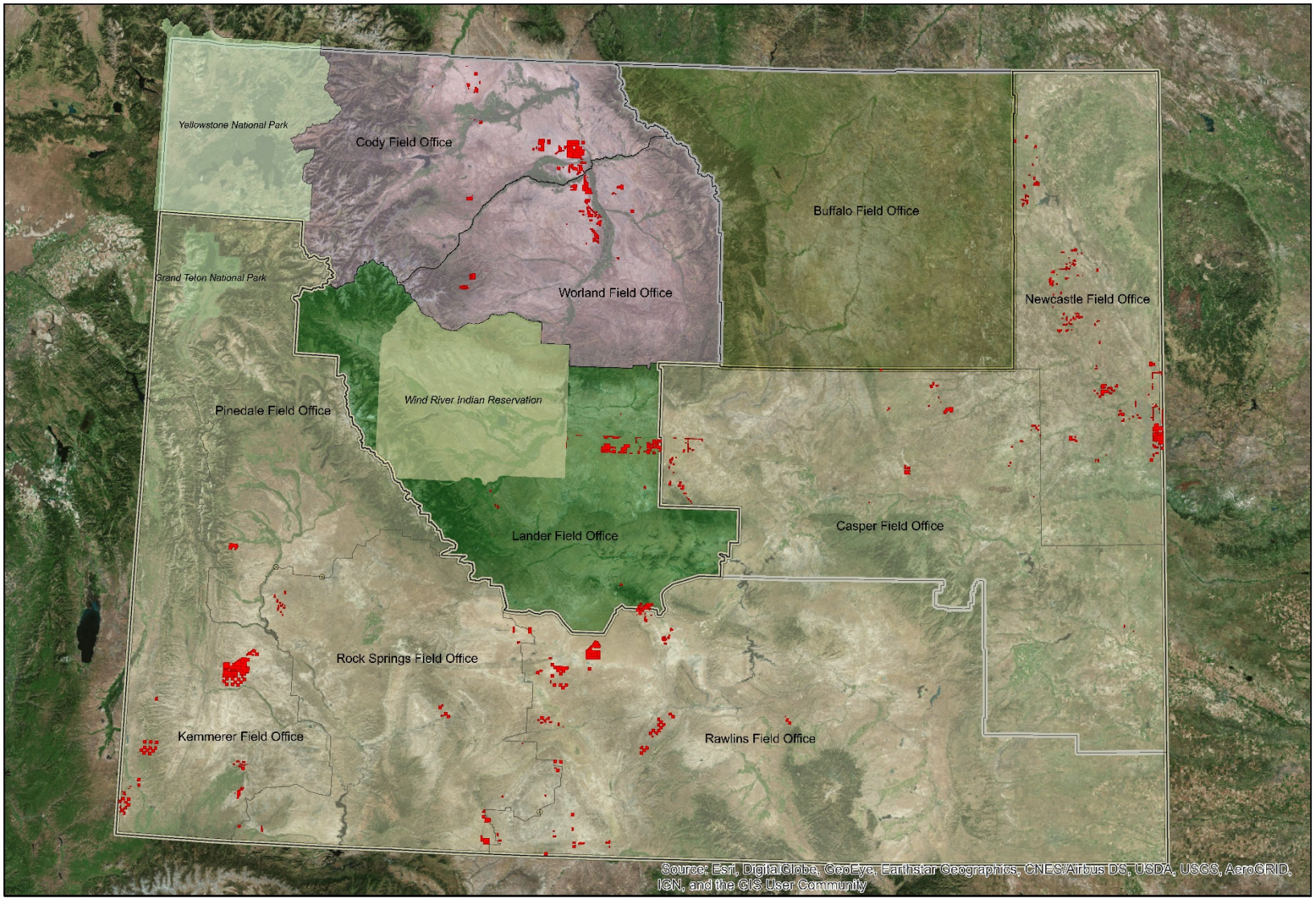
On March 19, 2019, the U.S. District Court for the District of Columbia issued a decision in *WildEarth Guardians, et al. vs. Zinke* Case No. 1:16-cv-01724-RC. The Court decision reviewed five Bureau of Land Management (BLM) decisions to offer parcels at Wyoming oil and gas lease sales in May 2015, August 2015, November 2015, May 2016,[1] and August 2016.[2] BLM sold and issued leases for all 283 parcels that were offered at the sales. The Court remanded BLM's decisions to offer the parcels for lease, and specifically directed BLM to further analyze the greenhouse gas (GHG) emissions expected to result from leasing and subsequent development of these parcels. This Environmental Assessment (EA) documents that additional analysis.

In accordance with the Mineral Leasing Act of 1920, as amended [30 U.S.C. § 181 et seq.], Federal Onshore Oil & Gas Leasing Reform Act of 1987 [30 U.S.C. § 181 et seq.] and Title 43 Code of Federal Regulations (CFR) 3120.1-2(a), the BLM Wyoming State Office (WSO) conducts a quarterly competitive oil and gas lease sale for lands that are eligible and available for leasing. A Notice of Competitive Oil and Gas Lease Sale (Sale Notice), which lists parcels to be offered at the auction, was published by the WSO at least 45 days before each of the subject auction dates. Applicable lease stipulations for each parcel were identified in the Sale Notices. The decision as to which public lands and minerals are open for leasing and what leasing stipulations may be necessary is made during the BLM's land use planning process in accordance with the Federal Land Policy and Management Act of 1976 (FLPMA) [43 U.S.C. § 1712]. Surface management/use for mineral extraction on non-BLM administered surface overlying Federal minerals is determined by the BLM in consultation with the appropriate surface management agency or the private surface owner when surface use is proposed by the leaseholder or its designated operator.

[1] Plaintiffs also challenged federal oil and gas lease sale decisions in Colorado and Utah. The case has been divided into phases, and challenges to the lease sale decisions in those states have not yet been litigated.

[2] BLM had planned to sell the parcels at six individual sales including May 2015, August 2015, November 2015, February 2016, May 2016 and August 2016. However, the February 2016 sale was cancelled due to a major snowstorm. The February 2016 parcels were subsequently sold along with the May 2016 parcels, at the May 2016 competitive oil and gas lease sale. This resulted in BLM processing six sets of leases, but only holding five competitive lease sales.

Figure 1. Sold and Issued Leases May 2015 (1505) -August 2016 (1608)



1.2 Background

BLM is responsible for oil and gas leasing on about 700 million acres of BLM, national forest, and other Federal lands, and seeks to ensure that mineral resources are developed in an environmentally responsible manner.

In accordance with the MLA and 43 CFR § 3120.1-2, the BLM WSO conducts quarterly competitive oil and gas lease sales for lands that are eligible and available. Private individuals or entities may file Expressions of Interest (EOIs) to suggest parcels for consideration for leasing by the BLM. The authorized officer also may identify lands for leasing consideration. Additional information on the competitive lease sale process is available on-line at: https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/leasing

The offering and subsequent issuance of oil and gas leases, in and of itself, does not cause or directly result in any surface disturbance. The BLM cannot determine, prior to conducting a lease sale, whether a proposed parcel actually will be leased, or if it is subsequently leased, whether the lease will be explored or developed.

Once a parcel is sold and the lease is issued, the lessee has the right to use the leased lands to explore and drill for all of the oil and gas within the lease boundaries, subject to the stipulations attached to the lease, restrictions derived from specific nondiscretionary statutes, and other reasonable measures to minimize adverse impacts (see 43 § CFR 3101.1-2). Further, relevant regulations at 43 CFR § 3162.5-1(a) provide: "The operator shall conduct operations in a manner which protects the mineral resources, other natural resources, and environmental quality. In that respect, the operator shall comply with the pertinent orders of the authorized officer and other standards and procedures as set forth in the applicable laws, regulations, lease terms and conditions, and the approved drilling plan or subsequent operations plan. Before approving any Application for Permit to Drill submitted pursuant to § 3162.3-1 of this title, or other plan requiring environmental review, the authorized officer shall prepare an environmental record of review or an environmental assessment, as appropriate. These environmental documents will be used in determining whether or not an environmental impact statement is required and in determining any appropriate terms and conditions of approval of the submitted plan." Accordingly, the BLM can subject development of existing leases to reasonable conditions to minimize impacts to other resources, through the application of COAs at the time of permitting. Any constraints must conform with the applicable land use plan and be consistent with rights granted to the holder under the lease. In addition, upon cessation of lease operations, the lessee must plug the well(s) and abandon any facilities on the lease. The surface must also be reclaimed to the satisfaction of the BLM authorized officer, in accordance with the MLA, Section 17g [30 U.S.C. § 226(g)].

Oil and gas leases are issued for a 10-year period and continue for so long thereafter as oil or gas is produced in paying quantities. If a lessee fails to produce oil or gas, does not make annual rental payments, does not comply with the terms and conditions of the lease, or relinquishes the lease, the lease may terminate or be cancelled, and BLM may consider offering the lands for lease at another lease sale after a new review process.

1.3 Purpose and Need

The purpose and need for this environmental analysis is to comply with the court's decision in *WildEarth Guardians, et al. vs. Zinke* (D.D.C. No. 1:16-cv-01724-RC) (March 19, 2019), which found that "BLM had failed to take a 'hard look' at GHG emissions from the challenged Wyoming lease sales, and therefore the EAs and Findings of No Significant Impact (FONSIs issued for those sales did not comply with the National Environmental Policy Act (NEPA)" (Opinion at 59). The court directed BLM to "supplement those documents, addressing the deficiencies identified by the Court." *Id.*

1.3.1 Decisions to Be Made

BLM will decide, based on this analysis, whether to affirm the issuance of the subject leases.

1.4 Tiering and Conformance with BLM Land Use Plans and Other Environmental Assessments

Pursuant to 40 CFR § 1508.28 and § 1502.21, this EA tiers to the Final Environmental Impacts Statements (FEISs) prepared for each Field Office (FO) Resource Management Plan (RMP), and any subsequent amendments or updates, and incorporates by reference the relevant portions of the FEISs. The impacts analysis in the FEISs for the effects from oil and gas leasing and development incorporates the Reasonably Foreseeable Development (RFD) scenarios (i.e., the level of oil and gas development projected for the life of the plan based on historically and projected trends).

The sale and issuance of the leases conforms to the approved RMPs (43 CFR § 1610.5) and Records of Decision (RODs) for the applicable planning areas, as amended or updated, including:

High Plains District (HPD)

- The Casper Field Office (CFO) RMP ROD approved on December 7, 2007 (supported by June 2007 FEIS), as amended by the Wyoming Greater Sage-grouse Land Use Plan Amendment Rocky Mountain Region ROD approved on September 21, 2015 and amended on March 15, 2019 (GSG ARMPA) (supported by May 2015 and December 2018 FEISs').
- The Newcastle Field Office (NFO) RMP ROD approved on August 25, 2000 (supported by June 1999 FEIS), as amended by the GSG ARMPA (supported by May 2015 and December 2018 FEISs').

Wind River/Bighorn Basin District (WRBBD)

- The Lander Field Office (LFO) RMP ROD signed on June 26, 2014 (supported by February 2013 FEIS), as amended by the (GSG ARMPA) (supported by May 2015 and December 2018 FEISs').
- The Cody Field Office (CYFO) Bighorn Basin/Rocky Mountain Region RMP ROD approved on (supported by May 2015 FEIS); amended on March 15, 2019 (supported by December 2018 FEIS).
- The Worland Field Office (WFO) Bighorn Basin/Rocky Mountain Region RMP/ROD approved on (supported by May 2015 FEIS); amended on March 15, 2019 (supported by December 2018 FEIS).

High Desert District (HDD)

- The Rawlins Field Office (RFO) RMP ROD approved on December 24, 2008 (supported by January 2008 FEIS) as amended by the GSG ARMPA (supported by May 2015 and December 2018 FEISs').
- The Green River (Rock Springs Field Office (RSFO)) RMP ROD approved on August 8, 1997 (supported by April 1996 FEIS), as amended by the GSG ARMPA (supported by May 2015 and December 2018 FEISs').
- The Pinedale Field Office (PFO) RMP ROD approved on November 26, 2008 (supported by August 2008 FEIS), as amended by the GSG ARMPA (supported by May 2015 and December 2018 FEISs').
- The Kemmerer Field Office (KFO) RMP ROD approved on May 24, 2010 (supported by August 2008 FEIS), as amended by the GSG ARMPA (supported by May 2015 and December 2018 FEISs')

The FO RMPs include allocation decisions which identify lands as either open or closed to fluid mineral leasing, and (if open) provide stipulations that are attached to new leases to mitigate effects of potential development operations.

This EA discloses the affected environment, as well as the anticipated reasonably-foreseeable GHG emissions' related impacts of leasing and development, and potential mitigation of those impacts. The EA provides information for BLM to determine whether this project would have significant impacts not already disclosed and analyzed in other NEPA documents, warranting an EIS. The RMP EISs have already evaluated potentially significant impacts arising from the BLM's land use planning decisions. *See* 43 CFR § 46.140(c). Therefore, the BLM may issue a "finding of no significant impacts" (FONSI), if no such impacts are identified. If a FONSI is reached, a Decision Record (DR) may be signed approving the selected alternative, which could be the proposed action, the no-action alternative, or a combination thereof.

1.5 Relationship to Statutes, Regulations, and Other Plans or Decisions

The proposed action and alternatives are consistent with other statutes, including the following:

- Federal Land Policy and Management Act of 1976, as amended [43 U.S. Code § 1701 et seq.]
- Mineral Leasing Act of 1920, as amended [30 U.S.C. § 181 et seq.]
- Federal Onshore Oil & Gas Leasing Reform Act of 1987 [30 U.S.C. § 181 et seq.]
- The National Environmental Policy Act [42 U.S.C. 4321 et seq.]
- Clean Air Act [42 U.S.C. § 1857 et seq.], as amended and recodified [42 U.S.C. § 7401 et seq.]

The proposed action also is consistent with other plans, programs, and policies of other Federal agencies, the State of Wyoming, local governments, and affected Tribes, to the extent practical.

1.6 Scoping

No scoping was conducted for this decision; issues addressed in this EA are limited only to those identified in *WEG v Zinke.*

1.7 Public Participation

BLM provided opportunities for public participation during development of the RMPs, and again prior to the lease sales. News releases announced the availability of the original EAs on the BLM Wyoming website for 30-day public comment periods. BLM provided a 10-day comment period for this EA was provided beginning on April 12, 2019, through BLM's eplanning site.

2. Description of Alternatives, Including Proposed Action

2.1 Introduction

The alternatives analyzed in this EA involve 283 leases that were sold and issued as a result of five competitive oil and gas lease sales held in 2015 and 2016. The list of leases is included in Section 7.1.1. The court's directive found error with BLM's analysis of climate change and greenhouse gas emissions-related impacts; as such, the analysis in this EA is limited to a discussion of Climate Change and Greenhouse Gas Emissions.

The May 2015 and August 2015 competitive lease sale EAs predated the GSG ARMPA, and were tiered to the exiting RMP EISs. All subsequent lease sale NEPA analyses were tiered to the RMP EISs for the Bighorn Basin (Cody and Worland Field Offices), Lander, and the GSG ARMPA. The GSG ARMPA amended the Casper, Newcastle, Pinedale, Kemmerer, Rawlins and Rock Springs (Green River) RMPs. The recent planning decision analysis areas that encompass the Proposed Action are shown below:

Table 1: Proposed Action Total Number of leases by Planning Area

Planning Decision Analysis Area	# of Leases	Acres of Leases
Bighorn Basin RMP	42	63,945.1
Lander RMP	28	34,256.5
GSG ARMPA	213	205,794.1

Among the 283 leases involved in the case, the 213 leases in the FOs covered by the GSG ARMPA, include:

Table 2: Proposed Action Leases subject to the GSG ARMPA

Field Office	Leases
Casper	31
Newcastle	83
Kemmerer	34
Pinedale	2
Rawlins	47
Rock Springs	16

The following table shows the leases sold at each of the five sales, by planning unit.

Table 3: Proposed Action Leases by Lease Sale and Planning Unit

Sale	Total Number of Leases Offered	Total Number of Leases Offered by Planning Unit	Planning unit	Total Acreage Of Leases Sold
May 2015	31	31	GSG ARMPA	30,382.2
August 2015	61	9	Bighorn	4,998.2
		6	Lander	9,134.4
		46	GSG ARMPA	42,778.9
November 2015	39	39	GSG ARMPA	61,353.7
May 2016	76	14	Lander	20,294.9
		62	GSG ARMPA	50,507.1

August 2016	76	33	Bighorn	58,946.9
		8	Lander	4,827.2
		35	GSG ARMPA	20,491.9

2.2 Proposed Action Alternative

Under the Proposed Action Alternative, BLM Wyoming would affirm the issuance of leases for 283 parcels offered and sold between May 2015 and August 2016.

2.3 No Action Alternative

Under the No Action Alternative, BLM Wyoming would negate the issuance of leases for 283 parcels. Choosing the No Action alternative would not prevent future leasing in these areas consistent with land use planning decisions and subject to appropriate stipulations, identified in the respective land use plans.

2.4 Alternatives Considered and Eliminated from Further Analysis

No other alternatives were considered for this analysis.

3. Affected Environment

3.1 Introduction

This section describes the present conditions of climate change and existing levels of GHGs that could be affected under the action alternatives, if the leases are affirmed, and if oil and gas exploration and development operations are eventually authorized by the BLM.

3.2 Climate

The HDD is located in a semi-arid, mid-continental climate regime typified by dry, windy conditions, limited rainfall, and long, cold winters (Trewartha and Horn 1980). The HDD region is subject to strong, gusty winds that are often accompanied by snow and blizzard conditions during the winter. Winds frequently originate from the west to northwest, and the mean annual wind speed is 9 miles per hour but can have sustained winds greater than 40 miles per hour.

The climate in the HPD is generally temperate and is a semi-arid region with long cold winters and short summers. The major factors controlling climate in the planning area are elevation, strong westerly winds, moisture flow, and mountainous barriers to the west. Wind speed and direction are highly variable because of the effect of local topography in the planning area. Wind speeds are generally strong and gusts above 40 miles per hour are not unusual.

The climate in the WRBBD is designated as a combination of Intermountain Semi-Desert and Southern Rocky Mountain Steppe. Summers are generally short and hot and winters long and cold. Precipitation has historically been low, though greater at higher elevations, and distributed across the year, with the exception of the drier summer months. Wind speeds are variable but strong.

In general, wind strength and frequency affects dispersion of noises, odors, and transport of dust and other airborne elements. Therefore, Wyoming's strong winds increase the potential for atmospheric dispersion of pollutants.

3.3 Climate Change

Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer. "Global warming" refers to the recent and ongoing rise in global average temperature near Earth's surface. It is caused mostly by increasing concentrations of greenhouse gases in the atmosphere. Global warming is causing climate patterns to change. However, global warming itself represents only one aspect of climate change. Climate is both a driving force and limiting factor for ecological, biological, and hydrological processes, and has potential to influence resource management.

The scientific community recognizes that global temperatures have risen at an increased rate and the likely cause is gases that trap heat in the atmosphere, referred to as GHGs. The Intergovernmental Panel on Climate Change (IPCC, 2007) concluded that "warming of the climate system is unequivocal" and "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations." Extensive research and development efforts are underway in the field of carbon capture and sequestration technology, which could help direct management strategies in the future. The IPCC has identified a target worldwide "carbon budget" to estimate the amount of CO_2 the world can emit while still having a likely chance of limiting global temperature rise to 2°C above pre-industrial levels. The international community estimates this budget to be 1 trillion tons of carbon and also acknowledges that varying amounts of this budget have already been consumed (IPCC, 2014).

In 2009, based primarily on the scientific assessments of the U.S. Global Change Research Program, the National Research Council, and the IPCC, the EPA issued a finding that the changes in our climate caused by elevated

concentrations of GHGs in the atmosphere are reasonably anticipated to endanger the public health and public welfare of current and future generations.

Statewide, National, and Global Climate Change (Temperature and Precipitation)
According to the National Oceanic and Atmospheric Administration Climate Prediction Center[3], "global mean surface temperatures increased nearly 1.8°F from 1890 to 2006. They further report that "the 2017 average global temperature across land and ocean surface areas was 0.84°C (1.51°F) above the twentieth-century average of 13.9°C (57.0°F), making it the third-warmest year on record behind 2016 (warmest) and 2015 (second warmest). Models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Northern latitudes (above 24°N) have exhibited temperature increases of nearly 2.1° F since 1900, with nearly a 1.8°F increase since 1970 alone."

The American Meteorological Society also produces annual State of the Climate Reports. Chapter 7 of the 2017 report, discloses:

> [t]he annual average temperature in 2017 for the contiguous United States (CONUS) was 12.5°C or 1.0°C above the 1981–2010 average—its third warmest year since records began in 1895, 0.2°C cooler than 2016 and 0.4°C cooler than 2012 (Fig. 7.3). The annual CONUS temperature over the 123-year period of record is increasing at an average rate of 0.1°C decade, with the trend increasing since 1970 to 0.3°C decade.
>
> The nationally averaged precipitation total during 2017 was 104% of average, the 20th wettest year in the historical record. The annual CONUS precipitation total is increasing at an average rate of 4.3 mm decade. Outside the CONUS, Alaska had its seventh warmest year (+1.2°C departure) since statewide records began in 1925, and near-median precipitation (104% of average).
>
> Locations across the West, Great Plains, Great Lakes, Deep South, Midwest, and Northeast had a wetter-than-average year in 2017, while areas of the Northern Rockies and Plains were drier than average (Fig. 7.4b). Six states had annual precipitation totals above their 90th percentile, including Michigan, which was record wet, while only North Dakota was below its 10th percentile. Areas of the West, particularly California, experienced significant drought relief in early 2017, with a multiyear drought nearly eradicated due to the heavy winter precipitation. However, the wet winter allowed vegetation to flourish, creating an abundance of fuels for wildfires during the subsequent dry season. In the Northern Plains, a dry spring and summer set the stage for a rapidly expanding and intensifying drought. The year began and ended with about one-quarter of the contiguous U.S. in drought.
>
> The CONUS winter precipitation was 120% of average, its wettest since 1997/98 and ninth wettest on record. Above-average winter precipitation occurred across the West and parts of the Northern Plains and Midwest. Nevada and Wyoming each had their wettest winter. Spring 2017 was tenth wettest for the CONUS, with 119% of average precipitation. Above-average precipitation occurred across the Northwest, Central Plains, Midwest, Northeast,
>
> For the CONUS, ten months in 2017 were warmer than their respective 1981–2010 average. Every state, except Washington, had a warmer-than-average annual temperature (Fig. 7.4a). Arizona, Georgia, New Mexico, North Carolina, and South Carolina were each record warm.

Specific to Wyoming, temperatures in western Wyoming are expected to increase by 0.25 to 0.40 degrees Fahrenheit per decade, while temperatures in surrounding locations in Utah, Wyoming, and Colorado are expected to increase by 0.40 to 1.2 degrees Fahrenheit per decade (see figure, below). Precipitation across western Wyoming is expected to decrease by 0.1 to 0.6 inches per decade with the largest decrease expected in southwestern Wyoming. The eastern portions of the state are expected to get warmer and wetter.

