Analysis of the Overlap between Priority Greater Sage-Grouse Habitats and Existing and Potential Energy Development Across the West

Final Report

October 16, 2014

Prepared for:

Western Values Project

Prepared by:

Chad LeBeau, Jeff Fruhwirth, and J.R. Boehrs

Western EcoSystems Technology, Inc.
415 West 17th Street, Suite 200
Cheyenne, Wyoming 82001

October 16, 2014

EXECUTIVE SUMMARY

Greater sage-grouse have experienced range-wide population declines, and many monitored populations have declined, on average 2% per year since 1965. Decline in greater sage-grouse populations has been attributed to degradation of sagebrush habitats from disturbance factors, including agricultural conversion, invasions of exotic plants leading to increased fire frequencies, and, more recently, energy exploration and development. Greater sage-grouse was proposed to be listed as an endangered or threatened species under the Endangered Species Act (ESA) of 1973, and in 2010, the U.S. Fish and Wildlife Service (USFWS) found that the proposed listing was warranted but precluded by higher priority listing actions. The USFWS is required to issue its proposed listing decision in September 2015. The impending listing decision of greater sage-grouse has prompted an inter-state, inter-agency planning effort by federal agencies and states within the greater sage-grouse range. Each state mapped key greater sage-grouse habitats and the USFWS used these as the basis for identifying Priority Areas for Conservation (PACs). Loss of habitat as a result of further infrastructure development within the PACs, among other factors, would reduce long-term viability of sage-grouse populations.

The objectives of this study are twofold:

1. to evaluate the overlap between the PACs and existing leases and rights-of-way (ROWs) for coal, oil and gas, solar and wind energy development on federal lands and minerals;[1] and
2. to analyze the development potential for oil and gas, solar, and wind energy on federal lands and minerals within the PACs and compare that to the development potential for lands outside of the PACs.[2]

We restricted the analysis to seven states that include 92% of the PACs: Colorado, Idaho, Montana, Nevada, Oregon, Utah and Wyoming. We further restricted the analysis to federal lands and minerals that are managed by the Bureau of Land Management (BLM) and United States Forest Service (FS). We acquired energy development leases and ROWs from the BLM's LR2000 and energy development potential from various sources, and then used this information to calculate the acreages and percentages included in this study.

The principal findings of this analysis are as follows:

- **There is less than 13% overlap between the PACs and existing leases and ROWs for coal, oil and gas, solar and wind energy development on federal lands and**

[1] When discussing all of the activities (e.g., coal, oil and gas, solar, and wind), this study uses the term "federal lands and minerals." However, federal minerals data is not applicable to solar and wind. Thus, we use the term "federal lands" when discussing those specific activities.
[2] Development potential for coal was not available.

minerals. Less than 1% of federal lands and minerals within the PACs are leased for coal and less than 12% are leased for oil and gas (only 2% of which are in-production). Also, there are no approved solar ROWs within the PACs and less than 1% of the PACs are covered by wind ROWs.

- **The majority of federal lands and minerals within the PACs have zero to low potential for oil and gas, solar, and wind energy development.** For oil and gas, approximately 84% of federal lands and minerals within the PACs have zero to low development potential. For solar, approximately 70% federal lands within the PACs have very low to low development potential. And for wind, approximately 94% of