The following figure shows the deviation in Temperature and Precipitation from the average annual in the United States (State of the Climate Report, Chapter 7, page S195 (2017)).

[3] https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature (accessed 04052019)

Figure 2: Deviation In Temperature and Precipitation From The Average Annual In The United States

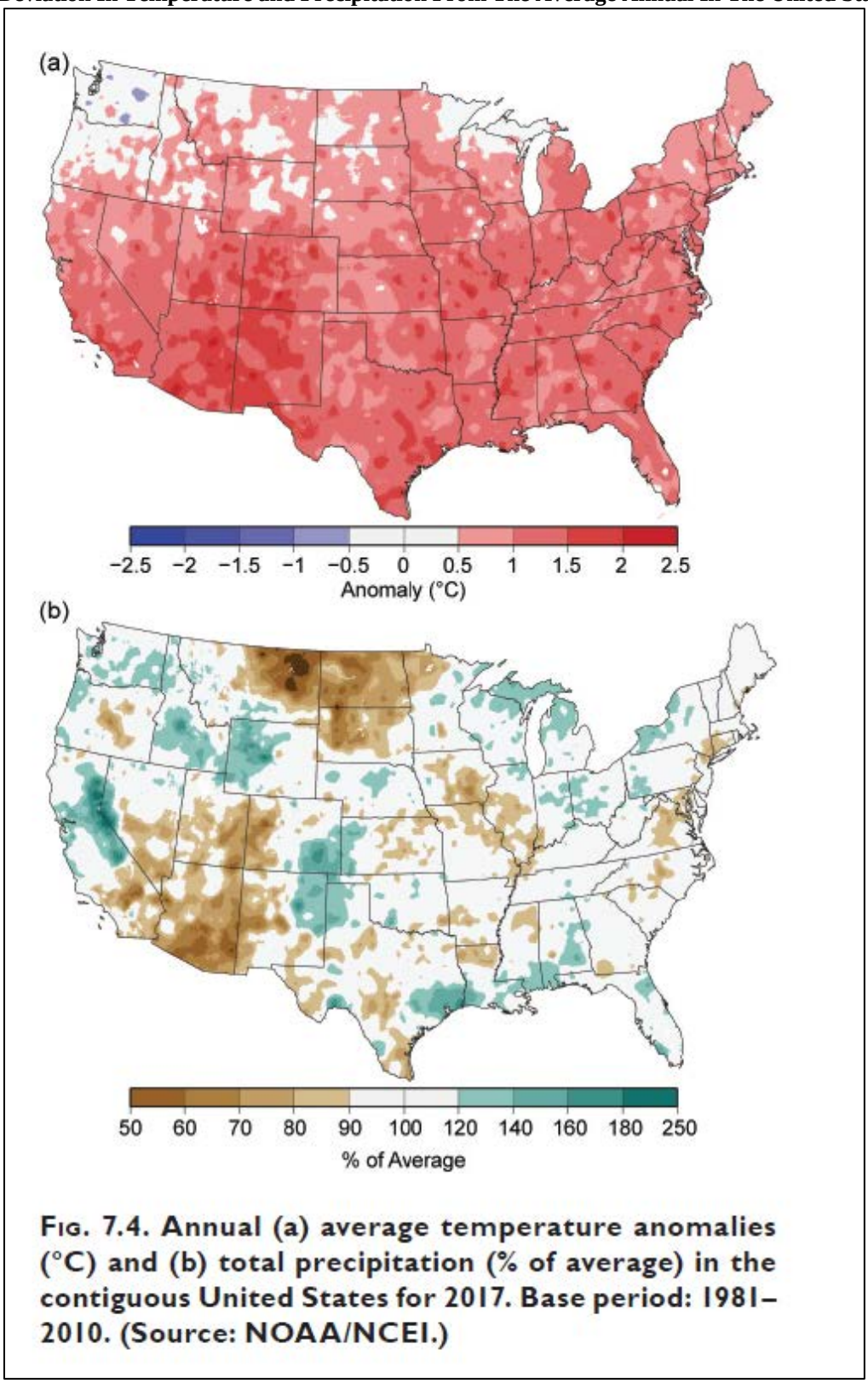


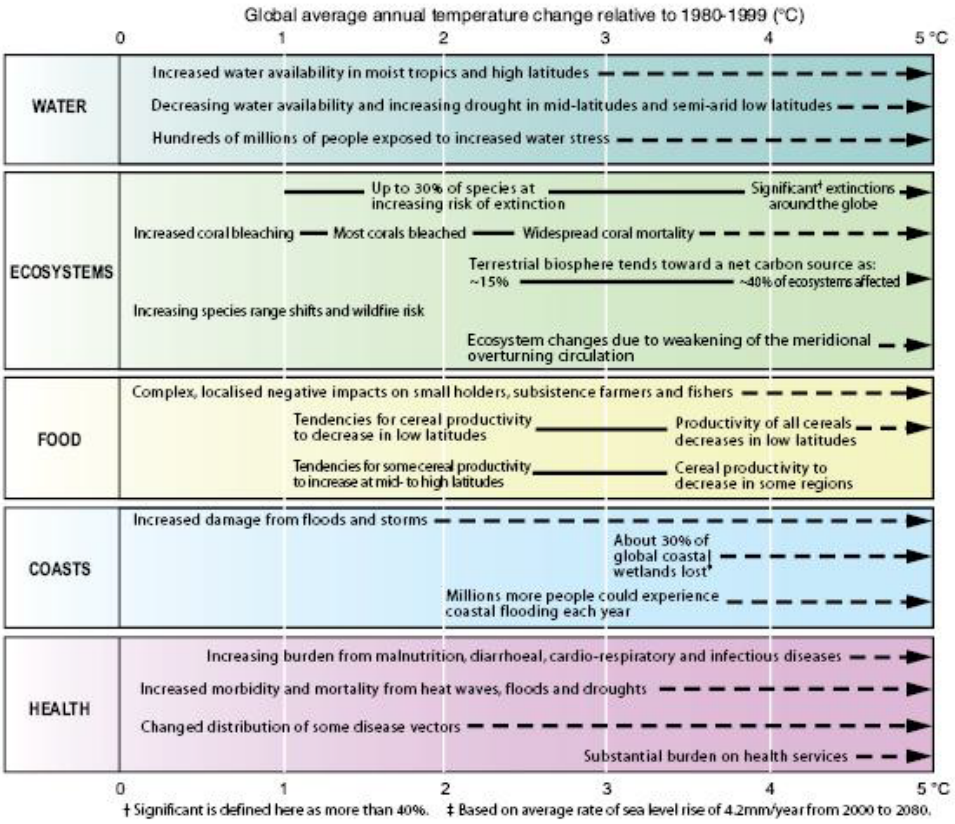
FIG. 7.4. Annual (a) average temperature anomalies (°C) and (b) total precipitation (% of average) in the contiguous United States for 2017. Base period: 1981–2010. (Source: NOAA/NCEI.)

(https://www.ametsoc.net/sotc2017/Ch07_RegionalClimates.pdf)

The next figure, taken from the IPCC's Fourth Assessment Report, indicates varying responses of the natural world to increasing temperatures as a result of increasing global temperatures.

Figure 3: Examples of Impacts Associated with Global Average Temperature Change

(Impacts will vary by extent of adaptation, rate of temperature change and socio-economic pathway).



3.4 Greenhouse Gas Emissions

In order to assess the potential for climate change, and the resultant effects of climate change, the standard approach is to measure and predict emissions of GHGs. Greenhouse gases are composed of molecules that absorb and re-radiate infrared electromagnetic radiation. When present in the atmosphere the gas contributes to the greenhouse effect. Some GHGs such as carbon dioxide occur naturally and are emitted to the atmosphere through natural processes and human activities. Other GHGs (e.g., fluorinated gases) are created and emitted solely through human activities. The primary GHGs that enter the atmosphere as a result of anthropogenic activities include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), and fluorinated gases such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Fluorinated gases are powerful GHGs that are emitted from a variety of industrial processes including production of refrigeration/cooling systems, foams and aerosols. Fluorinated gases are generally unrelated to the activities authorized by the BLM and will not be discussed further in this document.

GHGs are often presented using the unit of metric tons of CO_2 equivalent (mt CO_2e) or Million Metric Tons (MMT CO_2e), a metric to express the impact of each different greenhouse gas in terms of the amount of CO_2 making it possible to express greenhouse gases as a single number. For example, 1 ton of methane would be equal to 28 tons of CO_2 equivalent, because it has a GWP 28 times that of CO_2. As defined by EPA, the GWP provides "ratio of the time-integrated radiative forcing from the instantaneous release of one kilogram of a trace substance relative to that of one kilogram of CO_2." The GWP of greenhouse gas is used to compare global impacts of different gases and

used specifically to measure how much energy the emissions of one ton of gas will absorb over a given period of time (e.g. 100 years), relative to the emissions of one ton of CO_2. The GWP accounts for the intensity of each GHGs heat trapping effect and its longevity in the atmosphere. The GWP provides a method to quantify the cumulative effects of multiple GHGs released into the atmosphere by calculating carbon dioxide equivalent for the GHGs.

- Carbon dioxide, by definition, has a GWP of 1 regardless of the time period used because it is the gas being used as the reference. CO_2 remains in the climate system for a very long time; CO_2 emissions cause increases in the atmospheric concentrations of CO_2 that will last thousands of years (EPA, 2016).
- Methane is estimated to have a GWP of 28-36 times that of CO_2 over 100 years depending upon the source (28 is generally used for oil and Gas, and 36 is used for coal). CH_4 emitted today lasts about a decade on average, which is much less time than CO_2. But CH_4 also absorbs much more energy than CO_2. The net effect of the shorter lifetime and higher energy absorption is reflected in the GWP. The methane GWP also accounts for some indirect effects, such as the fact that methane is a precursor to ozone, and ozone is in itself a greenhouse gas (EPA, 2016).
- Nitrous Oxide has a GWP of 298 times that of CO_2 for a 100-year timescale. N_2O emitted today remains in the atmosphere for more than 100 years, on average (EPA, 2016).

Reasonably Foreseeable Development (RFD) Scenario

In order to analyze impacts of various alternatives in RMP EISs, the BLM develops Reasonably Foreseeable Development (RFD) projections that coincide with the lands in the planning area. Ultimately, the approved RMP is associated with a particular RFD for the lands that are open to oil and gas development, in consideration of the constraints placed on development under the RMP. Constraints include the various stipulations that can be attached to lease instruments. The EISs for the RMPs approved or amended in 2015 included updated RFDs. The RFD is the result of a technical analysis that projects the total number of wells that could be developed in a field office, based upon known geologic and economic conditions, current development technology, and industry-provided data about future planned development. The economic or technical viability of potential geologic plays were not revisited in the air analysis as they were accounted for in the development of the RFDs. The RFDs for the Wyoming planning areas are shown in the following table. The RFDs may include oil wells, gas wells, and Coalbed Natural Gas wells (CBNG) and are projections over the life of the plan, which is generally 20 years. This information indicates that on average, statewide, approximately 998 Federal wells could be developed annually.

Table 4: Reasonably Foreseeable Well Development BLM Wyoming

Planning Area	RFD Federal Mineral Estate (Number of Wells)	RFD All Mineral Ownership Lands (Number of Wells)	Total Federal Mineral Acreage Open to Leasing under RMP(s)
Lander FO	1695	4254	2,640,000
Buffalo FO	4767	11018	3,300,000
Bighorn Basin District (Cody and Worland)	1141	6054	2,500,000
GSG ARMPA	12355	14818	22,100,000

While the above projections may include specific projections of CBNG development, the CBNG plays in Wyoming are not currently active and most CBNG wells are being plugged across the state; therefore, the RFD and any associated projection of emissions attributed to CBNG may be an overestimate. The status of existing CBNG development in each of the field offices is described below.

RFO: Production from CBNG wells is occurring within the RFO; approximately 8.5 percent of the active wells in the RFO are CBNG wells. Thus, based on the existing development and the RFD for the RFO, CBNG-related emissions can be expected.

KFO: Although the RFD for the KFO RMP assumes a CBNG development rate of up to 15 wells per year, there currently is no active or proposed CBNG development in the KFO; therefore, there are no expected emissions from CBNG.

PFO: Several CBNG wells were installed in the PFO, but have proven unproductive; therefore, no emissions are expected from this source, although they are included in the estimation of GHG emissions as the geologic potential still remains.

WRBBD (Cody, Worland, and Lander Field Offices): CBNG production does not currently exist within the WRBBD; a total of 14 CBNG wells have been installed in the LFO; all but one were plugged without producing in economical quantities. Although the RFD scenarios for both the LFO and Bighorn Basin RMPs assumes a CBNG development rate of up to 15 wells per year, there is no active or proposed CBNG development in the field offices; therefore, there are no expected emissions although they are included in the estimation of GHG emissions as the geologic potential still remains.

BFO: While some CBNG production still occurs the BFO, the most current RFD projects no new Federal CBNG wells will be drilled/completed; active plugging operations of existing Federal and state wells are ongoing.

Development of oil and gas is ongoing and continues to be a major source of activity, and associated emissions, in Wyoming. Development density (wells per square mile) and number of wells installed annually depend on a number of variables including market trends, technology available (vertical, directional, or horizontal drilling), the geology of the hydrocarbon-bearing zone, and the application of Controlled Surface Use (CSU) and No Surface Occupancy (NSO) stipulations. As a result, the number of wells in these field offices that could potentially be put into production under a full-field development scenario for the leases is highly uncertain.

Current Leasing and Drilling Activity

At the end of fiscal year 2018, BLM Wyoming had 12,780 leases in effect, covering approximately 8.08 million acres. Of this total, 4,076,711 acres are in production, which is 50.4% of the total under lease. Over the last eleven years, based on BLM Public Land Statistics, approximately 47% of all leases, are in producing[4] status.

From 2008-2018, BLM Wyoming issued an average of 469 leases per year. The average annual acreage leased was 431,433. Since 2008, BLM Wyoming has leased 3,385,795 acres and issued 5,157 new leases.

[4] Production could be actual or allocated; allocated production means the lease is sharing in production from another lease, such as through a unit or communitization agreement. Actual production means that a well is producing directly from the Federal lease.

Figure 4: BLM Wyoming New Federal Leases Issued 2008-2018

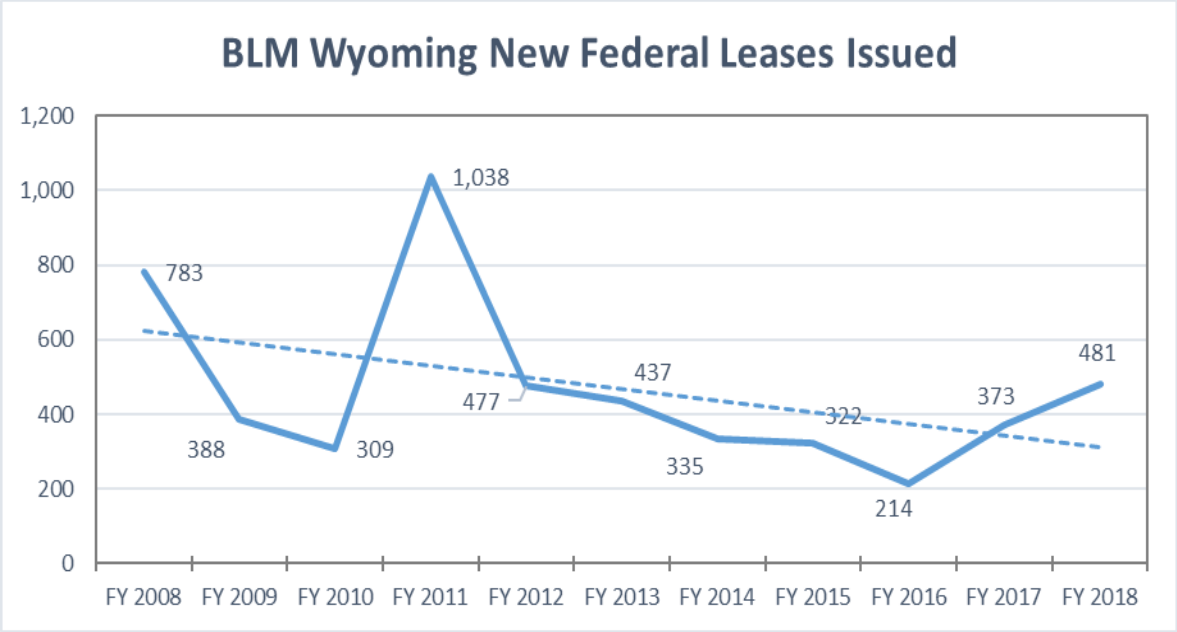
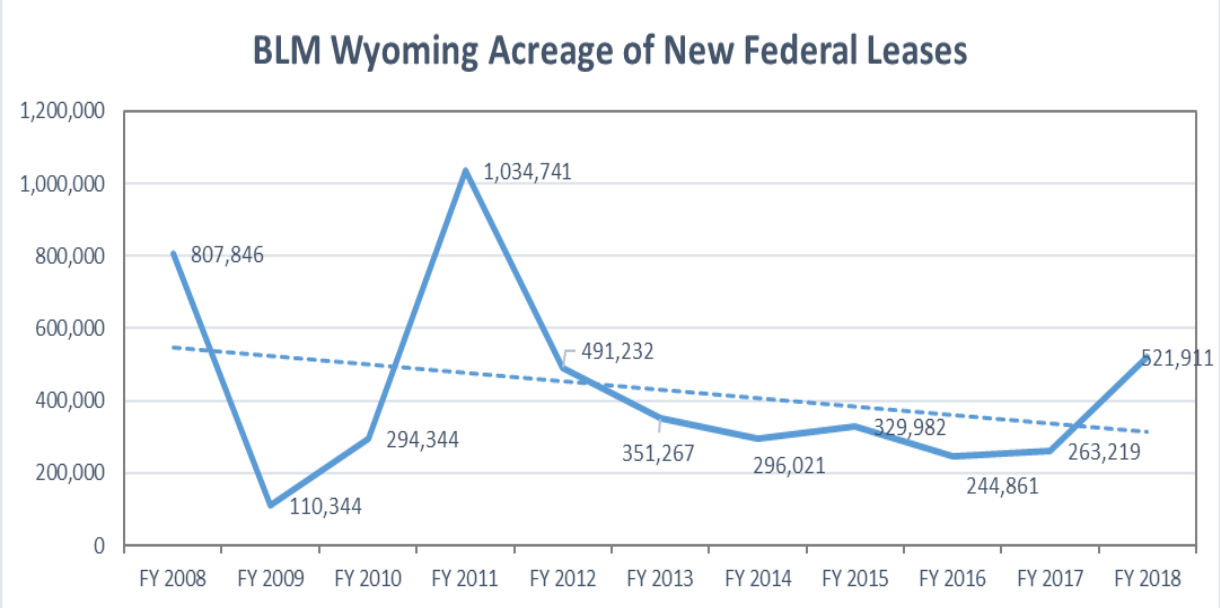


Figure 5: BLM Wyoming Total Acreage of New Federal Leases 2008-2019



Similarly, from 2008 through 2018, an average of 745 wells were completed annually statewide. The total number of wells per year, per field office, can vary as economic conditions fluctuate and as new fields and drilling technologies are explored. From 2008 to 2018, the highest annual rate of well completions, and in total, has been in the PFO. Only two of the leases addressed by this EA are in the PFO. The second highest rate of well completions has occurred within the Buffalo Field Office (BFO); no leases addressed in this EA are within the BFO. The largest proportion of the 283 leases addressed in this EA are in the NFO.

Table 5: BLM Wyoming Federal Well Activy (FY2009-FY2018)

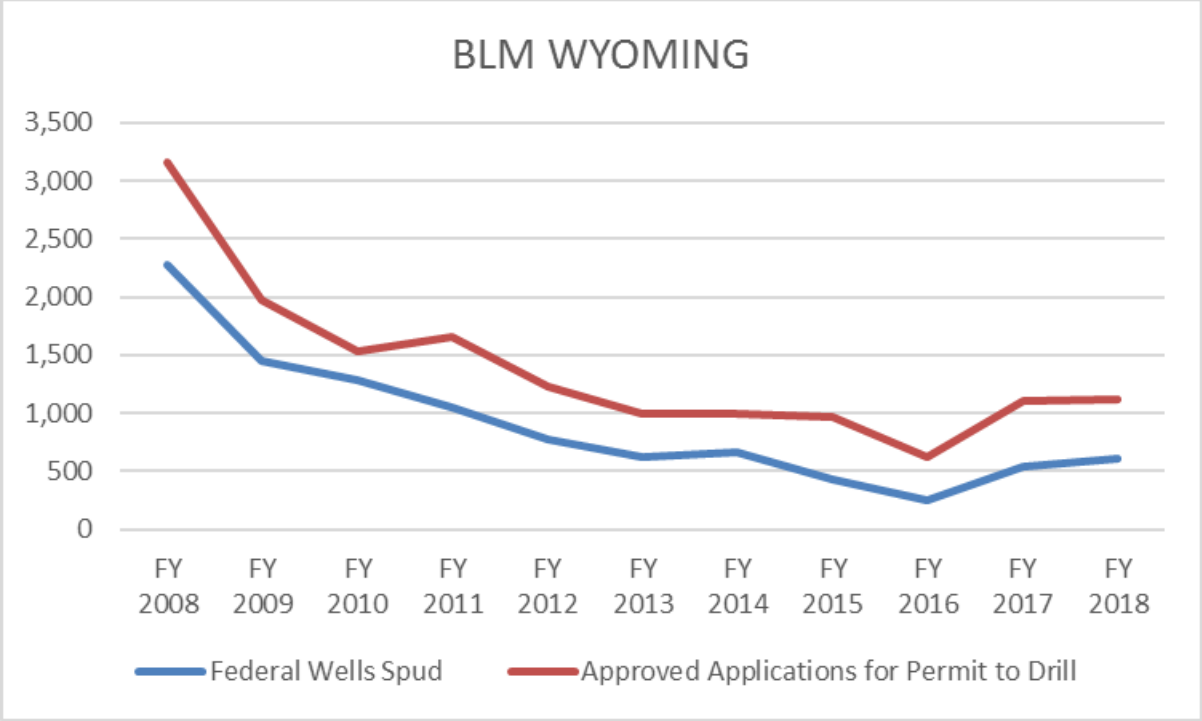
BLM Wyoming Well Activity: 10/1/08 - 9/30/18					
Planning Document	Field Office	No. Approved Applications for Permit to Drill	No. Wells Started	No. Wells Completed for Production	Average Well Completions/year
GSG ARMPA	RS	253	222	226	22.6
	KFO	78	54	54	5.4
	PFO	3372	3230	3128	312.8
	RFO	647	557	577	57.7
	CFO	1956	871	554	55.4
	NFO	266	246	215	21.5
Buffalo RMP	BFO	2168	2208	2450	245
Lander RMP	LFO	188	152	131	13.1
Bighorn Basin RMP	CYFO	9	74	75	7.5
	WFO	5	55	36	3.6
Average over 9 years		894.2	766.9	744.6	74.46

Based on the average wells per year projected under the planning area RFDs, well completion rates are well within the current RFD projection (998 wells per year) (See Table 4).

The number of usable completions in the BFO has decreased over time as the coalbed natural gas play has largely ceased production as discussed above, while new horizontal drilling rates have increased in the CFO, in the southern portion of the BFO, and in discrete areas of the RFO and PFO. The majority of new horizontal wells produce from multiple mineral estates (fee [private], state, Federal) due to the long reach of the wellbore and the large reservoir drainage area.

Similarly, as shown in the below table, new wells spud and the total number of Applications for Permit to Drill that were approved on Federal lands in Wyoming, has decreased over time and is approximately 27% of the activity levels in 2008, although there was slight increase between 2016 and 2017. The increase in permits likely corresponds to improved economic conditions during this timeframe. Across the state, approximately 50% of the Federal Applications for Permit to Drill that are approved are actually started.

Figure 6: BLM Wyoming Federal Applications For Permit to Drill Approvals and Federal Well Starts (Spuds)



Based on the above information on well development, the RFD is a valid estimate of future well development for Federal lands in Wyoming.

Statewide GHG Emission Levels

Outside of coal development, oil and gas development is the single largest contributor to total air pollutant emissions in Wyoming compared to other management activities. The Center for Climate Strategies (CCS) prepared the Wyoming Greenhouse Gas Inventory and Reference Case Projection 1990-2020 (Spring, 2007), for the Wyoming Department of Environmental Quality through an effort of the Western Regional Air Partnership. The CCS inventory report presents a draft GHG emissions inventory and forecast from 1990 to 2020 for all Federal and Non-Federal emission-generating activities in Wyoming. This report provides an initial comprehensive understanding of Wyoming's current and possible future CO_2e emissions. The information presented provides a starting point for estimating statewide emissions, as the initial estimates may be revised as improvements to data sources and assumptions are identified.

The CCS inventory report explains that all GHG-emission generating and consumptive activities in Wyoming accounted for approximately 56 MMT of gross CO_2e emissions in 2005, an amount equal to 0.8% of total U.S. gross GHG emissions. These emission estimates focus on activities in Wyoming and are consumption-based[5]; they exclude consumptive emissions associated with electricity that is consumed by users not in Wyoming. The report concludes that Wyoming's gross GHG emissions increased 25% from 1990 to 2005, while national emissions rose by only 16% from 1990 to 2004; annual sequestration (removal) of GHG emissions due to forestry and other land-uses in Wyoming is estimated at 36 MMT CO_2e in 2005. The increase in per capita emissions in Wyoming is mostly due to increased activity in the fossil fuel industry, while national per capita emissions have changed relatively little.

[5] "The emissions inventory generally includes estimates of electricity generation and in-state consumption, transportation related consumption, manufacturing consumption, and specific to the oil and gas industry include production, processing, transmission, and distribution of fossil fuels and through the consumption of energy by the residential, commercial and industrial sectors of Wyoming economy."

The analysis in the report indicates that Wyoming's per capita emission rate is more than four times greater than the national average of 25 MMT CO_2e/yr. This large difference between national and state per capita emissions occurs in most of the sectors, including: electricity, industrial, fossil fuel production, transportation, industrial process and agriculture. The reasons for the higher per capita intensity in Wyoming are varied, but include the state's strong fossil fuel production industry and other industries with high fossil fuel consumption intensity, large agriculture industry, large distances, and low population base. While the information in the CCS report is from 2005, no updates are available and the report remains the best available synthesis of potential and future GHG emissions in Wyoming.

The Wyoming CCS inventory report also explains that emissions from the fossil fuel sector grew 101% from 1990 to 2005, largely attributable to the tight sand gas play in Western Wyoming, and the CBNG boom that occurred in the Powder River Basin. The report projected that these emissions would increase by a further 10% between 2005 and 2020 (if economic incentives remain).[6] The natural gas industry is the major contributor to both GHG emissions and emissions growth, with CH_4 emissions from coal mining second in terms of overall contribution. A significant portion of the emissions attributed to the natural gas industry are due to vented gas from processing plants, many of which are used for injection in enhanced oil recovery operations.

The U.S. Energy Information Administration (EIA) is one of the primary agencies in charge of producing energy outlook forecasts for the U.S. Government. Within its forecasts, the EIA includes Wyoming within the Rocky Mountain Region, which also includes Colorado, Utah, Idaho, Nevada, Arizona and portions of New Mexico. Wyoming also borders Montana, which is part of the Northern Great Plains Region; the Northern Great Plains Region also includes North and South Dakota. In discussing regional oil and gas trends, Wyoming's contribution to the oil and gas industry, and associated GHG emissions, they should be evaluated in the context of these two assessment areas. As discussed in the EIA's Assumptions to the Annual Energy Outlook: 2019: Oil and Gas Supply Module, total technically recoverable oil volumes in these two regions is 51.3 Billion barrels (BBL); the Rocky Mountain region is expected to contribute 24.9 BBLS and the Northern Great Plains region is expected to contribute 26.4 BBLS. Similarly for dry natural gas, these two regions are thought to contain a total of approximately 357.4 trillion cubic feet (tcf) of technically recoverable natural gas; of this total, the Rocky Mountain Region is estimated to contain 314.8 tcf and 42.6 tcf in the Northern Great Plains Region.

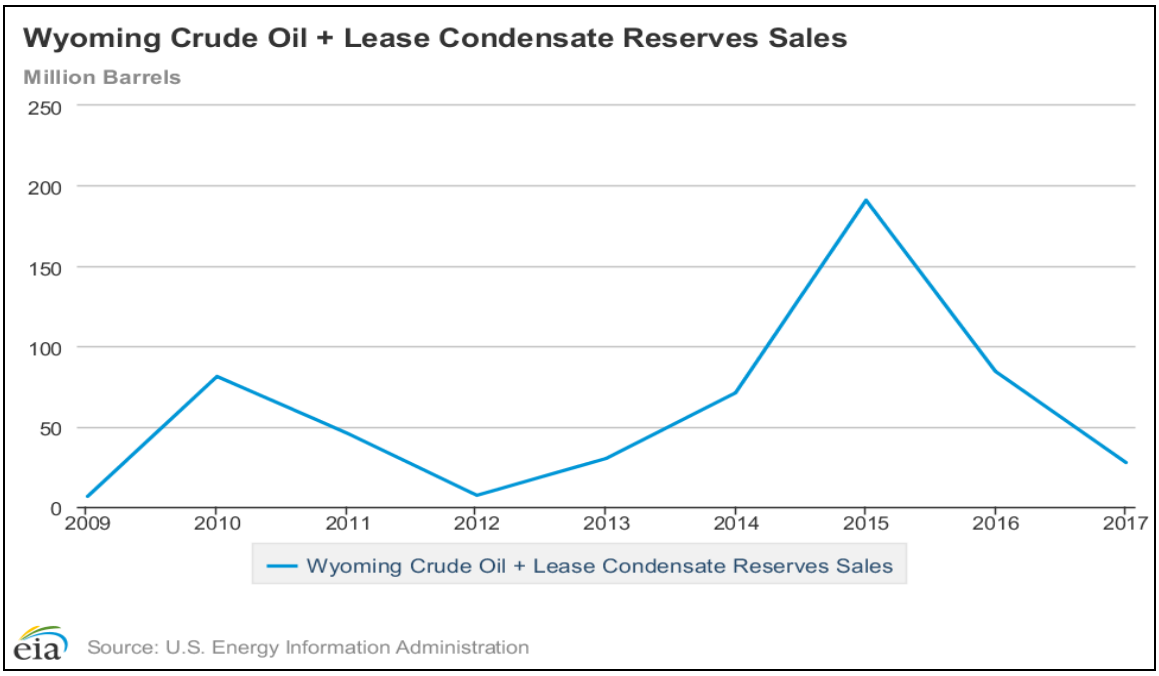
Specific to the State of Wyoming, the EIA estimates that current recoverable reserves, as of December 31, 2017, are 22,352 billion cubic feet of wet gas, and 1,119 million barrels of crude oil plus lease condensate.

The following figure shows total Wyoming Crude Oil plus Lease Condensate Reserves Sales from 2009 to present[7]:

[6] As discussed on page 18 above, the economic incentive for CBNG is no longer in play, and plugging of existing wells is ongoing.

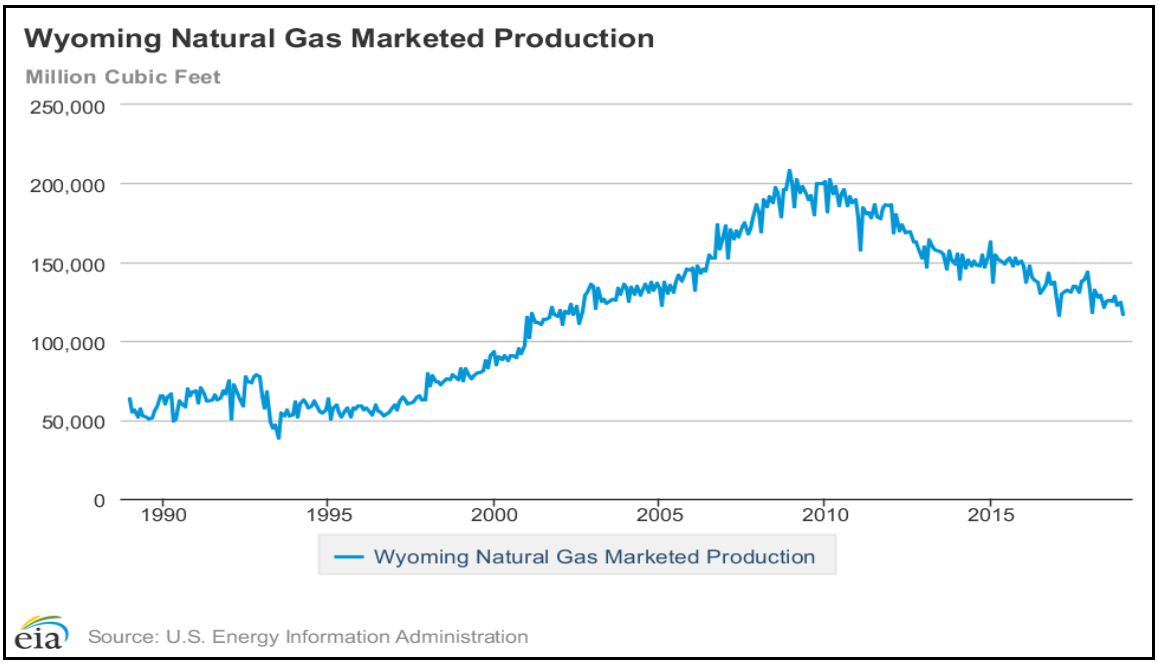
[7] https://www.eia.gov/dnav/ng/hist/res_epccond_r05_swy_mmbbla.htm (accessed 04052019)

Figure 7: Total Wyoming Crude Oil plus Lease Condensate Reserves Sales From 2009 to Present



Similarly, the following figure shows total marketed natural gas from 1990 to present[8]:

Figure 8: Total Wyoming Natural Gas Marketed Production 1990 to Present



[8] https://www.eia.gov/dnav/ng/hist/n9050wy2m.htm (accessed 04042019)

Statewide[9] and Nationwide Federal Lands

In 2018, the U.S. Geological Survey (USGS) produced a Scientific Investigations Report (SIR) at the request of BLM: Federal Lands Greenhouse Gas Emissions and Sequestration in the United States—Estimates for 2005–14.[10] The USGS SIR presents gross GHG emission estimates for all Federal mineral estates in the U.S., and each of the states which contain Federal minerals, including those within the Rocky Mountain and Northern Great Plains regions.

> The emissions estimates span a 10-year period (2005–2014) and are reported for 28 States and two offshore areas. Nationwide emissions from all fossil fuels produced on Federal lands in 2014 were 1,279.0 MMT (1,279,000,000 mt) of CO_2e for carbon dioxide (CO_2), 47.6 MMT CO_2e for methane (CH4), and 5.5 MMT CO_2e for nitrous oxide (N_2O). Compared to 2005, the 2014 totals represent decreases in emissions for all three greenhouse gases (decreases of 6.1 percent for CO_2, 10.5 percent for CH_4, and 20.3 percent for N_2O). Emissions from fossil fuels produced on Federal lands represent, on average, 23.7 percent of national emissions for CO_2, 7.3 percent for CH_4, and 1.5 percent for N_2O over the 10 years included in this estimate.

The report also found that of the total emission estimate Federal lands in Wyoming contributed approximately 727,700,000 mt (727.7 MMT) of CO_2e in 2014. Oil and Gas related direct emissions from stationary sources totaled 9,480,000 mt (9.48 MMT) and the extractive emissions were 9,089,000 mt (9.089 MMT) CO_2e. Coal mining in Wyoming, by comparison, contributed approximately 3,800,000 mt (3.8 MMT) CO_2e in 2014.[11] From 2005 through 2014, 2008 had the highest CO_2e emissions in Wyoming from Federal fossil fuel development, when the total was 889,500,000 mt (889.5 MMT).

More specifically the SIR reports the following:

> In general, as of 2014, Wyoming, offshore Gulf, New Mexico, Louisiana, and Colorado had the highest CO_2 emissions from fuels produced on Federal lands (fig. 2). The CO_2 emissions attributed to Federal lands in Wyoming are 57 percent of the total from Federal lands in all States and offshore areas combined. Emissions estimates for the release of CH_4 are also highest for Federal lands in Wyoming (28 percent), followed by New Mexico, offshore Gulf, Colorado, and Utah (fig. 3).
>
> Unsurprisingly, the trends and relative magnitudes of the emissions estimated are roughly parallel to the Federal lands production volumes (U.S. Energy Information Administration, 2015a). States that produced the most fuel from Federal lands are associated with the highest emissions for CO_2, CH_4, and N_2O. These relationships vary slightly relative to absolute production because different fuels require different extraction methods and fuel uses emit varying amounts of greenhouse gases.

While the USGS SIR reports that total emissions from all fossil fuel development on Federal lands in Wyoming totaled approximately 728,000,000 mt/yr, it also notes that approximately 26,200,000 mt is sequestered by natural resources, such that the net total CO_2 emissions from fossil fuel production in Wyoming is 701,500,00 mt.

Using 2014 production information from the Wyoming Oil and Gas Commission[12] (WOGCC), BLM calculated that total estimated CO_2e emissions from all (Federal, state, fee[private]) oil and gas production in the state was approximately 140,100,00 mt (140.1 MMT CO_2) where total oil production was 75,706,328 BBLs and natural gas production was 1,966,535,934 million cubic feet (Mcf).[13] This is approximately 11% of the total 1,279 MMT described in the USGS SIR. In 2018, also based on WOGCC production information for all lands, total CO_2e was

[9] As it relates to information presented in the USGS SIR, and the WOGCC calculations, the emissions are based on raw production information (rather than being produced from a well-emission factor through an air quality analysis which would have included specific BTU and therm information), they are generally presented in total CO_2 even though the EPA Equivalency Calculator will report them as CO_2e. All Proposed Action calculated indirect emission estimates presented in this EA were calculated using the EPA equaivalency calculator and are presented as CO2e. Regional emission comparisons in Section 4.0 are also presented in CO_2e, even though they are reported as CO2 in the USGS SIR, for consistencies sake.

[10] https://pubs.er.usgs.gov/publication/sir20185131 (accessed 3/22/2019)

[11] https://eerscmap.usgs.gov/fedghg/

[12] http://pipeline.wyo.gov/StatsForState.cfm?oops=ID96179

[13] Volumes converted to CO_2 using EPA greenhouse gas calculator.

134,600,000 mt (total oil production 83,538,577 BBLs, total natural gas production 1,803,004,880 Mcf) (calculated using EPA's Greenhouse Gas Equivalency Calculator).

National GHG Emissions

EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016[14] discusses total U.S. CO2 emissions (page ES-10):

> [a]pproximately 32,294 MMT of CO_2 were added to the atmosphere through the combustion of fossil fuels in 2015, of which the United States accounted for approximately 15 percent. Within the United States, fossil fuel combustion accounted for 93.5 percent of CO_2 emissions in 2016 (EPA, 2018). Between 1990 and 2016, CO_2 emissions from fossil fuel combustion increased from 4,740.3 MMT CO_2e. to 4,966.0 MMT CO_2 Eq., a 4.8 percent total increase over the twenty-seven-year period. Conversely, CO_2 emissions from fossil fuel combustion decreased by 780.9 MMT CO_{2e}. from 2005 levels, a decrease of approximately 13.6 percent between 2005 and 2016. From 2015 to 2016, these emissions decreased by 83.2 MMT CO_{2e} (1.6 percent). In 2016, total gross U.S. greenhouse gas emissions were 6,511.3 MMT of CO2e.
>
> Total U.S. emissions have increased by 2.4 percent from 1990 to 2016, and emissions decreased from 2015 to 2016 by 1.9 percent (126.8 MMT CO_2e). The decrease in total greenhouse gas emissions between 2015 and 2016 was driven in large part by a decrease in CO_2 emissions from fossil fuel combustion. The decrease in CO_2 emissions from fossil fuel combustion was a result of multiple factors, including: (1) substitution from coal to natural gas and other non-fossil energy sources in the electric power sector; and (2) warmer winter conditions in 2016 resulting in a decreased demand for heating fuel in the residential and commercial sectors.
>
> Relative to 1990, the baseline for the EPA Inventory, gross emissions in 2016 are higher by 2.4 percent, down from a high of 15.7 percent above 1990 levels in 2007. Overall, net emissions in 2016 were 11.1 percent below 2005 levels.

The information presented by the EPA Inventory coincides well with information contained in a report prepared by the International Energy Agency, Global Energy and CO2 Status (March, 2019),[15] which found:

> [I]n 2015, natural gas emissions surpassed coal emissions, and the Annual Energy Outlook 2019 (AEO2019) Reference case projects that natural gas CO_2 emissions will continue increasing as natural gas use increases. The U.S. electric power sector—now the largest consuming sector for natural gas—has added generating capacity from natural gas in recent years and has used those power plants more often. Natural gas surpassed coal to become the most prevalent fuel used to generate electricity in the United States in 2016.
>
> Other sectors have also increased their consumption of natural gas. By the mid-2020s, EIA projects that the industrial sector will again become the largest consumer of natural gas, using natural gas as a feedstock in chemical industries, as lease and plant fuel, for industrial heat and power applications, and for liquefied natural gas production. The residential and commercial sectors are also expected to continue using more natural gas. For instance, EIA projects that natural gas furnaces and boilers will be used in 55% of U.S. homes in 2050, an increase from their 49% share in 2018.
>
> Coal CO_2 emissions in the United States are almost all from the electric power sector. Only about 10% of coal CO_2 emissions came from the industrial sector in 2018, and this percentage is expected to remain the same through 2050. Although the AEO2019 Reference case projects that nearly one-third of the existing coal-fired electricity generating capacity retires within the next decade, the surviving fleet is used more

[14] https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2016 (accessed 7/24/2018); EPA has published a new version of this report, and was accepting comments through February 2019. It currently remains in Draft; as such, it is not cited in this EA.
[15] https://www.eia.gov/todayinenergy/detail.php?id=38773 (accessed 04012019)

often, meaning coal's projected decline in electricity generation is less than the capacity retirements would suggest.

4. Impacts Analysis

The sale of parcels and issuance of oil and gas leases is an administrative action, without direct impacts to surface resources such as habitat, and watershed resources. Potential lease parcels are reviewed under the approved RMP, and stipulations are attached to mitigate any known environmental or resource conflicts that may occur on a proposed lease parcel. On-the-ground impacts do not occur until a lessee or its designated operator applies for and receives approval to undertake surface-disturbing and lease development actions.

If BLM receives a proposal for site-specific lease operations, it conducts additional environmental documentation and technical analysis to support its decision on the proposal. Aside from the protection measures required under the lease stipulations or measures that may be voluntarily committed to by a project proponent, additional measures may be required as conditions of approval (COAs) attached to BLM's authorization of lease occupancy and disturbance (see 43 CFR 3101.1-2, Surface Use Rights and Reasonable Measures) based on technical and site-specific NEPA review.[16]

As described in Section 1.4, above, this EA tiers to the applicable RMP EISs, in accordance with 40 CFR § 1502.20:

> Agencies are encouraged to tier their environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review... the subsequent ...environmental assessment need only summarize the issues discussed in the broader statement and incorporate discussions from the broader statement by reference and shall concentrate on the issues specific to the subsequent action.

For additional descriptions of the potential direct, indirect, and the cumulative impacts for the alternatives considered below as they relate to resources not addressed in this EA, please refer to the RMP FEISs referenced in Section 1.4, as well as the original lease sale EAs.[17]

4.1 Proposed Action Alternative

Quantitative assessment of impacts is necessarily limited by uncertainties regarding the number, nature, and specific location of resources and proposed future activities. In general, however, oil and gas leasing may lead to the installation and production of new wells, which may consequently result in direct GHG emissions associated with installing and producing new wells, and indirect emissions associated with any downstream use of any lease product. The primary sources of GHG emissions from these processes include the following:

- Fossil fuel combustion for construction and operation of oil and gas facilities – e.g., vehicles driving to and from production sites, engines that drive drill rigs. These produce CO_2 in quantities that vary depending on the age, types, and conditions of the equipment as well as the targeted formation, locations of wells with respect to processing facilities and pipelines, and other site-specific factors;
- Fugitive CH_4 – CH_4 that escapes from wells (both gas and oil), oil storage, and various types of processing equipment. This is a major source of global CH4 emissions. These emissions have been estimated for various aspects of the energy sector, and starting in 2011, producers are required under 40 CFR 98, to estimate and report their CH_4 emissions to the EPA; and
- Combustion of produced oil and gas – BLM expects future operations to produce marketable quantities of oil and gas. Combustion of the oil and gas would release CO_2 into the atmosphere. Fossil fuel combustion is the largest source of global CO_2.

4.1.1 Direct Emissions

[16] Typically, COAs are attached to approved Applications for Permit to Drill
[17] https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/leasing/regional-lease-sales/wyoming

A number of existing authorized activities within the BLM Wyoming FOs generate GHG emissions. Oil and gas development activities can generate GHGs during the drilling, completion and production operations. Carbon dioxide emissions result from the use of combustion engines for off highway vehicles and other recreational activities. Wildland fires also are a source of CO_2 and other GHG emissions, and livestock grazing is a potential source of methane. Other activities with the potential to contribute to climate change include soil erosion from disturbed areas and fugitive dust from roads, which have the potential to darken snow-covered surfaces and cause faster snowmelt.

In order to determine the volume of emissions that authorized activities on public lands could emit, BLM Wyoming's air quality impact analysis in the RMP EISs began with the preparation of emissions inventories for all existing sources in the planning area in accordance with existing guidance. These emissions inventories were compared to existing air quality data, Federal emission factors and other available information in order to determine the base year emissions, from all sources, at the time of analysis. For the oil and gas program, these emission inventories resulted in specific well emission factors. The emissions inventories, and the resultant emission factors, were then used to prepare an emissions estimate for the projected RFD (which included drilling, completing and placing the wells in production). BLM then calculated total oil-and gas-related annual emissions for the field office, for each year of the RMPs expected life, based on those expected emissions, and the expected well development RFD scenario (rate, density and type of wells, and where the greatest potential is in each field office). Peak emissions based on the maximum year of construction and the maximum year of production were then used to compare the alternatives under consideration in the EIS. Emissions were calculated using conservative assumptions about the likelihood of potential activities occurring under each alternative.

In the emission inventories, BLM quantified the direct emissions of the greenhouse gases CO_2, CH_4, and N_2O from new and existing sources in terms of CO_2e. Estimates of emissions from oil and gas activities in the subject RMP EISs', including CO_2e, assumed that all of the potential development identified in the RFD would occur.[18] The RMP EISs' used a 100-year GWP timeline to ensure that consistent comparisons could be made across Federal agency estimates and data.

Specific to oil and gas development, the RMP EISs quantified emissions from the following specific emissions-generating activities, by well type. All of these activities are included in BLM's estimates of direct CO_2e emissions and are generally referred to as "operational" emissions in the RMP EIS'.

<u>Leasable Fluid Minerals – Conventional Natural Gas Development</u>
Well pad and compressor station pad construction
Road construction and maintenance
Well drilling, completion, and testing
Well completion flares
Well workovers
Construction vehicle exhaust and fugitive dust
Maintenance vehicle exhaust and fugitive dust
Commuting vehicle exhaust and fugitive dust
Natural gas fired compressors
Dehydrator, separator, and water tank heaters
Dehydrator vents
Tank venting, flashing, and load-out
Wellhead equipment leaks
Pneumatic pumps and devices
Well pad and road reclamation
Wind erosion

<u>Leasable Fluid Minerals – Coalbed Natural Gas Development</u>

[18] This was a necessary assumption of the RMP EIS analysis n order to compare the maximum expected emission levels between alternatives, and the allowable levels of oil and gas development that would be allowed.

Well pad, compressor station pad, and water disposal well pad construction
Road construction and maintenance
Well drilling, completion, and testing
Well workovers
Construction vehicle exhaust and fugitive dust
Maintenance vehicle exhaust and fugitive dust
Commuting vehicle exhaust and fugitive dust
Natural gas fired compressors
Dehydrator and tank heaters
Dehydrator vents
Wellhead equipment leaks
Pneumatic pumps and devices
Well pad and road reclamation
Wind erosion
Produced water evaporation ponds

Leasable Fluid Minerals – Oil Development
Well pad and compressor station pad construction
Road construction and maintenance
Well drilling, completion, and testing
Well completion flares
Well workovers
Construction vehicle exhaust and fugitive dust
Maintenance vehicle exhaust and fugitive dust
Commuting vehicle exhaust and fugitive dust
Natural gas fired compressors
Dehydrator, separator, and water tank heaters
Dehydrator vents
Tank venting, flashing, and load-out
Wellhead equipment leaks
Pneumatic pumps and devices
Well pad and road reclamation
Wind erosion

In general, the estimated direct emissions in the RMP EISs were determined using the following assumptions:

- Activities would proceed in accordance with the projections in the RFDs, which are based upon known geologic conditions, current development technology, and industry-provided data about future planned development.[19]
- Appropriate Required Design Features and Best Management Practices will be applied as appropriate and consistent with regulatory authority.
- Operations would comply with Federal and state rules and regulations promulgated under the Clean Air Act.
- BLM may require project proponents to conduct pre-construction and/or project air monitoring to assist in environmental analysis.
- BLM will work cooperatively with Wyoming Department of Environmental Quality (WDEQ) to determine the best mechanism to submit, track, and approve project specific pre-construction monitoring or other monitoring data required by project approval decisions.
- BLM will work cooperatively with WDEQ to share data collected from the existing BLM-operated Wyoming Air Resource Monitoring System (WARMS) network and to support Wyoming DEQ's air monitoring network through siting, operation, and funding of additional monitoring sites.

[19] *Id* at 14

- BLM will continue to fund and operate existing National Atmospheric Deposition Program (NADP) monitoring site in accordance with existing agreements.

While the above assumptions do not generally affect the total emissions that may result from the Proposed Action, they demonstrate that adequate regulatory mechanisms are in place to allow BLM to monitor development, and minimize future site-specific or cumulative impacts in Wyoming. The RFDs include assumptions about the pace and timing of mineral development activities, which depend on a variety of factors outside the control of the BLM, including national and international energy demand and prices, production factors within the planning area, and individual strategic choices made by operators. Additional discussion of uncertainty in the projected emission estimates is provided in Section 4.1.3.1.

The administrative acts of offering parcels and issuing leases (or in this case, affirming the issuance of leases) have no direct impacts to air quality. Any potential effects to air quality would occur only if the leases are developed. The annual planning area direct CO_2e emission levels presented below represent baseline emission levels from existing development plus new emissions from the projected RFDs, which include both non-Federal and Federal well projections. See Section 3.4 for the planning area total RFDs.

Table 6: BLM Wyoming Total Annual Federal Direct Oil and Gas CO_2e

Planning Area	Total Federal Mineral Acreage Available to Leasing	Total Annual Federal Direct Oil & Gas CO_2e (mt/year)
LFO	2,640,000	1,502,877.0
BFO	3,300,000	614,307.4[20]
BHB	2,500,000	910,000.0
GSG ARMPA	22,100,000	3,291,209.0
TOTAL	30,540,000.0	6,318,393.4

In this EA, due to the statewide distribution of the leases analyzed under the Proposed Action, and the varying types, levels and potential for development across all lands in Wyoming, BLM Wyoming has calculated estimates of GHG emissions associated with the Proposed Action based on existing planning area RFD well total estimates and the projected RMP direct emissions estimates (CO_2e) and expected annual production. BLM has prorated the expected emissions from the RFDs by the acreage of the Proposed Action leases. BLM Wyoming considered estimating emissions based on estimates of numbers of new wells that could potentially be installed on the Proposed Action lease parcels, but concluded that this approach would duplicate the analysis that was used to develop the RFDs. Moreover, in consideration of the variability in well types, depths, specific drilling technology, and the rate of well development in Wyoming (See Table 5), development of specific well-emission estimates for lease parcels is problematic because it would require untenable assumptions (e.g. different well types can't be "averaged" together). By contrast, the total emissions estimate for a planning area, which accounts for differences in emissions among well types expected across the planning area, can readily be averaged across the are and pro-rated to lease parcels. This step-down, planning-area-based analysis provides greater consistency and continuity with previous analyses and utilizes existing data, including the RFD reports prepared for the RMP EISs by BLM Wyoming's Reservoir Management Group (RMG), as previously described. These RFDs represent the best available data about the potential future oil and gas activity on BLM administered mineral estates in Wyoming.

Specifically, BLM Wyoming is utilizing the total annual CO_2e estimates for each planning area (based on existing development and RFDs), divided by total Federal mineral estate open to leasing in the planning area. This calculation yields a conservative per-acre CO_2e emission factor that can be used to calculate an estimate of total lease sale acreage direct CO_2e (metric tons/year). This approach prorates total annual direct emissions across the

[20] See Cumulative Impacts, Section 5.1, for calculations of BFO's direct O&G CO_2e emissions for a comparison of the 100-yr GWP to 20-year GWP values.

proposed lease acreage by the total Federal mineral estate open to oil and gas leasing under the planning area RMP ROD. This approach therefore accounts for any type of well that may be drilled, as well as the increasing horizontal drilling activity that is occurring in the state, since these types of wells typically drill into and produce from multiple mineral estates.

The following table provides the per-acre direct CO_2e emission factor applied to the Proposed Action lease acreage and the resultant total projected annual direct CO_2e from the Proposed Action if developed consistent with the RMP RFD.

Table 7: BLM Wyoming Planning Area Per-acre Direct CO2e and Projections for the Proposed Action

Planning Area	Total FO Mineral Acreage Open to Leasing	Direct Oil & Gas CO_2e from full Federal and Non-Federal existing Oil & Gas plus all-lands RFD (mt/year)	CO_2e/ acre	Number of leases	Total acreage of the leases	Projected annual direct CO_2e for 283 leases (mt/year)
LFO	2,640,000	1,502,877.0	0.57	28	34,256.5	19,501.3
BFO	3,300,000	614,307.4	0.19	0	0.0	0.0
BHB	2,500,000	910,000.0	0.36	42	63,945.1	23,276.0
GSG ARMPA	22,100,000	3,291,209.0	0.15	213	205,794.1	30,647.6
Totals	30,540,000.0	6,318,393.4		283	303,995.7	73,424.8

- The projected direct emissions from development of the Proposed Action (73,424.8 mt/year) represent approximately 1.16% of the total BLM Wyoming planning documents projected annual direct CO_2e (6,318,393.4 mt/year). According to EPA's GHG Equivalency Calculator, the emissions would equal 8,792 homes' energy use for one year, or 0.019 coal-fired power plants in one year, or 9,362,566,469 smartphones charged.
- As compared to the 2014 USGS estimate of 9,480,000 mt (9.48 MMT) of CO2e in 2014, the Proposed Action represents 0.77%.

The currently available information about GHGs and climate change does not permit an assessment of the relationship between specific project-scale GHG emissions and specific effects on climate change because climate change operates on a global scale. Assessing the impacts of GHG emissions on global climate change likewise requires modeling on a global scale, which would not be sensitive to the comparatively small contribution of emissions from the proposed action. Potential effects on climate change are influenced by GHG emission sources from around the globe, and current methodologies cannot distinguish global climate change impacts associated with GHG emissions originating from a discrete, and relatively small, area such as the project area. Global climate considerations are discussed in Section 5. Additional information regarding potential impacts of climate change are discussed in Section 4.2 of this EA, Section 4.9 of the Lander RMP FEIS, Section 3.9 of the Bighorn Basin RMP FEIS, Section 3.2.7 and page 4-57 of the GSG ARMPA FEIS.

4.1.2 Indirect Emissions

The BLM RMG and BLM field and district office staff provided information on production of oil and gas to support analysis in the RMP EISs. For each planning unit (or field office within a planning unit), BLM developed total annual oil and gas production estimates for each EIS alternative. The information used to develop these estimates included the number of wells drilled annually in each field office or planning unit by alternative (from the RFD), the percent of oil wells versus gas wells, the percent of wells completed, production decline curves for oil and gas wells, and estimates of cross-production from both oil and gas wells.

As discussed in Appendix N, Social and Economic Impact Analysis Methodology, from the ARMPA FEIS, the procedure to determine total Federal production was as follows: For each year, the estimated number of wells completed was broken down into oil or gas wells based on the breakdown assumptions for the field office and planning unit provided by BLM staff. For each well type, the average first year production rate (volume) from the annual decline curves for each field office and planning unit (as provided by RMG) was applied to determine the total production from first-year wells. For subsequent years, the appropriate average production rates from the decline curves were applied to the number of second year wells, third year wells, and so on. Total production was summed across all the well age cohorts for each year within the analysis period. Cross-production volume was calculated based on the numbers of wells of each type and the cross-production rates from the RMG, and added to the total production volume.

The number below reflects the estimated total production for each of the planning area's RMP RODs based on the selected alternatives RFD. The EPA GHG Equivalences Calculator was then used to calculate the total CO_2e, assuming 100% combustion of the produced oil and gas. For comparison purposes, one coal-fired power plant, in a single year, emits on average 70,700,000 mt CO_2e.

Table 8: BLM Wyoming Total Annual Indirect CO_2e

BLM Wyoming Federal Year Projected Indirect Annual CO_2e (mt) for the year 2020						
Planning Unit	Gas (MCF)	Oil (BBLS)		Gas (mt CO_2e)	Oil (mt CO_2e)	Total Annual Indirect CO_2e
ARMPA	993,733,861	12,012,924		54,742,811.0	5,165,557.3	59,908,368.3
Bighorn Basin	8,500,000	4,000,000		468,248.0	1,720,000.0	2,188,248.0
Lander	238,200,000	2,400,000		13,121,962.0	1,032,000.0	14,153,962.0
Buffalo	47,000,000	3,800,00		2,589,136.0	1,634,000.0	4,223,136.0

Emission Factor Source: EPA GHG Equivalencies Calculator
https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator
CO_2 emissions generated from oil consumption: 0.43 metric tons CO2/barrel oil
* MCF=one thousand cubic feet
* BBLS=barrels

Similar to the calculations made for direct CO_2e, the following table shows the per-acre indirect CO_2e emission rate for the various planning areas, and the leases considered here. BLM used this methodology to calculate indirect emissions to account for the same variability in resource distribution and production methods described in the discussion of the direct emissions calculation methods.

Table 9: BLM Wyoming Planning Area per-acre Annual Indirect CO2e and Projections for the Proposed Action

Planning Area	Total BLM Wyoming Mineral Acreage Open to Lease	Total BLM Wyoming Indirect Federal O&G CO_2e (mt/yr)*	Average Annual Indirect CO_2e /acre	Number of Proposed Action Leases	Total acreage in the Proposed Action	Total Projected Federal Indirect CO_2e (mt/yr) for the Proposed Action
Lander	2,640,000	14,153,962.0	5.36	28	34,256.5	183,661.1
Buffalo	3,300,000	4,223,136.0	1.28	0	0.0	0.0
Bighorn Basin	2,500,000	2,188,248.0	0.88	42	63,945.1	55,971.1
GSG ARMPA	22,100,000	59,908,368.3	2.71	213	205,794.1	557,863.7.7

*Year 2020	Total: 283	303,995.7	797,495.9

Accordingly, the per-acre indirect CO_2e emission rate for the Proposed Action ranges from 0.88 mt/acre for lands in the Bighorn Basin to over 5.36 mt/acre in the LFO. BLM would expect the annual emission rate to average approximately 797,495.9 mt/year if all wells under the current RFDs were drilled and put on production, and if all subsequent production was combusted at some point in the future.

- The Proposed Action acreage represents approximately 0.99% of the annual total expected indirect CO_2e emissions from Federal production (80,473,714.3 mt/year) in Wyoming, based on BLM planning estimates.

- According to WOGCC production data for 2018, and the calculated total statewide emissions are 134,600,000 mt of CO_2e; the annual indirect emissions from the Proposed Action, represent approximately 0.59%.

- Based on the USGS 2014 estimate of 9,089,000 mt (9.089 MMT) of CO2e indirect emissions, the Proposed Action represents approximately 8.77%.

According to EPA,[21] Wyoming's total combustion-related GHG emissions from the petroleum and natural gas system sector in 2017, was 4.1 MMT (4,100,000 mt) of CO_2e. Since this number represents only those sources that are required to report under EPA regulations promulgated at 40 CFR Part 98, Mandatory Greenhouse Gas Reporting, this estimate only represents a subset of the fluid mineral fossil fuel industry and may not provide an accurate gauge of the contribution to annual indirect CO_2e from the Proposed Action, but would represented approximately 1.79% .

Based on the USGS 2014 total gross CO_2e emissions for BLM Wyoming Federal fossil fuel operations (727.7 MMT CO_2e), the total gross (direct plus indirect) emissions from the Proposed Action represent approximately 0.12% of the total (870,920.7 mt / 727,700,00 mt). Similarly, the total gross emissions from the Proposed Action represent approximately 4.69% of the 2014 USGS estimate for oil and gas related emissions (18,569,000 mt).

4.1.3 Uncertainty

4.1.3.1 Direct and Indirect Emission Estimate Uncertainties

The direct and indirect emission estimates above provide an estimate of the full potential for GHGs released into the atmosphere from initial wellsite construction, well drilling and completion, production, and end use. A rough estimate was possible using full field constrained potential well development estimates prepared for the GSG ARMPA, Bighorn Basin and Lander RMP EISs.

Although this EA presents quantified estimates of potential direct and indirect GHG emissions associated with the potential for oil and gas development on the leases, GHG emission estimates involve significant uncertainty due to unknown factors including actual production, how produced substances are used, the form of regulation of GHG parameters by delegated agencies, and whether any Best Available Control Technologies are utilized at the upstream or downstream activity location(s). To illustrate the uncertainty regarding specific well estimates, economically viable vertical gas wells on 40 acre downhole spacing within the PFO can be drilled into a conventional reservoir at approximately 7,000 feet deep, but just 30 miles away, a tight sand reservoir is produced by directional wells, on 10-acre downhole spacing with wells that can be in excess of 14,000 feet deep. Similarly, a coalbed methane well in the RFO can be as deep as 4,000 feet; but just 1,000 feet deep in the BFO. Deeper wells in this example require engines with a greater horsepower, and take longer to drill but may produce for shorter or longer periods of time. The BTU content of the product can also vary substantially which will ultimately influence any estimates of GHGs produced

[21] https://ghgdata.epa.gov/ghgp/main.do (accessed 3/22/19)

or combusted, as can the total volume of liquids produced with the gas stream which also requires handling. As another example, horizontal wells in the RFO may be in the range of 6,000 feet deep, but a similar horizontal oil well in the CFO may be 12,000 feet deep due to changing geologic conditions.[22] Within the RSFO, approximately 15% of the existing wells are less than 5,000 feet deep, 43% are between 5,000 – 10,000 feet deep, 40% are between 10,000 – 15,000 feet deep, and 1% are greater than 15,000 feet deep. These wells depths are associated with both gas and oil wells; approximately 34% were drilled directionally, 3% were drilled horizontally, and 39% were drilled vertically.

The vast majority of the horizontal play in Wyoming is still exploratory; as operators increase their reservoir and drilling knowledge gained, the time to drill, complete and put horizontal wells in production may decrease over time. Ultimately, while estimates in this EA are based on the best available data, including information from existing operators regarding future drilling plans and targets, these estimates are subject to many conditions that are largely beyond the BLM's control. Unforeseen changes in factors such as geologic conditions, drilling technology, economics, demand, and federal, state, and local laws and policies could result in different outcomes than those projected in the RFD and RMP EIS', and in this EA. The ultimate result in changing laws or policies cannot be predicted with any accuracy; resultantly, the RFD could not be realized if these policies restricted future oil and gas development..

To this extent, the RFD scenario reports prepared for the relevant RMPs disclose variable rates of success over time for wells drilled in these planning areas. Based on both historical and current information, the rate of production success for wells ranges from a low of 13% to nearly 90%, depending upon the location within the individual field offices, the geologic formations targeted, price indexes, and technological advances. As discussed in the RFD reports, success rates are expected to decline due to future exploration of unconventional resources: "From the early 1990's to present, activity has focused almost entirely on very low risk development drilling in and around known field areas, which helped to improve the overall success rate. More future exploratory drilling will be required to discover new resources in the Planning Area and to determine whether its potential coalbed natural gas resource is economic to produce. Since the risk of failure is higher for these types of activities, the success rates could decline slightly in the future." See RFO RFD (2004), pages 4 - 5, KFO RFD (2006), pages 4-7 to 4-19, and PFO RFD (2006), Table 5]. [See Bighorn Basin (2014), pages 24 - 27, and LFO RFD (2006), pages 12-15]. See BFO RFD (2012) pages 16-17, and CFO RFD (2005) pages 7-9. RFD well numbers for the RFO, KFO, PFO, CFO and NFO were updated under the GSG ARMPA (2015).[23]

4.1.3.2 Oil and Gas Production and End Use Uncertainty

The rough estimates of indirect CO_2e emissions presented above are qualified by uncertainty in potential future production, and in predicting the end uses for the fuels extracted from a particular leasehold. Future production is uncertain with regard to the actual levels of development over time, levels of development over the life of the lease, new technology, geologic conditions, and the ultimate level of production from any given well (whether reservoir related, or for economic reasons). As noted in the foregoing explanations, BLM is using a per-acre average emission estimate; this approach may overestimate or underestimate emissions in areas where resource conditions depart from "average" but it allows the BLM to assume for analysis purposes that all lands have equal potential for production. While this may not hold true based on site-specific geology, it is a reasonable forecast that assumes all lands may be produced at some point in the future and accounts for the large spacing units associated with Wyoming's exploratory horizontal wells. After extraction from federal leases, end uses of oil and gas may include refining for transportation fuels, fuel oils for heating and electricity generation, or production of asphalt and road oil. Oil and gas may also be used in the chemical industry, for the manufacture of medicines and everyday household items, plastics, military defense and for the manufacture of synthetic materials. The BLM does not control the

[22] Both horizontal well fields are targeting the Niobrara formataion, but are found at different depths due to geologic processes.

[23] With a few exceptions, all of the aforementioned RFDs can be found on BLM's eplanning pages for the subject RMP. A separate RFD technical report was not prepared for the GSG ARMPA, but the information from the base RMPs was updated to address any new constraints resulting from the analysis in the EIS' associated with the 2015 ROD. The NFO RFD is discussed within the RMP FEIS and can be provided upon request; and for the BFO, an updated RFD report is provided as Appendix G in the approved RMP and the original technical report can be provided upon request.

specific end use of the oil and gas produced from federal leases. As a result, the BLM can only provide an estimate of potential GHG emissions by conservatively assuming that all produced oil and gas would eventually be combusted.

Fossil fuels can be consumed, but not combusted, when they are used directly as construction materials, chemical feedstocks, lubricants, solvents, waxes, and other products. Common examples include petroleum products used in plastics, natural gas used in fertilizers, and coal tars used in skin treatment products. According to EPA's Energy Star program, in 2017, about 13% of total petroleum products consumed were for non-combustion use. Natural gas non-combustion use accounted for about 3% of the total amount for natural gas, while coal was less than 1%. Information regarding non-combustion use of oil products was not provided.

4.2 Climate Change Impacts

The EPA identifies Wyoming as part of the Mountain West and Great Plains region.The following bullet points summarize potential changes that are expected to occur at the regional scale (http://www.epa.gov/Region8/climatechange/pdf/ClimateChange101FINAL.pdf).

- The region is expected to experience warmer temperatures with less snowfall.
- Temperatures are expected to increase more in winter than in summer, more at night than in the day, and more in the mountains than at lower elevations.
- Earlier snowmelt means that peak stream flow would be earlier, weeks before the peak needs of ranchers, farmers, recreationalist, and others. In late summer, rivers, lakes, and reservoirs would be drier.
- More frequent, more severe, and possibly longer-lasting droughts are expected to occur.
- Crop and livestock production patterns could shift northward; less soil moisture due to increased evaporation may increase irrigation needs. Drier conditions would reduce the range and health of ponderosa and lodge pole pine forests, and increase the susceptibility to fire. Grasslands and rangelands could expand into previously forested areas.
- Ecosystems would be stressed and wildlife such as the mountain lion, black bear, long-nose sucker, marten, and bald eagle could be further stressed.

Other impacts could include:

- Increased particulate matter in the air as drier, less vegetated soils experience wind erosion.
- Shifts in vegetative communities which could threaten plant and wildlife species.
- Changes in the timing and quantity of snowmelt, which could affect both aquatic species and agricultural needs.
- Projected and documented broad-scale changes within ecosystems of the U.S. are summarized in the Climate Change Supplemental Information Report (2010). Some key aspects include:

    - Large-scale shifts have already occurred in the ranges of species and the timing of the seasons and animal migrations. These shifts are likely to continue (Climate Change SIR 2010). Climate changes include warming temperatures throughout the year and the arrival of spring an average of 10 days to 2 weeks earlier through much of the U.S. compared to 20 years ago. Multiple bird species now migrate north earlier in the year.
    - Fires, insect epidemics, disease pathogens, and invasive weed species have increased and these trends are likely to continue. Changes in timing of precipitation and earlier runoff increase fire risks.
    - Insect epidemics and the amount of damage that they may inflict have also been on the rise. The combination of higher temperatures and dry conditions have increases insect populations such as pine beetles, which have killed trees on millions of acres in western U.S. and Canada. Warmer winters allow beetles to survive the cold season, which would normally limit populations; while concurrently, drought weakens trees, making them more susceptible to mortality due to insect attack.

The USGS, in cooperation with the BLM, produced a report entitled the Wyoming Basin Rapid Ecological Assessment,[24] which provides projections of future climatic changes, while cautioning that reasonably foreseeable changes in climate vary due to natural inter-annual and decadal variability, uncertainty about future greenhouse gas emissions, and the range of uncertainties in the existing global climate models. The report recognizes that climate models differ in how they represent climate processes such that the models will produce different climate projections for a given time period and location, even with the same future emissions scenario. Based on the analysis, the report's analysis generally agrees with the determination that global temperatures are expected to increase (IPCC, 2013) such that warmer temperatures in the future can be expected, although the magnitude and consequences of warming are uncertain, and summers are projected to warm more than winters (an increase of 4.5 ºF versus 3.5 ºF) (fig. 5.1 in Lukas et al., 2014). No statistically significant changes in precipitation are predicted in the Wyoming Basin, but winters may be wetter and summers likely drier. Despite the lack of statistically significant projected changes in precipitation, the results suggest that temperature increase alone could increase evaporation and plant water demand; thus, even without a decrease in precipitation, water availability for ecosystems could decrease if precipitation remains about average.

4.2.1 Mitigation of Impacts from GHG Emissions and Climate Change Impacts

The BLM regulates portions of natural gas and petroleum systems identified in the EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks report. In carrying out its responsibilities, BLM has developed BMPs designed to reduce emissions from field production and operations. Analysis and approval of future development on the lease parcels may include application of BMPs within BLM's authority, as Conditions of Approval (COAs), to reduce or mitigate GHG emissions. Additional measures developed at the project development stage also may be incorporated as applicant-committed measures by the project proponent, or added to necessary State of Wyoming air quality permits.

Mitigation measures to reduce the impacts of climate change and GHG emissions may include, but are not limited to:

- Flare hydrocarbon and gases at high temperatures in order to reduce emissions of incomplete combustion through the use of multi-chamber combustors;
- Water dirt roads during periods of high use in order to reduce fugitive dust emissions;
- Require that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored;
- Installation of liquids gathering facilities or central production facilities to reduce the total number of sources and minimize truck traffic;
- Use of natural gas fired or electric drill rig engines;
- The use of selective catalytic reducers and low-sulfur fuel for diesel-fired drill rig engines; and,
- Adherence to BLM's Notice to Lessees (NTL)-4a concerning the venting and flaring of gas on Federal leases for natural gas emissions that cannot be economically recovered,
- Flaring of hydrocarbon gases at high temperatures in order to reduce emissions of incomplete combustion;
- Protecting frac sand from wind erosion;
- Implementation of directional and horizontal drilling technologies whereby one well provides access to petroleum resources that would normally require the drilling of several vertical wellbores;
- Performing interim reclamation to reclaim areas of the pad not required for production facilities and to reduce the amount of dust from the pads.

Additionally, the BLM encourages oil and gas natural gas companies to adopt proven cost-effective technologies and practices that improve operation efficiency and reduce natural gas emissions, to reduce the ultimate impact from the emissions.

[24] https://pubs.er.usgs.gov/publication/ofr20151155

In October 2012, the EPA promulgated air quality regulations for completion of hydraulically fractured gas wells. These rules require air pollution mitigation measures that reduce the emissions of VOCs during gas well completions. Mitigation includes a process known as "green completion" in which the recovered products are sent through a series of aboveground, closed, separators which negates the need for flowing back into surface pits as the product is immediately sent to gas lines and the fluids are transferred to onsite tanks. Green completions have been required by the Wyoming Department of Environmental Quality for many years in the Upper Green River Basin and the requirement was expanded throughout the State of Wyoming in 2015.

EPA Inventory data show that by adopting the BMPs proposed by the EPA Natural Gas Energy Star program, the industry has reduced emissions from oil and gas exploration and development: "During calendar year 2018, Partners submitted an annual report detailing their efforts in 2017 to reduce methane emissions from their operations. These voluntary activities consisted of 45 technologies and practices and resulted in emissions reductions of 96.8 Bcf for the year. These methane emissions reductions have cross-cutting benefits on domestic energy supply, industrial efficiency, revenue generation, improved air quality, and greenhouse gas emissions reductions. The emission reductions are equivalent to additional revenue of approximately $291 million in natural gas sales (assumes an average natural gas price of $3.00 per thousand cubic feet)."

Specifically, EPA reports that 89% of the methane reductions came from the oil and gas production sector, by utilizing a variety of technologies including: reducing blow down frequency, installing vapor recovery units, and converting gas-driven pumps to electric, mechanical, or solar driven pumps. The BLM will continue to work with industry to promote the use of the relevant BMPs for operations proposed on Federal mineral leases where such mitigation is consistent with agency authorities and policies, and is supported by BLM's NEPA analysis.

In addition to efforts to better respond and adapt to climate change, other Federal initiatives are also being implemented to mitigate climate change. The Carbon Storage Project was implemented to develop carbon sequestration methodologies for geological (i.e., underground) and biological (e.g., forests and rangelands) carbon storage. The project is a collaboration of Federal and nonfederal stakeholders to enhance carbon storage in geologic formations and in plants and soils in an environmentally responsible manner. The Carbon Footprint Project[25] is an effort to develop a unified GHG emission reduction program for the DOI, including setting a baseline and reduction goal for the Department's GHG emissions and energy use.

4.3 No Action Alternative

Under the No Action Alternative, the issued leases would not continue. As no development would occur, no CO2e emissions would be generated from the Proposed Action, nor would they contribute to any ongoing or projected changes in climatic conditions and resultant landscape effects identified.

The No Action Alternative would result in the continuation of already-approved land uses, but would not result in impacts relating to exploration and development of these oil and gas leases. Other exploration and development activities would continue in surrounding areas that are currently leased and could contribute to any ongoing or projected changes in climatic conditions and resultant landscape effects identified.

[25] https://www.carbonfootprint.com/carbonoffsetprojects.html (accessed 04052019)

5.0 Cumulative Impacts

Past, Present, and Reasonably Foreseeable Future Actions
Past, present, and reasonably foreseeable future actions are considered in the analysis to identify whether and to what extent the environment has been degraded or enhanced, whether ongoing activities are causing impacts, and trends for activities and impacts in the area. Projects and activities are evaluated on the basis of proximity, connection to the same environmental systems, potential for subsequent impacts or activity, similar impacts, the likelihood a project would occur, and whether the project is reasonably foreseeable.

The general cumulative impacts analysis area is defined as the Federal fluid mineral estate within the State of Wyoming since the leases are located throughout the State. For cumulative direct emissions, the cumulative impact analysis area includes discussion of total direct statewide, regional and nationwide emission levels.

For cumulative indirect GHG emissions, the cumulative impact analysis discusses total statewide and regional consumption estimates.

Since climate change is global phenomenon, this section also includes consideration of global climate change and the global carbon budget.

The BLM holds quarterly oil and gas lease sales, in compliance with the law and regulation. As a result, numerous oil and gas lease sale parcels are being considered for public lands around the West at any given time (among other land use plan implementation decisions). The RMP EISs to which this EA tiers, address potential cumulative effects to resources, in consideration of effects from other reasonably foreseeable future actions within or outside of their respective planning areas.

5.1 Greenhouse Gas Emissions

To the extent that economics, availability, and regulatory requirements encourage natural gas replacement of other existing fossil fuel use, global GHG emissions could be reduced by increased production of natural gas. For example, the EIA predicts that fuel switching will prompt an 83 percent increase in electric power sector natural gas consumption from 2009 to 2030 (EIA 2009).

While natural gas is likely to displace some fossil fuels, renewable energy is expected to replace some natural gas usage in a variety of applications, such as home heating and electric power generation. The EIA predicts that total natural gas consumption in the United States will fall by 14 percent from 2009 to 2030 (EIA 2009). If natural gas consumption decreases, natural gas production of Federal minerals in Wyoming may be less than the levels of development included in the RFD scenarios included in Section 3.4 and Table 4.

U.S. GHG emissions may not necessarily increase by the magnitude of potential GHG emissions from oil and gas production of Federal minerals in Wyoming. Oil and gas development may decline in other portions of the United States, thereby decreasing total U.S. GHG emissions from oil and gas production, even when new development in these areas is added. If GHG emission reduction regulations applicable to oil and gas activities are implemented by U.S. EPA in the future, oil and gas development may preferentially increase in fields that produce these fuels with lower than average GHG emissions.

5.1.1 Cumulative Direct Emissions-Wyoming

Using similar methodologies and the same RMP derived data, the BLM has calculated cumulative direct and indirect emission estimates for all existing and reasonably foreseeable Federal lease projects in Wyoming (BLM Wyoming considers all lease sales currently undergoing internal review to be reasonably foreseeable). The only difference is these are calculated using a statewide average per-acre emission factor to account for all Federal development and production actions that could be ongoing in the state. This average is a reasonable proxy for the multiple types of

development that could occur on Federal lands in Wyoming.

The following table shows the total cumulative direct CO2e emissions from Federal lands in Wyoming. Similar methods to those used for the direct and indirect emissions calculations in this EA were used to calculate total direct CO2e, except BLM calculated an average statewide per-acre emission estimate. This emission estimate generalizes emissions across the state, but accurately accounts for the variable drilling rates and well types across the state, because it assumes that all Federal acreage has the same average potential to produce. In reality, resource conditions vary across the state, and changing future conditions may result in shifts in production expectations for different lands (such as the changes in expectations for CBNG, and the shift from gas development to oil development on other lands).

Table 10: BLM Wyoming Cumulative Existing and Reasonably Foreseeable Direct Annual CO_2e Emissions

Planning Area	Total FO Mineral Acreage Open to Leasing	Total projected Direct Federal Oil & Gas CO_2e (mt/year)	Direct Federal CO_2e/acre/year	End of Calendar Year 2018 Total Existing Leased acreage	Proposed Action EA acreage	Total 4th Quarter 2018 (20184Q) Offered Lease Sale Acreage	Total 1st Quarter 2019 (20191Q) Offered Lease Sale Acreage	Total 2nd Quarter 2019 (20192Q) Proposed lease sale acreage	Total Cumulative Existing and Proposed lease acreage
LFO	2,640,000	1,502,877.0	0.57						
BFO	3,300,000	614,307.4*	0.19						
BHB	2,500,000	910,000.0	0.36						
GSG ARMPA	22,100,000	3,291,209.0	0.15						
	Total Federal Acreage Open to Oil and Gas 30,540,000	Total Annual Direct CO_2e from all Federal Development 6,318,393.4	Statewide annual average per-acre Direct CO_2e per-acre estimate: 0.21	8,096,034	303,966.0	769,942.1	148,908.9	205,855.0	8,754,763.9
Total Cumulative BLM Wyoming Direct Annual CO_2e (mt/year) [Total Cumulative acreage * 0.21 mt/ac]									2,036,613.9 mt/yr

* BLM has calculated updated direct CO_2e emissions projected in the BFO RMP in response to a court order in Western Organization of Resource Councils et al. v. BLM, D. Mont. [No. CV 16-21-GF-BMM] (March 26, 2018) for this EA while the larger RMP is being amended The numbers below represent an alternative 100 year GWP for methane (24) and N_2O (298); it also shows the IPCC's 20-year GWP.

BFO 2024	**tons/year**	**conversion factor**	**Metric tons**	**GWP (100 Yr)**	**mt CO_2e**	**GWP (20 year)***	**mt CO_2e**
CO2	209,261	1.102	189,892	1	189,892	1	189,892
CH4	19,456	1.102	17,650.2	24	423,604.8	87	1,535,567.4
N2O	3	1.102	2.72	298	810.6	289	786.1
	618,877				614,307.4		1,726,245.5

*https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

From information in Table 10, total existing cumulative projected statewide annual direct CO_2e, represents approximately 32.2% of the total cumulative BLM Wyoming planning projections (2,036,613.9/6,318,393.4 mt/yr). Based on BLM public land statistics, the fact that only 50% of BLM existing leases are in producing status, BLM expects that only about 50% of these Federal Wyoming emissions are expected to occur (1,018,307 mt).

Likewise, as shown in Table 11 below, the reasonably foreseeable projects (Proposed Action, 20184Q, 20191Q and 20192Q acreage), using the statewide per-acre average, would add approximately 300,020.6 mt/yr to the total existing average annual direct emissions (2,036,613.9-300,020.6=1,736,593.3 mt/yr), or 17.2% of the existing total direct CO_2e. The direct emissions expected from the Proposed Action represent 3.1% of the existing total direct CO_2e (63,832.9/173,6593.3 mt).

Table 11: BLM Wyoming Cumulative Reaonably Foreseeable Direct Annual CO_2e Emissions

Statewide annual average per-acre Direct CO2 per-acre estimate:		Proposed Action Acreage	Total 4th Quarter 2018 (20184Q) Offered Lease Sale Acreage	Total 1st Quarter 2019 (20191Q) Offered Lease Sale Acreage	Total 2nd Quarter 2019 (20192Q) Proposed lease sale acreage	Total Direct CO2e from Reasonably Foreseeable Lease Actions
		303,966.0	769,942.1	148,908.9	205,855.0	
0.21	Total Annual Direct CO_2e	63,832.9	161,687.8	31,270.9	43229.6	300,020.6

Regional Direct Emission Estimates

In order to determine the existing annual direct CO_2 emissions from the Rocky Mountain and Northern Great Plains Regions for comparison purposes, we first divided each states 2014 emission estimates from the USGS SIR by their respective 2014 total Federal producing acreage; this calculation resulted in a 2014 per-acre direct CO_2e emission factor by state. The resulting 2014 per-acre emission estimate was then used to calculate total existing CO_2e emissions for the years 2015-2018 using BLM information on annual producing acreage for each state. The 2015-2018 total calculated emissions for each state were then added to the 2014 USGS estimate to get total existing emissions through 2018. Since we want to compare emission levels expected on an annual basis, the five year total was then divided by 5 to get an annual estimate (referred to as a 5-year average annual total). Please refer to the full USGS SIR for specific information that the USGS incorporated into its analysis. For comparison purposes, it is the best available information at this time. This analysis is shown in the following table:

Table 12: Regional Total Federal Direct CO_2e

EIA REGION	Geographic State	Total 2014 O&G extraction (Direct) CO_2e (MMT)	Total 2014 O&G extraction (Direct) CO_2e (mt)	2014 Total Federal Producing Acreage	2014 Total Federal O&G Direct CO_2e (mt/acre)	Calculated Total 2015-2018 Federal Direct CO_2e (mt)	Calculated Total 2014-2018 Federal Direct CO_2e (mt)
ROCKY MOUNTAIN	Arizona	0	0	0	0.00	0.0	0.0
	Colorado	2.61	2,610,000	1,478,105	1.77	10,636,910.8	13,246,910.8
	Idaho	0	0	0	20.45	143,103.8	143,103.8
	Nevada	0.009322	9,322	22,077	0.42	43,101.6	52,423.6
	New Mexico	11.77	11,770,000	3,727,864	3.16	47,605,601.8	59,375,601.8
	Utah	2.49	2,490,000	119,366	20.86	94,125,463.9	96,615,463.9

NORTHERN GREAT PLAINS	Montana	0.8332	833,200	766,544	1.09	3,127,478.0	3,960,678.0
	North Dakota	0.2002	200,200	570,645	0.35	836,540.3	1,036,740.3
	South Dakota	0.01781	17,810	44,589	0.40	75,049.7	92,859.7
					Average per-acre direct CO_2e emission factor: 5.39	Total 2015-2018: 156,593,249..9	Total 2014-2018 174,523,781.9

Similarly, based on the information in Table 12, the Federal direct CO_2e 5-year annual average for each of the aforementioned states is shown in Table 13 below:

Table 13: Regional Average Annual Federal Direct CO_2e

EIA REGION	Geographic State	Federal 5-year Average Annual Direct CO_2e (mt)
ROCKY MOUNTAIN	Arizona	0.0
	Colorado	2,649,382.2
	Idaho	28,620.8
	Nevada	10,484.7
	New Mexico	11,875,120.4
	Utah	19,323,092.8
NORTHERN GREAT PLAINS	Montana	792,135.6
	North Dakota	207,348.1
	South Dakota	18,571.9

Thus, the Federal 5-year annual average direct CO_2e emissions in the Rocky Mountain Region is 6,777,340.2 mt/yr and 203,611.1 mt/yr in the Northern Great Plains Region. Across both regions, the Federal 5-year average annual direct CO_2e emissions is 6,980,951.3 mt/yr.

- As part of the Rocky Mountain Region, the projected annual direct CO_2e from the Proposed Action (Table 7) is approximately 1.08% of the total. Based on the 5-year average for both the Rocky Mountain and Northern Great Plains Regions, the Proposed Action equates to approximately 1.05% of the annual total.

Average leasing activity in these states from 2008-2017[26] is provided in the following table:

Table 14: Regional Average Number of Leases Issued Per Year

State	Average number of leases issued per year	State	Average number of leases issued per year
Arizona	1	New Mexico	99
Colorado	126	North Dakota	83
Idaho	2	South Dakota	75
Montana	116	Utah	75
Nevada	199	Wyoming	468

As mentioned above, the BLM is required to have quarterly lease sales in states where eligible lands are available for lease. Based on average lease sale numbers, annual average contributions to total emissions are expected to remain constant, or decrease if projections regarding future activity remains true (e.g., the expectation that natural

[26] *Id.* at 11

gas usage will continue to grow but may be offset as additional renewable resources come online). Since BLM's consisderation of lands for leasing is largely externally driven, it is impossible to project future leasing activity with a greater certainty than these general trends.

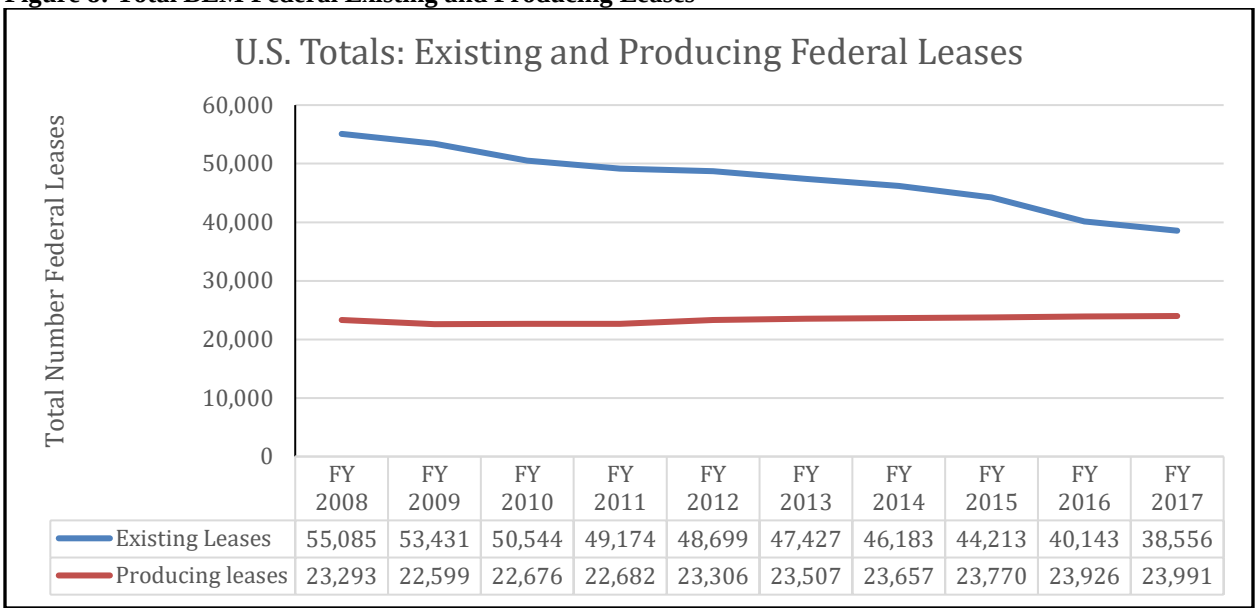
As compared to the more comprehensive Federal data in the USGS SIR, the existing and projected cumulative Federal Wyoming contribution from direct CO_2e would represent approximately 6.0% of the Rocky Mountain Regions annual average total (33,886,700.8 mt/yr), and 5.8% of the combined Rocky Mountain and Northern Great Plains annual average total (34,904,756.4 mt/yr).

The Proposed Action emissions (Table 7), represents approximately 0.22% of the Rocky Mountain Region, and 0.21% of the combined Rocky Mountain and Northern Great Plains Regions' average annual total.

National Direct Emission Estimates

Nationally, the BLM had 38,556 leases in effect in 2017, and of these, 23,991 were in producing status (62%) according to BLM summary statistics.[27] These 38,556 leases contained approximately 12,790,557 acres. Trends in BLM national leasing activity is shown in the following figure:

Figure 8: Total BLM Federal Existing and Producing Leases



	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Existing Leases	55,085	53,431	50,544	49,174	48,699	47,427	46,183	44,213	40,143	38,556
Producing leases	23,293	22,599	22,676	22,682	23,306	23,507	23,657	23,770	23,926	23,991

According to EPA, total 2017 U.S. GHG emissions (direct) from reporting oil and gas systems is 94 MMT (94,000,000 mt) CO_2e. Wyoming's cumulative direct CO_2e emission estimate of 2,036,613.9 mt/yr, is approximately 2.2% of the national 2017 total. Direct CO_2e from the Proposed Action represents 0.078% of the total EPA 2017 direct CO_2e estimate from reporting sources.

5.1.2 Cumulative Indirect Emissions- Wyoming

BLM's analysis to determine the cumulative indirect emissions based on an average annual per-acre emission factor for Federal lands in Wyoming is similar to the method used cumulative direct emissions. This data analysis is shown in the following table:

[27] https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/oil-and-gas-statistics

Table 15: BLM Wyoming Cumulative Existing and Reasonably Foreseeable Indirect Annual CO_2e Emissions

Planning Area	RFD Federal Mineral Estate Open to Leasing (wells)	RFD Federal and Nonfederal Lands (wells)	Total FO Federal Mineral Acreage Open to Leasing	Total Indirect All Lands Oil and Gas CO_2e (mt/year)	Indirect annual CO_2e/ acre/year	End of Calendar Year 2018 Total Existing Federal Leased acreage	Total 4th Quarter 2018 Offered Lease Sale Acreage	Total Proposed Action acreage	Total 1st Quarter Offered Lease Sale acreage	Total 2nd Quarter Proposed Lease Sale acreage	Total Cumulative Existing and Proposed Lease acreage
LFO	1695	4254	2,640,000	14,153,962	5.36						
BFO	4767	11018	3,300,000	4,223,136.0	1.28						
BHB	1141	6054	2,500,000	2,188,248.0	0.88						
GSG ARMPA	12355	14818	22,100,000	59,908,368.3	2.71						
Statewide Totals:	19,958	36,144	30,540,000	80,473,714.3	Statewide average CO_2e/ac/year 2.63	Totals: 8,096,034.0	769,942	303,966	148,909	205,855	9,524,706
Total Cumulative BLM Wyoming Indirect annual CO_2e (mt/year) [Total Cumulative acreage * 2.63 mt/ac] =											25,049,989.9 mt/yr

Based on estimates from BLM Wyoming's planning documents, calculated total existing Federal indirect CO_2e is approximately 21,292,569.4 mt/yr based on a statewide average per-acre estimate of 2.63 CO_2e /acre. Total existing plus reasonably foreseeable Federal lease actions is projected to result in 25,049,989.9 mt/yr.

Total new annual indirect CO_2e from the reasonably foreseeable actions (Proposed Action, 20184Q, 20191Q and 20192Q lease sales) would add approximately 3,757,420.5 mt/yr to existing levels which represents an approximately 17.6% of the existing annual emissions.

As shown in Table 15, of the total indirect CO_2e projected under BLM's planning documents the combined existing and reasonably foreseeable cumulative indirect emissions represent 31.2% of the total potential emissions (25,049,989.9 / 80,317,035.3 mt/yr). As only 50% of the existing leases at the end of fiscal year 2018 were in producing status, 12,524,995 mt/yr would be expected from the combined production of existing and reasonably foreseeable leases.

Of the total indirect CO_2e projected under BLM Wyoming's planning documents, the contribution from the Proposed Action (Table 9) represents approximately 0.99% (797,495.9 / 80,317,035.3 mt/yr).

Regional Indirect Consumption Estimates

BLM calculated regional indirect CO2e emission estimates using the same methodology as for regional direct emission estimates. However, the USGS data includes more combustion sources than just lease-generated production information (for example, information for refineries, which aggregate fluids from multiple sources) and we refer the reader to the full report for specific information that the USGS incorporated into its analysis. For comparison purposes, it is the best available information at this time. This data analysis, and the resulting average annual emissions estimates, are shown in the following table:

Table 16: Total Regional Federal Indirect Emissions

EIA REGION	Geographic State	Total 2014 Federal Oil & Gas combustion (Stationary sources) (MMT)	Total 2014 Federal Oil & Gas combustion (Stationary sources) (mt)	2014 Total Federal Producing Acreage	2014 Total Federal Oil & Gas Indirect CO_2e (mt/acre/year)	2015-2018 Total Federal Indirect CO_2e (mt)	Total 2014-2018 Federal Indirect CO_2e (mt)
ROCKY MOUNTAIN	Arizona	0	0	0	0.00	0.0	0.0
	Colorado	1.31	1,310,000	1,478,105	0.89	5,338,832.6	6,648,832.6
	Idaho	0	0	0	20.45	143,103.8	143,103.8
	Nevada	0.018227	18,227	22,077	0.83	84,275.2	102,502.2
	New Mexico	40.314	40,314,000	3,727,864	10.81	163,056,264.5	203,370,264.5
	Utah	14.8	14,800,000	119,366	123.99	559,460,588.4	574,260,588.4
NORTHERN GREAT PLAINS	Montana	0.911319	911,319	766,544	1.19	3,420,703.5	4,332,022.5
	North Dakota	2.12474	2,124,740	570,645	3.72	8,878,274.5	11,003,014.5
	South Dakota	0.0156382	156,382	44,589	3.51	658,979.2	815,361.2
					Average per-acre Indirect CO_{2e} emission factor: 18.38	Total 2015-2018: 741,041,021.7	Total 2014-2018 800,675,689.7

Based on the information in the above table, the 5-year annual average for each of the aforementioned states is shown in Table 17:

Table 17: Regional Average Annual Indirect CO_2e

EIA REGION	Geographic State	Federal 5-year Average Annual Indirect CO_2e (mt)
ROCKY MOUNTAIN	Arizona	0
	Colorado	1,329,766.5
	Idaho	28,620.8
	Nevada	20,500.4
	New Mexico	40,674,052.9
	Utah	114,852,117.7
NORTHERN GREAT PLAINS	Montana	866,404.5
	North Dakota	2,200,602.9
	South Dakota	163,072.2

Resultantly, the total 5-year annual average indirect CO_2e emissions in the Rocky Mountain Region is 156,905,058.3 mt/yr and 3,230,079.6 mt/yr in the Northern Great Plains Region. Across both regions, the 5-year average annual indirect CO_2e emissions are 160,135,137.9 mt/yr.

As part of the Rocky Mountain Region, the projected annual indirect CO_2e from the Proposed Action, Table 8 numbers, is approximately 0.51% of those states listed above. Based on the total 5-year average for both the Rocky Mountain and Northern Great Plains Regions, emissions from the Proposed Action equate to approximately 0.498% of the average annual total.

The projected cumulative increase in indirect CO_2e emissions from reasonably foreseeable leases (Proposed Action, 20184Q, 20191Q and 20192Q) (i.e. excluding existing leases), utilizing the statewide per-acre average identified in Table 15, would represent an increase of approximately 2.4% of the Rocky Mountain Region's annual average indirect total (156,905,058.3), and 1.08% of the Rocky Mountain/Northern Great Plains annual average indirect total (160,135,137.9 mt/yr). Utilizing the same statewide average per-acre estimate, the Proposed Action represents 0.19% of the Rocky Mountain average annual emissions, and 2.3% of the combined Rocky Mountain/Northern Great Plains average annual emissions.

National Indirect Consumption Estimates

According to EPA, total 2017 U.S. indirect GHG emissions from reporting combustion-related sources, is 4,920,500,000 mt CO_2e. Wyoming's projected cumulative indirect emissions estimate of 25,049,989.9 mt/yr (Table 15) represent 0.48% of EPA's total national estimate.

Acreage associated with the Proposed Action (Table 7) represents approximately 0.016% of the EPA 2017 U.S. total indirect annual GHG emission estimate.

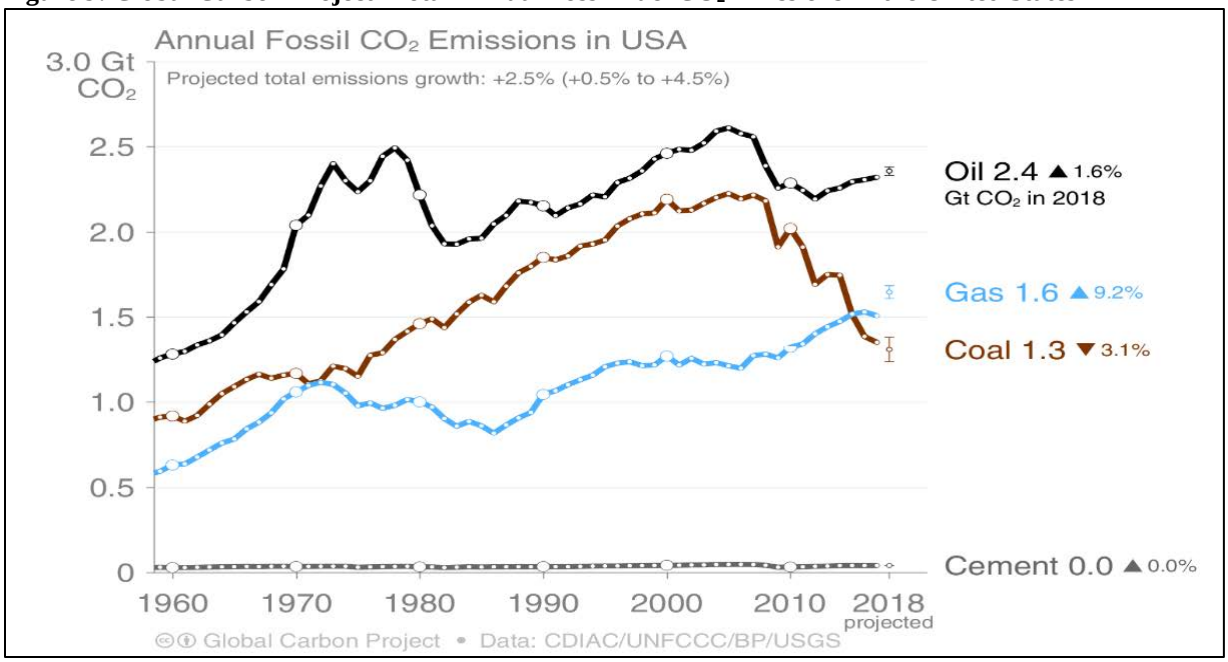
Total Wyoming Direct and Indirect Emissions

The cumulative gross total of BLM Wyoming's emissions (direct CO_2e plus indirect CO_2e) is approximately 27,086,603.8 mt/yr. As compared to the total emissions estimate of 134,600,000 mt CO_2e in Wyoming for 2018, derived from the 2018 WOGCC production numbers, the Federal portion of Wyoming's estimated 2018 total is 20.1%.

According to EPA, in 2017 the total gross GHG emissions in the U.S. were 6,472.3 MMT CO_2e; Wyoming's contribution, based on the BLM Wyoming's cumulative emission estimate, is approximately 0.39%.

Compared to the Global Carbon Project's projected 2018 total of 4.0 Gt[28] for both oil and gas, the total Wyoming Federal cumulative emission estimate represents approximately 0.66%.

Figure 9: Global Carbon Project- Total Annual Fossil Fuel CO_2 Emissions In the United States



This EA, along with the analyses in RMP EISs for the Lander RMP, Bighorn Basin RMP, and ARMPA, qualitatively describes impacts from climate that could be associated with potential development of the federal mineral estate from the actions analyzed. Included within the subject RMP EISs[29] are regional economic analyses. Terms such as "benefits" and "costs" can have different and very specific definitions within a discipline, such as economics, which can differ from their meaning in an "ordinary language sense." While the RMP-EIS analyses use terms such as "benefits," the analyses conducted in the RMP-EISs are regional economic impact analyses that discuss the effects of management actions on local/regional economic activity (often expressed in terms of employment, income, and output), and these effects are not the same as "economic benefits" in the context of an economic cost-benefit analysis. The distinction is more than semantic because principles of cost-benefit analysis do not allow comparison of economic impacts with economic costs and benefits as part of the net benefit calculation.

"Social cost of carbon" estimates are one approach that an agency can take to examine climate consequences from greenhouse gas emissions resulting from a proposed action. However, this EA provides no quantitative monetary estimates of any benefits or costs. NEPA does not require an economic cost-benefit analysis (40 C.F.R. § 1502.23), although NEPA does require consideration of "effects" that include "economic" and "social" effects (40 C.F.R. 1508.8(b)). Quantifying only the costs of oil and gas development by using the social cost of carbon metrics but not the benefits (as measured by the economic value of the proposed oil and gas development and production generally equaling the price of oil and gas minus the cost of producing, processing, and transporting the minerals) would yield information that is both inaccurate and not useful for the decision-maker, especially given that there are no current criteria or thresholds that determine a level of significance for social cost of carbon monetary values.

[28] 4.0 Gt equal 4,000,000,000 mt (1,000,000,000 metric tons = 1 metric gigaton)

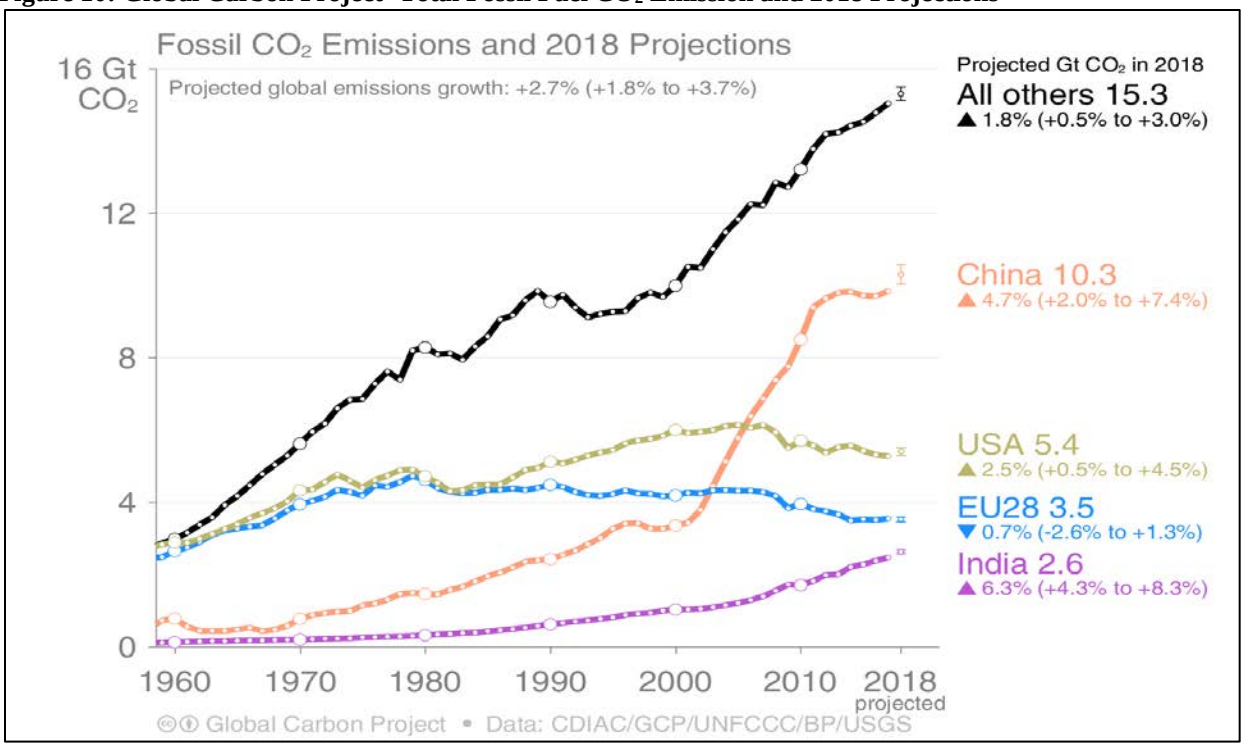
[29] Please refer to the applicable RMP FEISs for additional discussion of socioeconomic conditions within the project area. Specific information can be found at: GR RMP FEIS pgs 330-331, 336-337, 439, 441, KFO RMP FEIS pgs. 3-166 and 3-178, PFO RMP FEIS pgs. 3-80 - 3-81, RFO RMP FEIS pgs. 3-74 - 3-77, LFO RMP FEIS pgs. 246-247 and 576-577, BFO RMP FEIS pgs. 614-615 and 631-632, BHB RMP FEIS pgs. 3-251 - 3-252 and 3-281 - 3-283, NFO RMP FEIS pgs. 103, CFO RMP FEIS pgs. 3-128, 3-135 - 3-136; ARMPA 4-177 - 4-187.

Instead, BLM's approach to GHG and climate change impacts analysis in this EA includes calculations to show estimated direct and indirect GHG emissions from potential future development of the 283 leases, and from oil and gas activities in Wyoming and the region. BLM also includes a qualitative discussion of potential climate impacts at global and regional scales. BLM's approach recognizes that there are adverse environmental impacts related to climate change associated with the development and use of fossil fuels, provides potential GHG emission estimates, and discusses potential climate change impacts qualitatively. This effectively informs the decision-maker and the public of the potential for GHG emissions and the potential implications of climate change. This approach presents the data and information in a manner that follows many of the guidelines for effective climate change communication developed by the National Academy of Sciences (National Research Council 2010) by making the information more readily understood and relatable to the decision-maker and the general public.

5.2 Global Considerations

The EPAs Inventory of U.S. Greenhouse Gas Emissions and Sinks and estimates of U.S. emissions from the Global Carbon Project show that on average, the U.S. accounts for 14.2% of the global fossil fuel CO_2 emissions on an annual basis (since 2015). According to the EIA, domestic energy production accounts for about 90% of all U.S. energy consumption. The three major fossil fuels— petroleum (28%), natural gas (31.8%), and coal (17.8%) — combined accounted for about 77.6% of this production, while renewable energy sources (12.7%) and nuclear electric power (9.6%) provide the remainder. The EIA's Annual Energy Outlook (AEO) report provides modeled projections of domestic energy markets through 2050, and includes cases with different assumptions regarding macroeconomic growth, world oil prices, technological progress, and energy policies. In general, the last few years of baseline reference case data has shown strong domestic production coupled with relatively flat energy demand. The reference case estimates that natural gas consumption will grow the most on an absolute basis (0.8% annually), and nonhydroelectric renewables will grow the most on a percentage basis. Petroleum and coal annual growth is projected to be negative over the projection period, at -0.3% and -0.2% respectively. The outlook suggests that the U.S. could become a net energy exporter over the projection period in most cases.

Figure 10: Global Carbon Project- Total Fossil Fuel CO_2 Emission and 2018 Projections



According to EIA, anticipated growth in domestic energy demand "is likely to contribute to budget pressure even as growth in the renewable energy sector is forecast to continue at the fastest rate on a percentage basis (3.1%). It is unclear how or if public policy advancements, technological advancements, free energy market shifts, governmental energy investments and tax strategies (credits), and global collaboration on these issues will take shape to provide for the changes necessary to transform the make-up of our modern infrastructure to one with a lower carbon state. The tight timeline of the carbon budget makes interim overshoot likely, as well as the need to deploy carbon dioxide removal measures at scale in the future to correct for any overshoot if the global consensus still centers on maintaining warming to 1.5°C." Implementing these types of measures and policy changes are beyond BLM's decision authority.

There are currently no established significance thresholds for GHG emissions that BLM can reference in NEPA analyses, but all GHGs contribute incrementally to the climate change phenomenon. When determining NEPA significance for an action, BLM is constrained to the extent that cumulative effects (such as climate change) are only considered in the determination of significance when such effects can be prevented or modified by decision-making (see BLM NEPA Handbook, pg.72). While GHG emissions resulting from individual decisions can certainly be modified or potentially prevented by analyzing and selecting reasonable alternatives that appropriately respond to the action's purpose and need, BLM has limited decision authority to meaningfully or measurably prevent the cumulative climate change impacts that would result from global emissions. The data presented above show BLM Wyoming's limited potential contribution to global emissions relative to the latest iteration of the carbon budget.

6.0 EA Preparers/Reviewers

The following individuals were involved or consulted during the development of this EA:

BLM Wyoming State Office

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Jessica M. Montag	Regional Socioeconomic Specialist	Socioeconomics
James Chase	Petroleum Engineer, Chief Reservoir Management Group	Reservoir Management, Reasonably Foreseeable Development Scenario's

6.1 References

Planning Documents

BLM 2005a. Final Statewide Programmatic Biological Assessment: Black-footed Ferret (Mustela nigripes). Submitted to U.S. Department of Interior, Bureau of Land Management. Wyoming State Office. Cheyenne, Wyoming.

BLM 2013. Proposed Resource Management Plan and Final Environmental Impact Statement for the Lander Field Office Planning Area, February 22, 2013 (two volumes). U.S. Department of the Interior, Bureau of Land Management, Wyoming.
https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=28453

BLM 2014. Record of Decision and Approved Resource Management Plan for the Lander Field Office Planning Area. U.S. Department of the Interior, Bureau of Land Management, Wyoming.
https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=28453

BLM 2015. Lander Field Office, Post ROD RMP Maintenance Actions.
https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=28453

BLM 2015. Bighorn Basin Proposed Resource Management Plan and Final Environmental Impact Statement, May 28, 2015. U.S. Department of the Interior, Bureau of Land Management, Wyoming.
https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=19107

BLM 2015. Rocky Mountain Region Record of Decision and Approved Resource Management Plan for the Worland Field Office Planning Area. U.S. Department of the Interior, Bureau of Land Management, Wyoming.
https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=19107

BLM 2015. Rocky Mountain Region Record of Decision and Approved Resource Management Plan for the Cody Field Office Planning Area. U.S. Department of the Interior, Bureau of Land Management, Wyoming.
https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=19107

BLM 2015. Rocky Mountain Region Record of Decision and Approved Resource Management Plan for the Wyoming Greater Sage-grouse Proposed Land Use Plan Amendment U.S. Department of the Interior, Bureau of Land Management, Wyoming.

BLM 2019. Rocky Mountain Region Record of Decision and Approved Resource Management Plan for the Wyoming Greater Sage-grouse Proposed Land Use Plan Amendment U.S. Department of the Interior, Bureau of Land Management, Wyoming.

U.S. Department of the Interior, Bureau of Land Management. 1996. Green River Proposed Resource Management Plan and Final Environmental Impact Statement.

U.S. Department of the Interior, Bureau of Land Management. 1997. Green River Approved Resource Management Plan and Record Of Decision.

U.S. Department of the Interior, Bureau of Land Management. 2008. Kemmerer Proposed Resource Management Plan and Final Environmental Impact Statement.

U.S. Department of the Interior, Bureau of Land Management. 2010b. Kemmerer Approved Resource Management Plan and Record of Decision..

U.S. Department of the Interior, Bureau of Land Management. 2008. Pinedale Proposed Resource Management Plan and Final Environmental Impact Statement.

U.S. Department of the Interior, Bureau of Land Management. 2008. Rawlins Approved Resource Management Plan Record of Decision.

Informational References

BEA (Bureau of Economic Analysis), 2012a. Table CA25N: Total full-time and part-time employment by NAICS industry. http://www.bea.gov/iTable/iTable.cfm?ReqID=70&step=1&isuri=1&acrdn=5

BEA (Bureau of Economic Analysis), 2012b. Regional definitions. http://www.bea.gov/regional/definitions/nextpage.cfm?key=Private nonfarm employment

U.S. Bureau of Economic Analysis (BEA). 2017a. Table CA5N. Personal Income by Major Component and Earnings by Industry. https://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=7#reqid=70&step=1&isuri=1 (accessed May 21, 2018).

U.S. Bureau of Economic Analysis (BEA). 2017b. Table CA25N. Total Full-Time and Part-Time Employment by Industry. https://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=7#reqid=70&step=1&isuri=1 (accessed May 21, 2018).

Colorado State University, VIEWS 2.0. 2014. VIEWS Data Wizard. Available online: http://views.cira.colostate.edu/web/DataWizard/.

Goddard Institute for Space Studies. 2007. Annual Mean Temperature Change for Three Latitude Bands. Datasets and Images. GISS Surface Temperature Analysis, Analysis Graphs and Plots. New York, New York. (Available on the Internet: http://data.giss.nasa.gov/gistemp/graphs/Fig.B.lrg.gif).

National Academy of Sciences. 2006. Understanding and Responding to Climate Change: Highlights of National Academies Reports. Division on Earth and Life Studies. National Academy of Sciences. Washington, D.C. (Available on the Internet: http://dels.nas.edu/basc/Climate-HIGH.pdf).

Outdoor Industry Foundation. 2006. “The Active Outdoor Recreation Economy.” www.outdoorindustryfoundation.org

U.S. Department of the Interior. 2013. “Department of the Interior’s 2012 Economic Contributions.” July 2013.

United States Government Accountability Office. 2012. “OIL AND GAS, Information on Shale Resources, Development, and Environmental and Public Health Risks”, GAO-12-732.

U.S. Census, 2010a. 2010 Census Urban and Rural Classification and Urban Area Criteria. http://www.census.gov/geo/www/ua/2010urbanruralclass.html

U.S. Census 2010b. Table DP-1 Geography-Campbell County, Converse County, Crook County, Goshen County, Natrona County, Niobrara County, Weston County.

Manuals and Handbooks

BLM 2008. Handbook 1790-1, National Environmental Policy Act Handbook. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.
https://www.blm.gov/sites/blm.gov/files/uploads/Media_Library_BLM_Policy_Handbook_h1790-1.pdf

BLM 2005. Handbook 1601-1, Land Use Planning Handbook. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.
https://www.blm.gov/sites/blm.gov/files/uploads/Media_Library_BLM_Policy_Handbook_h1601-1.pdf

BLM 2013. Handbook 1624-1, Planning For Fluid Mineral Resources, U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.
https://www.blm.gov/sites/blm.gov/files/uploads/Media_Library_BLM_Policy_Handbook_H_1624_1.pdf

BLM 2013. Handbook H-3120-1, Competitive Leases (P), U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.
https://www.blm.gov/sites/blm.gov/files/uploads/Media_Library_BLM_Policy_h3120.pdf

BLM 2004. Handbook 8120-1, General Procedural Guidance for Native American Consultation (Public). U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.
https://www.blm.gov/sites/blm.gov/files/uploads/Media_Library_BLM_Policy_H-8120-1.pdf

Instruction Memorandums

U.S. Department of the Interior, Bureau of Land Management. 2000. Instruction Memorandum No. WO-2004-089, Policy for Reasonable Foreseeable Development (RFD) Scenarios for Oil and Gas.

> Re: WO Instruction Memorandum No. WO-2004-089: Rocky Mountain Federal Leadership Forum. 2004. Interagency Reference Guide: Reasonably Foreseeable Development Scenario's and Cumulative Effects Analysis for Oil and Gas Activities on Federal Lands in the Greater Rocky Mountain Region.

U.S. Department of the Interior, Bureau of Land Management. 2009. Instruction Memorandum No. WO-2009-215, Planning for Special Designations within the National System of Public Lands.
https://www.blm.gov/policy/im-2009-215

U.S. Department of the Interior, Bureau of Land Management. 2009. Washington Office Instruction Memorandum 2009-184, Courtesy Notification of Surface Owners When Split Estate Lands are Included in an Oil and Gas Notice of Competitive Lease Sale
https://www.blm.gov/policy/im-2009-184

U.S. Department of the Interior, Bureau of Land Management. 2018. Instruction Memorandum WY-2016-024, dated August 15, 2016, "Greater Sage-grouse Habitat Management Policy on Bureau of Land Management (BLM) Wyoming Administered Public Lands Including the Federal Mineral Estate." Cheyenne, Wyoming

U.S. Department of the Interior Bureau of Land Management. 2016. Instruction Memorandum WO-2018-034, dated January 31, 2018, "Updating Oil and Gas Leasing Reform – Land Use Planning and Lease Parcel Reviews" Washington D.C.

U.S. Department of the Interior Bureau of Land Management. 2016. Instruction Memorandum WO-2018-026, dated December 27, 2017, "Implementation of the Greater Sage-Grouse Resource Management Plan Revisions or Amendments – Oil & Gas Leasing and Development Sequential Prioritization." Washington D.C.

Air Quality, Climate, and Greenhouse Gas Emissions

Carr, N.B., and Melcher, C.P., eds., 2015, Wyoming Basin Rapid Ecoregional Assessment: U.S. Geological Survey Open-File Report 2015–1155, 896 p., http://dx.doi.org/10.3133/ofr20151155

Corner, A., Lewandowsky, S., Phillips, M. and Roberts, O. (2015). The uncertainty handbook-A practical guide for climate change communicators. Bristol: University of Bristol.

Dietz, T. (2013). Bringing values and deliberation to science communication. Proceedings of the National Academy of Sciences (PNAS) 110(3): 14081-14087.

Etkin, D. and Ho, E. (2007). Climate change: Perceptions and discourses of risk. Journal of Risk Research 10(5): 623-641.

Intergovernmental Panel on Climate Change (IPCC). 2014. "Climate Change 2014: Synthesis Report. Of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change" [Core Writing Team, Pachauri, R.K and Meyer, L.. (eds.)]. Intergovernmental Panel on Climate Change, Geneva, Switzerland, 139 pp.

EIA, 2009. Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009. U.S. Energy Information Administration (EIA). August 4. https://www.eia.gov/analysis/requests/2009/hr2454/pdf/sroiaf(2009)05.pdf

Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D.W. Fahey, J. Haywood, J. Lean, D.C. Lowe, G. Myhre, J. Nganga, R. Prinn, G. Raga, M. Schulz and R. Van Dorland, 2007: Changes in Atmospheric Constituents and in Radiative Forcing. *In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Hayes, D. J., R. Vargas, S. R. Alin, R. T. Conant, L. R. Hutyra, A. R. Jacobson, W. A. Kurz, S. Liu, A. D. McGuire, B. Poulter, and C. W. Woodall, 2018: Chapter 2: The North American carbon budget. In *Second State of the Carbon Cycle Report (SOCCR2): A Sustained Assessment Report* [Cavallaro, N., G. Shrestha, R. Birdsey, M. A. Mayes, R. G. Najjar, S. C. Reed, P. Romero-Lankao, and Z. Zhu (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 71-108, https://doi.org/10.7930/SOCCR2.2018.Ch2.

Intergovernmental Panel on Climate Change (IPCC). 2007. "Climate Change 2007: The Physical Basis (Summary for Policymakers)." Cambridge University Press. Cambridge, England and New York, New York. (Available on the Internet: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf).

Kotchen, M.J. (2011). Cost-benefit analysis. Chapter in: Encyclopedia of climate and weather, Second edition. Schneider, S.H., editor-in-chief. New York, Oxford University Press: pp 312-315.

Merrill, M.D., Sleeter, B.M., Freeman, P.A., Liu, J., Warwick, P.D., and Reed, B.C., 2018, Federal lands greenhouse gas emissions and sequestration in the United States—Estimates for 2005–14: U.S. Geological Survey Scientific Investigations Report 2018–5131, 31 p., https://doi.org/10.3133/sir20185131.

National Research Council. (2009). Informing decisions in a changing climate: Washington D.C.., The National Academies Press.

National Research Council. (2010). Informing an effective response to climate change: Washington D.C.., The National Academies Press.

URS, (2010) Climate Change Supplementary Information Report, Montana, North Dakota and South Dakota Bureau of Land Management. Denver, CO. Retrieved from http://www.blm.gov/mt/st/en/prog/energy/oil_and_gas/leasing/leasingEAs.html

U.S. Environmental Protection Agency (EPA). (2016h). Understanding global warming potentials. Retrieved from https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

Environmental Protection Agency, February 2, 2016, Greenhouse Gas Equivalencies Calculator, https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-andreferences.

U.S. Environmental Protection Agency (EPA). (2016h). Understanding global warming potentials. Retrieved from https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

U.S. Environmental Protection Agency, February 2, 2016, Greenhouse Gas Equivalencies Calculator, https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-andreferences

U.S. Environmental Protection Agency (EPA). 2003a. Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule. EPA-454/B-03-005. Available online: http://www.epa.gov/ttncaaa1/t1/memoranda/rh_envcurhr_gd.pdf

U.S. Environmental Protection Agency (EPA). 2012a. National Ambient Air Quality Standards (NAAQS). Available online: http://www.epa.gov/air/criteria.html

U.S. Environmental Protection Agency (EPA). 2014. Air Data, Monitor Values Report. Available online: http://www.epa.gov/airdata/ad_rep_mon.html

U.S. Environmental Protection Agency (EPA). 2018. Natural Gas Star Program (2017 data) Environmental Protection Agency, Washington, D.C.
Available online: https://www.epa.gov/natural-gas-star-program/natural-gas-star-program-accomplishments

Watson P., Wilson, J, Thilmany, D., and Winter, S. 2007. Determining economic contributions and impacts: What is the difference and why do we care? JRAP 37(2):1-15.

2017 Federal Land Manager Environmental Database
http://views.cira.colostate.edu/fed/AqrvMenu.aspx
http://views.cira.colostate.edu/fed/AqrvMenu.aspx

EPA

http://www.epa.gov/airdata

https://www.epa.gov/castnet

https://www.epa.gov/aboutepa/epa-region-8-mountains-and-plains

https://www.epa.gov/air-trends

Wyoming
http://wyvisnet.com/Data/Reports.aspx

Department of the Interior
https://www.doi.gov/ climate

Additional References

BLM Competitive Oil & Gas Leasing
https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/leasing

BLM 2017. Webpage: Leasing and Management of Split Estate. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.
https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/leasing/split-estate

BLM 2017. Webpage: Split Estate. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.
https://www.blm.gov/programs/energy-and-minerals/mining-and-minerals/split-estate

BLM 2007. Split Estate – Rights, Responsibilities, and Opportunities. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.
https://www.blm.gov/documents/national-office/public-room-blm-library/brochure/split-estate-rights-responsibilities-and

BLM 2008. Cultural Resource Requirements on Private Surface-Federal Minerals for Oil and Gas Development. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.
https://www.blm.gov/documents/national-office/blm-library/brochure/split-estate-cultural-resource-requirements-private

BLM, General Land Office. The Official Federal Land Records Site, provides live access to federal land conveyance records for the Public Land States. U.S. DOI, BLM, Washington, D.C.
http://www.glorecords.blm.gov/default.aspx

2017 Website: Wyoming Game and Fish Department
https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management

U.S. Department of the Interior, Bureau of Land Management. 2014. BLM Sensitive Species. Cheyenne, Wyoming.
http://www.blm.gov/wy/st/en/programs/pcp/species/sensitive.html

6.2 Acronyms

APD	Application for Permit to Drill
ARMPA	Approved Resource Management Plan Amendment
BBLS	Billion barrels
BFO	Buffalo Field Office
BLM	Bureau of Land Management
BMP	Best Management Practice
CFO	Casper Field Office
CFR	Code of Federal Regulation
CH4	methane
CO2	carbon dioxide
CO2e	CO_2 equivalents
COA	Condition of Approval
DOI	U.S. Department of Interior
EA	Environmental Assessment
EIA	U.S. Energy Information Agency
EIS	Environmental lmpact Statement
EPA	U.S.Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FLPMA	Federal Land Policy and Management Act
FONSI	Finding of No Signficant Impact
GHG	Greenhouse Gas
GSG	Greater Sage Grouse
GWP	Global Warming Potential
HDD	High Desert District
HPD	High Plains District
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
KFO	Kemmerer Field Office
LFO	Lander Field Office
MLA	Mineral Leasing Act
N2O	nitrous oxide
NEPA	National Environmental Protection Agency
NFO	Newcastle Field Office
PFO	Pinedale Field Office
RFD	Reasonably Foreseeable Development
RFO	Rawlins Field Office
RMG	Reservoir Management Group
RMP	Resource Management Plan
ROD	Record of Decision
RSFO	Rock Springs Field Office
USGS	U.S. Geological Survey
WRBBD	Wind River/Bighorn Basin District
WSO	Wyoming State Office

7.0 Attachments

7.1.1

Leases Issued

Sale	Lease Number	Field Office	Township	Range	Section	County	Acres
1505	WYW 184372	CASPER FIELD OFFICE	0380N	0760W	002	CONVERSE	239.91
1505	WYW 184243	KEMMERER FIELD OFFICE	0140N	1140W	3	UINTA	321.69
1505	WYW 184215	RAWLINS FIELD OFFICE	0200N	0820W	4	CARBON	613.79
1505	WYW 184230	RAWLINS FIELD OFFICE	0200N	0950W	32	SWEETWATER	278.75
1505	WYW 184236	RAWLINS FIELD OFFICE	0200N	0960W	20	SWEETWATER	1,900.83
1505	WYW 184231	RAWLINS FIELD OFFICE	0220N	0950W	6	SWEETWATER	1,275.09
1505	WYW 184233	RAWLINS FIELD OFFICE	0220N	0950W	18	SWEETWATER	2,240.40
1505	WYW 184238	RAWLINS FIELD OFFICE	0230N	0960W	1	SWEETWATER	319.06
1505	WYW 184219	RAWLINS FIELD OFFICE	0240N	0930W	2	SWEETWATER	880.96
1505	WYW 184223	RAWLINS FIELD OFFICE	0240N	0930W	19	SWEETWATER	2,241.54
1505	WYW 184225	RAWLINS FIELD OFFICE	0240N	0930W	30	SWEETWATER	2,459.46
1505	WYW 184226	RAWLINS FIELD OFFICE	0240N	0930W	31	SWEETWATER	2,541.44
1505	WYW 184374	CASPER FIELD OFFICE	0330N	0870W	18	NATRONA	236.80
1505	WYW 184403	CASPER FIELD OFFICE	0340N	0880W	5	NATRONA	2,536.48
1505	WYW 184382	CASPER FIELD OFFICE	0350N	0880W	7	NATRONA	507.07
1505	WYW 184376	CASPER FIELD OFFICE	0360N	0870W	1	NATRONA	1,441.38
1505	WYW 184377	CASPER FIELD OFFICE	0360N	0870W	2	NATRONA	2,390.69
1505	WYW 184378	CASPER FIELD OFFICE	0360N	0870W	3	NATRONA	2,422.38
1505	WYW 184383	CASPER FIELD OFFICE	0360N	0880W	1	NATRONA	649.15
1505	WYW 184384	CASPER FIELD OFFICE	0360N	0880W	5	NATRONA	2,275.42
1505	WYW 184387	LANDER FIELD OFFICE	0360N	0900W	5	FREMONT	1,203.65
1505	WYW 184388	LANDER FIELD OFFICE	0360N	0900W	6	FREMONT	911.64
1505	WYW 184389	LANDER FIELD OFFICE	0360N	0910W	6	FREMONT	2,074.21
1505	WYW 184393	LANDER FIELD OFFICE	0360N	0940W	2	FREMONT	2,438.80
1505	WYW 184394	LANDER FIELD OFFICE	0360N	0940W	7	FREMONT	2,226.14
1505	WYW 184345	NEWCASTLE FIELD OFFICE	0380N	0600W	6	NIOBRARA	1,892.81
1505	WYW 184346	NEWCASTLE FIELD OFFICE	0380N	0600W	10	NIOBRARA	1,928.15
1505	WYW 184347	NEWCASTLE FIELD OFFICE	0380N	0600W	18	NIOBRARA	2,502.80
1505	WYW 184348	NEWCASTLE FIELD OFFICE	0380N	0600W	22	NIOBRARA	2,013.66
1505	WYW 184349	NEWCASTLE FIELD OFFICE	0380N	0600W	34	NIOBRARA	1,609.15
1505	WYW 184350	NEWCASTLE FIELD OFFICE	0390N	0600W	31	NIOBRARA	241.31
1505	WYW 184354	NEWCASTLE FIELD OFFICE	0390N	0610W	30	NIOBRARA	2,106.20
1508	WYW 184351	NEWCASTLE FIELD OFFICE	0400N	0600W	3	NIOBRARA	2,291.55
1508	WYW 184352	NEWCASTLE FIELD OFFICE	0400N	0600W	7	NIOBRARA	2,196.70
1508	WYW 184353	NEWCASTLE FIELD OFFICE	0400N	0600W	30	NIOBRARA	1,032.70
1508	WYW 184357	NEWCASTLE FIELD OFFICE	0460N	0650W	5	WESTON	319.88
1508	WYW 184362	NEWCASTLE FIELD OFFICE	0460N	0660W	1	WESTON	722.60
1508	WYW 184359	NEWCASTLE FIELD OFFICE	0470N	0650W	2	WESTON	115.50
1508	WYW 184360	NEWCASTLE FIELD OFFICE	0470N	0650W	15	WESTON	199.36

1508	WYW 184401	NEWCASTLE FIELD OFFICE	0470N	0650W	17	WESTON	1,044.99
1508	WYW 184402	NEWCASTLE FIELD OFFICE	0470N	0660W	1	WESTON	960.60
1508	WYW 184368	NEWCASTLE FIELD OFFICE	0510N	0680W	10	CROOK	167.12
1508	WYW 184367	NEWCASTLE FIELD OFFICE	0510N	0680W	3	CROOK	168.51
1508	WYW 184396	CODY FIELD OFFICE	0560N	1000W	6	PARK	845.07
1508	WYW 184400	CODY FIELD OFFICE	0560N	1020W	8	PARK	128.10
1508	WYW 184395	CODY FIELD OFFICE	0570N	0990W	31	PARK	319.20
1508	WYW 184399	CODY FIELD OFFICE	0580N	1000W	32	PARK	880.48
1508	WYW 184369	NEWCASTLE FIELD OFFICE	0540N	0680W	19	CROOK	331.26
1508	WYW 184392	WORLAND FIELD OFFICE	0510N	0920W	35	BIG HORN	313.89
1508	WYW 184221	RAWLINS FIELD OFFICE	0240N	0930W	9	SWEETWATER	1,112.53
1508	WYW 184228	RAWLINS FIELD OFFICE	0250N	0930W	35	SWEETWATER	153.82
1508	WYW 184229	RAWLINS FIELD OFFICE	0190N	0950W	4	SWEETWATER	33.88
1508	WYW 184244	KEMMERER FIELD OFFICE	0150N	1140W	23	UINTA	1,769.00
1508	WYW 184381	CASPER FIELD OFFICE	0350N	0880W	4	NATRONA	638.94
1508	WYW 184216	RAWLINS FIELD OFFICE	0200N	0820W	14	CARBON	560.00
1508	WYW 184217	RAWLINS FIELD OFFICE	0130N	0920W	32	CARBON	80.00
1508	WYW 184218	RAWLINS FIELD OFFICE	0230N	0930W	20	SWEETWATER	600.00
1508	WYW 184220	RAWLINS FIELD OFFICE	0240N	0930W	8	SWEETWATER	160.00
1508	WYW 184222	RAWLINS FIELD OFFICE	0240N	0930W	17	SWEETWATER	720.00
1508	WYW 184224	RAWLINS FIELD OFFICE	0240N	0930W	26	SWEETWATER	1,280.00
1508	WYW 184227	RAWLINS FIELD OFFICE	0240N	0930W	35	SWEETWATER	640.00
1508	WYW 184232	RAWLINS FIELD OFFICE	0220N	0950W	26	SWEETWATER	1,920.00
1508	WYW 184234	RAWLINS FIELD OFFICE	0230N	0950W	22	SWEETWATER	2,560.00
1508	WYW 184235	RAWLINS FIELD OFFICE	0120N	0960W	15	SWEETWATER	640.00
1508	WYW 184237	RAWLINS FIELD OFFICE	0200N	0960W	26	SWEETWATER	320.00
1508	WYW 184239	ROCK SPRINGS FIELD OFFICE	0180N	0970W	6	SWEETWATER	40.00
1508	WYW 184240	ROCK SPRINGS FIELD OFFICE	0250N	0980W	13	SWEETWATER	640.00
1508	WYW 184241	RAWLINS FIELD OFFICE	0130N	0990W	25	SWEETWATER	640.00
1508	WYW 184242	ROCK SPRINGS FIELD OFFICE	0150N	0990W	12	SWEETWATER	160.00
1508	WYW 184245	KEMMERER FIELD OFFICE	0170N	1190W	26	UINTA	1,280.00
1508	WYW 184246	CASPER FIELD OFFICE	0340N	0880W	22	NATRONA	1,360.00
1508	WYW 184247	ROCK SPRINGS FIELD OFFICE	0200N	1020W	4	SWEETWATER	2,353.80
1508	WYW 184355	NEWCASTLE FIELD OFFICE	0360N	0630W	29	NIOBRARA	40.00
1508	WYW 184356	NEWCASTLE FIELD OFFICE	0370N	0650W	28	NIOBRARA	160.00
1508	WYW 184358	NEWCASTLE FIELD OFFICE	0460N	0650W	13	WESTON	160.00
1508	WYW 184361	NEWCASTLE FIELD OFFICE	0480N	0650W	34	WESTON	675.87
1508	WYW 184363	NEWCASTLE FIELD OFFICE	0460N	0660W	5	WESTON	600.00
1508	WYW 184364	NEWCASTLE FIELD OFFICE	0460N	0660W	24	WESTON	480.00
1508	WYW 184365	NEWCASTLE FIELD OFFICE	0460N	0660W	29	WESTON	1,160.00
1508	WYW 184366	NEWCASTLE FIELD OFFICE	0540N	0670W	32	CROOK	400.00
1508	WYW 184370	CASPER FIELD OFFICE	0350N	0690W	11	CONVERSE	240.00

1508	WYW 184371	CASPER FIELD OFFICE	0360N	0690W	12	CONVERSE	160.00
1508	WYW 184373	CASPER FIELD OFFICE	0330N	0770W	15	CONVERSE	40.00
1508	WYW 184375	CASPER FIELD OFFICE	0330N	0870W	29	NATRONA	200.00
1508	WYW 184379	CASPER FIELD OFFICE	0360N	0870W	19	NATRONA	240.00
1508	WYW 184380	CASPER FIELD OFFICE	0330N	0880W	12	NATRONA	320.00
1508	WYW 184385	CASPER FIELD OFFICE	0360N	0880W	12	NATRONA	360.00
1508	WYW 184386	LANDER FIELD OFFICE	0340N	0900W	34	FREMONT	280.00
1508	WYW 184390	WORLAND FIELD OFFICE	0500N	0910W	35	BIG HORN	591.44
1508	WYW 184391	WORLAND FIELD OFFICE	0470N	0920W	25	WASHAKIE	240.00
1508	WYW 184397	CODY FIELD OFFICE	0560N	1000W	10	PARK	1,040.00
1511	WYW 184398	CODY FIELD OFFICE	0570N	1000W	14	PARK	640.00
1511	WYW 184532	RAWLINS FIELD OFFICE	0190N	0890W	6	CARBON	2,395.82
1511	WYW 184533	RAWLINS FIELD OFFICE	0200N	0890W	12	CARBON	1,107.44
1511	WYW 184534	RAWLINS FIELD OFFICE	0200N	0890W	18	CARBON	1,640.87
1511	WYW 184535	RAWLINS FIELD OFFICE	0200N	0890W	32	CARBON	1,093.75
1511	WYW 184536	RAWLINS FIELD OFFICE	0180N	0900W	4	CARBON	2,390.85
1511	WYW 184537	RAWLINS FIELD OFFICE	0130N	0920W	20	CARBON	640.00
1511	WYW 184538	RAWLINS FIELD OFFICE	0130N	0940W	29	SWEETWATER	840.00
1511	WYW 184539	RAWLINS FIELD OFFICE	0140N	0940W	6	SWEETWATER	622.64
1511	WYW 184540	RAWLINS FIELD OFFICE	0130N	0950W	6	SWEETWATER	398.62
1511	WYW 184541	RAWLINS FIELD OFFICE	0230N	0950W	34	SWEETWATER	1,280.00
1511	WYW 184542	RAWLINS FIELD OFFICE	0230N	0960W	28	SWEETWATER	947.34
1511	WYW 184543	ROCK SPRINGS FIELD OFFICE	0240N	0970W	7	SWEETWATER	266.07
1511	WYW 184544	RAWLINS FIELD OFFICE, ROCK SPRINGS FIELD OFFICE	0250N	0970W	13	SWEETWATER	1,280.00
1511	WYW 184545	KEMMERER FIELD OFFICE	0210N	1130W	18	LINCOLN	1,597.28
1511	WYW 184546	KEMMERER FIELD OFFICE	0220N	1130W	4	LINCOLN	2,466.42
1511	WYW 184547	KEMMERER FIELD OFFICE	0220N	1130W	18	LINCOLN	2,513.48
1511	WYW 184548	KEMMERER FIELD OFFICE	0220N	1130W	19	LINCOLN	2,514.52
1511	WYW 184549	KEMMERER FIELD OFFICE	0220N	1130W	32	LINCOLN	1,871.44
1511	WYW 184550	KEMMERER FIELD OFFICE	0230N	1130W	22	LINCOLN	876.73
1511	WYW 184551	KEMMERER FIELD OFFICE	0230N	1130W	25	LINCOLN	1,801.56
1511	WYW 184552	KEMMERER FIELD OFFICE	0230N	1130W	33	LINCOLN	40.00
1511	WYW 184553	KEMMERER FIELD OFFICE	0130N	1140W	26	UINTA	400.00
1511	WYW 184554	KEMMERER FIELD OFFICE	0160N	1140W	2	UINTA	2,013.16
1511	WYW 184555	KEMMERER FIELD OFFICE	0210N	1140W	5	LINCOLN	2,153.48
1511	WYW 184556	KEMMERER FIELD OFFICE	0210N	1140W	6	LINCOLN	1,995.32
1511	WYW 184557	KEMMERER FIELD OFFICE	0210N	1140W	24	LINCOLN	2,505.47
1511	WYW 184558	KEMMERER FIELD OFFICE	0210N	1140W	20	LINCOLN	1,258.25
1511	WYW 184559	KEMMERER FIELD OFFICE	0220N	1140W	1	LINCOLN	280.00
1511	WYW 184560	KEMMERER FIELD OFFICE	0220N	1140W	10	LINCOLN	680.00
1511	WYW 184561	KEMMERER FIELD OFFICE	0220N	1140W	13	LINCOLN	2,360.00
1511	WYW 184562	KEMMERER FIELD OFFICE	0220N	1140W	18	LINCOLN	2,548.76

1511	WYW 184563	KEMMERER FIELD OFFICE	0220N	1140W	23	LINCOLN	2,560.00
1511	WYW 184564	KEMMERER FIELD OFFICE	0220N	1140W	26	LINCOLN	2,358.84
1511	WYW 184565	KEMMERER FIELD OFFICE	0220N	1140W	30	LINCOLN	1,747.49
1511	WYW 184566	KEMMERER FIELD OFFICE	0220N	1140W	31	LINCOLN	1,915.44
1511	WYW 184567	KEMMERER FIELD OFFICE	0170N	1190W	20	UINTA	2,560.00
1511	WYW 184568	KEMMERER FIELD OFFICE	0170N	1190W	30	UINTA	2,558.88
1511	WYW 184569	KEMMERER FIELD OFFICE	0200N	1190W	26	LINCOLN	520.00
1511	WYW 185098	NEWCASTLE FIELD OFFICE	0360N	0600W	8	NIOBRARA	560.00
1602	WYW 185099	NEWCASTLE FIELD OFFICE	0360N	0600W	9	NIOBRARA	160.00
1605	WYW 185100	NEWCASTLE FIELD OFFICE	0360N	0600W	28	NIOBRARA	1,075.22
1605	WYW 185101	NEWCASTLE FIELD OFFICE	0370N	0600W	3	NIOBRARA	1,003.49
1605	WYW 185102	NEWCASTLE FIELD OFFICE	0370N	0600W	7	NIOBRARA	2,241.48
1605	WYW 185103	NEWCASTLE FIELD OFFICE	0370N	0600W	15	NIOBRARA	1,878.24
1605	WYW 185104	NEWCASTLE FIELD OFFICE	0370N	0600W	15	NIOBRARA	1,200.15
1605	WYW 185105	NEWCASTLE FIELD OFFICE	0370N	0600W	19	NIOBRARA	2,283.49
1605	WYW 185106	NEWCASTLE FIELD OFFICE	0370N	0600W	22	NIOBRARA	2,326.31
1605	WYW 185107	NEWCASTLE FIELD OFFICE	0350N	0610W	1	NIOBRARA	641.03
1605	WYW 185108	NEWCASTLE FIELD OFFICE	0390N	0610W	11	NIOBRARA	120.00
1605	WYW 185109	CASPER FIELD OFFICE	0260N	0620W	20	GOSHEN	160.00
1605	WYW 185110	NEWCASTLE FIELD OFFICE	0390N	0630W	2	NIOBRARA	600.31
1605	WYW 185111	NEWCASTLE FIELD OFFICE	0390N	0630W	4	NIOBRARA	2,260.73
1605	WYW 185112	NEWCASTLE FIELD OFFICE	0400N	0630W	25	NIOBRARA	480.00
1605	WYW 185113	NEWCASTLE FIELD OFFICE	0400N	0630W	29	NIOBRARA	1,967.08
1605	WYW 185114	NEWCASTLE FIELD OFFICE	0350N	0640W	2	NIOBRARA	400.76
1605	WYW 185115	NEWCASTLE FIELD OFFICE	0390N	0640W	3	NIOBRARA	603.31
1605	WYW 185116	NEWCASTLE FIELD OFFICE	0410N	0640W	23	NIOBRARA, WESTON	240.00
1605	WYW 185117	NEWCASTLE FIELD OFFICE	0420N	0640W	12	WESTON	236.27
1605	WYW 185118	NEWCASTLE FIELD OFFICE	0460N	0640W	1	WESTON	320.69
1605	WYW 185119	NEWCASTLE FIELD OFFICE	0460N	0650W	19	WESTON	199.01
1605	WYW 185120	CASPER FIELD OFFICE	0330N	0670W	6	CONVERSE	40.00
1605	WYW 185121	CASPER FIELD OFFICE	0370N	0670W	4	CONVERSE	320.44
1605	WYW 185122	CASPER FIELD OFFICE	0370N	0670W	5	CONVERSE	720.35
1605	WYW 185123	NEWCASTLE FIELD OFFICE	0530N	0670W	21	CROOK	40.00
1605	WYW 185124	NEWCASTLE FIELD OFFICE	0530N	0670W	31	CROOK	80.00
1605	WYW 185126	NEWCASTLE FIELD OFFICE	0500N	0680W	10	CROOK	274.50
1605	WYW 185127	NEWCASTLE FIELD OFFICE	0540N	0680W	11	CROOK	283.76
1605	WYW 185129	CASPER FIELD OFFICE	0390N	0730W	14	CONVERSE	80.00
1605	WYW 185130	CASPER FIELD OFFICE	0390N	0730W	23	CONVERSE	160.00
1605	WYW 185132	CASPER FIELD OFFICE	0410N	0760W	28	CAMPBELL, CONVERSE	240.00
1605	WYW 185135	LANDER FIELD OFFICE	0360N	0890W	7	FREMONT	1,579.68
1605	WYW 185136	LANDER FIELD OFFICE	0360N	0890W	17	FREMONT	939.92

1605	WYW 185137	LANDER FIELD OFFICE	0360N	0890W	19	FREMONT	1,940.24
1605	WYW 185138	LANDER FIELD OFFICE	0360N	0890W	31	FREMONT	384.78
1605	WYW 185139	LANDER FIELD OFFICE	0360N	0900W	13	FREMONT	2,400.00
1605	WYW 185140	LANDER FIELD OFFICE	0360N	0900W	20	FREMONT	1,320.00
1605	WYW 185141	LANDER FIELD OFFICE	0360N	0910W	21	FREMONT	2,560.00
1605	WYW 185142	LANDER FIELD OFFICE	0360N	0910W	31	FREMONT	1,421.88
1605	WYW 185143	LANDER FIELD OFFICE	0380N	0910W	29	FREMONT	40.00
1605	WYW 185144	LANDER FIELD OFFICE	0360N	0920W	1	FREMONT	1,460.00
1605	WYW 185145	LANDER FIELD OFFICE	0360N	0920W	20	FREMONT	2,560.00
1605	WYW 185146	LANDER FIELD OFFICE	0360N	0920W	29	FREMONT	1,688.36
1605	WYW 185147	LANDER FIELD OFFICE	0360N	0920W	31	FREMONT	720.00
1605	WYW 185148	LANDER FIELD OFFICE	0360N	0920W	32	FREMONT	1,280.00
1605	WYW 185275	RAWLINS FIELD OFFICE	0250N	0880W	6	CARBON	439.13
1605	WYW 185276	RAWLINS FIELD OFFICE	0250N	0890W	13	CARBON	510.00
1605	WYW 185277	RAWLINS FIELD OFFICE	0250N	0890W	22	CARBON	1,420.00
1605	WYW 185278	RAWLINS FIELD OFFICE	0260N	0900W	2	SWEETWATER	2,105.76
1605	WYW 185279	RAWLINS FIELD OFFICE	0260N	0900W	13	SWEETWATER	280.00
1605	WYW 185280	RAWLINS FIELD OFFICE	0260N	0900W	22	SWEETWATER	680.00
1605	WYW 185281	RAWLINS FIELD OFFICE	0130N	0940W	26	SWEETWATER	720.00
1605	WYW 185282	RAWLINS FIELD OFFICE	0140N	0940W	31	SWEETWATER	320.00
1605	WYW 185283	RAWLINS FIELD OFFICE, ROCK SPRINGS FIELD OFFICE	0170N	0950W	4	SWEETWATER	2,031.73
1605	WYW 185285	ROCK SPRINGS FIELD OFFICE	0130N	0990W	29	SWEETWATER	1,921.04
1605	WYW 185286	ROCK SPRINGS FIELD OFFICE	0130N	0990W	32	SWEETWATER	640.00
1605	WYW 185287	RAWLINS FIELD OFFICE, ROCK SPRINGS FIELD OFFICE	0140N	0990W	19	SWEETWATER	1,751.52
1605	WYW 185288	ROCK SPRINGS FIELD OFFICE	0130N	1000W	24	SWEETWATER	960.00
1605	WYW 185289	ROCK SPRINGS FIELD OFFICE	0140N	1000W	1	SWEETWATER	999.67
1605	WYW 185290	ROCK SPRINGS FIELD OFFICE	0250N	1110W	5	LINCOLN	197.35
1605	WYW 185291	ROCK SPRINGS FIELD OFFICE	0250N	1110W	9	SWEETWATER	239.85
1605	WYW 185292	ROCK SPRINGS FIELD OFFICE	0260N	1110W	3	SWEETWATER	679.51
1605	WYW 185293	ROCK SPRINGS FIELD OFFICE	0260N	1110W	3	SWEETWATER	240.00
1605	WYW 185294	ROCK SPRINGS FIELD OFFICE	0260N	1110W	7	LINCOLN	817.68
1605	WYW 185295	ROCK SPRINGS FIELD OFFICE	0130N	1120W	30	UINTA	471.68
1605	WYW 185296	PINEDALE FIELD OFFICE	0290N	1140W	22	SUBLETTE	2,240.00
1605	WYW 185297	PINEDALE FIELD OFFICE	0290N	1140W	26	SUBLETTE	680.00
1605	WYW 185298	KEMMERER FIELD OFFICE	0170N	1190W	24	UINTA	480.00
1605	WYW 185299	KEMMERER FIELD OFFICE	0130N	1200W	6	UINTA	731.02
1605	WYW 185300	KEMMERER FIELD OFFICE	0140N	1200W	18	UINTA	1,835.25
1605	WYW 185301	KEMMERER FIELD OFFICE	0150N	1200W	14	UINTA	1,200.00
1605	WYW 185302	KEMMERER FIELD OFFICE	0130N	1210W	2	UINTA	797.32
1605	WYW 185303	KEMMERER FIELD OFFICE	0140N	1210W	12	UINTA	1,440.00
1605	WYW 185181	NEWCASTLE FIELD OFFICE	0430N	0640W	1	WESTON	280.23

1605	WYW 185182	NEWCASTLE FIELD OFFICE	0430N	0640W	2	WESTON	40.00
1605	WYW 185185	WORLAND FIELD OFFICE	0450N	1000W	3	HOT SPRINGS	240.00
1608	WYW 185186	WORLAND FIELD OFFICE	0450N	1000W	4	HOT SPRINGS	200.00
1608	WYW 185187	CODY FIELD OFFICE	0500N	1000W	16	PARK	1,354.53
1608	WYW 185188	CASPER FIELD OFFICE	0400N	0730W	21	CONVERSE	1,000.00
1608	WYW 185189	LANDER FIELD OFFICE	0280N	0910W	19	FREMONT	307.23
1608	WYW 185195	LANDER FIELD OFFICE	0270N	0900W	25	FREMONT	1,800.00
1608	WYW 185403	NEWCASTLE FIELD OFFICE	0360N	0600W	5	NIOBRARA	1,715.32
1608	WYW 185404	NEWCASTLE FIELD OFFICE	0360N	0600W	17	NIOBRARA	240.00
1608	WYW 185405	NEWCASTLE FIELD OFFICE	0380N	0600W	4	NIOBRARA	120.00
1608	WYW 185406	NEWCASTLE FIELD OFFICE	0390N	0600W	31	NIOBRARA	40.00
1608	WYW 185407	NEWCASTLE FIELD OFFICE	0390N	0600W	31	NIOBRARA	280.00
1608	WYW 185408	NEWCASTLE FIELD OFFICE	0410N	0600W	19	WESTON	479.96
1608	WYW 185409	NEWCASTLE FIELD OFFICE	0380N	0610W	18	NIOBRARA	600.00
1608	WYW 185410	NEWCASTLE FIELD OFFICE	0410N	0610W	13	WESTON	480.00
1608	WYW 185411	NEWCASTLE FIELD OFFICE	0410N	0610W	24	WESTON	480.00
1608	WYW 185412	NEWCASTLE FIELD OFFICE	0380N	0620W	7	NIOBRARA	1,513.32
1608	WYW 185413	NEWCASTLE FIELD OFFICE	0380N	0620W	24	NIOBRARA	200.00
1608	WYW 185414	NEWCASTLE FIELD OFFICE	0370N	0650W	29	NIOBRARA	960.00
1608	WYW 185415	NEWCASTLE FIELD OFFICE	0370N	0650W	33	NIOBRARA	600.00
1608	WYW 185416	NEWCASTLE FIELD OFFICE	0430N	0650W	5	WESTON	786.43
1608	WYW 185417	NEWCASTLE FIELD OFFICE	0440N	0650W	22	WESTON	440.00
1608	WYW 185418	NEWCASTLE FIELD OFFICE	0440N	0650W	23	WESTON	1,552.00
1608	WYW 185419	NEWCASTLE FIELD OFFICE	0430N	0660W	12	WESTON	840.00
1608	WYW 185420	NEWCASTLE FIELD OFFICE	0440N	0660W	8	WESTON	240.00
1608	WYW 185421	NEWCASTLE FIELD OFFICE	0440N	0660W	35	WESTON	80.00
1608	WYW 185422	NEWCASTLE FIELD OFFICE	0450N	0660W	14	WESTON	240.00
1608	WYW 185423	NEWCASTLE FIELD OFFICE	0510N	0670W	4	CROOK	521.09
1608	WYW 185424	NEWCASTLE FIELD OFFICE	0510N	0670W	4	CROOK	201.58
1608	WYW 185425	NEWCASTLE FIELD OFFICE	0510N	0670W	5	CROOK	562.57
1608	WYW 185426	NEWCASTLE FIELD OFFICE	0520N	0670W	29	CROOK	320.00
1608	WYW 185427	NEWCASTLE FIELD OFFICE	0500N	0680W	2	CROOK	448.71
1608	WYW 185428	NEWCASTLE FIELD OFFICE	0500N	0680W	2	CROOK	365.97
1608	WYW 185429	NEWCASTLE FIELD OFFICE	0510N	0680W	25	CROOK	441.72
1608	WYW 185430	NEWCASTLE FIELD OFFICE	0520N	0680W	24	CROOK	81.88
1608	WYW 185431	CASPER FIELD OFFICE	0380N	0720W	4	CONVERSE	2,379.90
1608	WYW 185432	CASPER FIELD OFFICE	0350N	0750W	14	CONVERSE	320.40
1608	WYW 185433	CASPER FIELD OFFICE	0350N	0750W	13	CONVERSE	314.01
1608	WYW 185434	CASPER FIELD OFFICE	0350N	0750W	23	CONVERSE	1,709.38
1608	WYW 185435	LANDER FIELD OFFICE	0270N	0900W	31	FREMONT	2,160.00
1608	WYW 185436	WORLAND FIELD OFFICE	0510N	0910W	18	BIG HORN	1,472.64
1608	WYW 185437	WORLAND FIELD OFFICE	0480N	0930W	3	WASHAKIE	2,055.96

1608	WYW 185438	WORLAND FIELD OFFICE	0480N	0930W	22	WASHAKIE	1,382.56
1608	WYW 185439	WORLAND FIELD OFFICE	0490N	0930W	2	BIG HORN	2,320.52
1608	WYW 185440	WORLAND FIELD OFFICE	0490N	0930W	12	BIG HORN	2,080.00
1608	WYW 185441	WORLAND FIELD OFFICE	0500N	0930W	17	BIG HORN	2,076.46
1608	WYW 185442	WORLAND FIELD OFFICE	0510N	0930W	6	BIG HORN	2,151.16
1608	WYW 185443	WORLAND FIELD OFFICE	0510N	0930W	30	BIG HORN	2,130.31
1608	WYW 185444	WORLAND FIELD OFFICE	0490N	0940W	1	BIG HORN	761.87
1608	WYW 185445	WORLAND FIELD OFFICE	0510N	0940W	1	BIG HORN	2,040.00
1608	WYW 185446	WORLAND FIELD OFFICE	0510N	0940W	24	BIG HORN	2,060.25
1608	WYW 185447	CODY FIELD OFFICE	0520N	0940W	1	BIG HORN	2,326.38
1608	WYW 185448	CODY FIELD OFFICE	0520N	0940W	19	BIG HORN	2,422.68
1608	WYW 185449	CODY FIELD OFFICE, WORLAND FIELD OFFICE	0520N	0940W	27	BIG HORN	942.72
1608	WYW 185450	CODY FIELD OFFICE	0530N	0940W	1	BIG HORN	2,505.74
1608	WYW 185451	CODY FIELD OFFICE	0530N	0940W	6	BIG HORN	2,543.43
1608	WYW 185452	CODY FIELD OFFICE	0530N	0940W	10	BIG HORN	2,522.91
1608	WYW 185453	CODY FIELD OFFICE	0530N	0940W	16	BIG HORN	1,959.70
1608	WYW 185454	CODY FIELD OFFICE	0530N	0940W	18	BIG HORN	2,551.96
1608	WYW 185455	CODY FIELD OFFICE	0530N	0940W	25	BIG HORN	2,555.36
1608	WYW 185456	CODY FIELD OFFICE	0530N	0940W	29	BIG HORN	2,558.08
1608	WYW 185457	CODY FIELD OFFICE	0530N	0940W	33	BIG HORN	1,890.16
1608	WYW 185458	CODY FIELD OFFICE	0520N	0950W	21	BIG HORN	678.56
1608	WYW 185459	CODY FIELD OFFICE	0530N	0950W	13	BIG HORN	2,040.00
1608	WYW 185460	CODY FIELD OFFICE	0530N	0960W	1	BIG HORN	2,235.81
1608	WYW 185461	CODY FIELD OFFICE	0530N	0960W	10	BIG HORN	1,980.96
1608	WYW 185462	CODY FIELD OFFICE	0530N	0960W	21	BIG HORN	1,237.02
1608	WYW 185463	LANDER FIELD OFFICE	0320N	0990W	11	FREMONT	80.00
1608	WYW 185464	LANDER FIELD OFFICE	0320N	0990W	13	FREMONT	160.00
1608	WYW 185465	LANDER FIELD OFFICE	0320N	0990W	13	FREMONT	80.00
1608	WYW 185466	LANDER FIELD OFFICE	0320N	0990W	14	FREMONT	40.00
1608	WYW 185467	LANDER FIELD OFFICE	0330N	0990W	14	FREMONT	200.00
1608	WYW 185468	WORLAND FIELD OFFICE	0450N	1000W	3	HOT SPRINGS	1,523.97
1608	WYW 185469	WORLAND FIELD OFFICE	0450N	1000W	19	HOT SPRINGS	1,709.77
1608	WYW 185470	CODY FIELD OFFICE	0540N	1000W	1	PARK	435.47
1608	WYW 185284	ROCK SPRINGS FIELD OFFICE	0150N	0960W	4	SWEETWATER	122.01
1608	WYW 185125	CASPER FIELD OFFICE	0370N	0680W	12	CONVERSE	360.00
1608	WYW 185402	NEWCASTLE FIELD OFFICE	0360N	0600W	3	NIOBRARA	897.61

7.1.2 Emission Estimates per Lease Sale

Wyoming Proposed Action-Per Sale Calculation: Direct CO_2e

Sale	Total Number of Leases Offered	Total Number of Leases Offered by Planning Unit	Planning unit	Total Acreage Leases Issued	Direct CO_2e by Sale and Planning Unit	Total Direct CO_2e by Sale
May-2015	31	31	GSG ARMPA	30,382.2	4,524.6	,4524.6
Aug-2015	61	9	Bighorn	4,998.2	1,819.3	
		6	Lander	9,134.4	5,200.0	
		46	GSG ARMPA	42,778.9	6,370.8	13,390.1
Nov-2015	39	39	GSG ARMPA	61,353.7	9,137.0	9,137.0
May-2016	76	62	GSG ARMPA	50,507.1	7,521.7	
		14	Lander	20,294.9	11,553.3	1,9075.0
Aug-2016	76	33	Bighorn	58,946.9	21,456.7	
		8	Lander	4,827.2	2,748.0	
		35	GSG ARMPA	19,594.2	2,918.0	27,122.7
						Total: 73,249.5

Wyoming Proposed Action-Per Sale Calculation: Indirect CO_2e

Sale	Total Number of Leases Offered	Total Number of Leases Offered by Planning Unit	Planning unit	Total Acreage Leases Issued	Total Indirect CO_2e by Sale and Planning Unit	Total Indirect CO_2e by Sale
May-2015	31	31	GSG RMPA	3,0382.2	81,852.9	81,852.9
Aug-2015	61	9	Bighorn	4,998.2	5,010.3	
		6	Lander	9,134.4	48,667.2	
		46	GSG ARMPA	42,778.9	115,250.9	168,928.3
Nov-2015	39	39	GSG ARMPA	61,353.7	165,293.3	165,293.3
May-2016	76	14	Lander	20,294.9	108171.6	
		42	GSG ARMPA	50,507.1	135,864.2	244,035.8
Aug-2016	76	33	Bighorn	58,946.9	59,089.7	
		8	Lander	4,827.2	25,718.9	
		35	GSG ARMPA	19,594.2	52,788.9	137597.5
						Total: 797,707.8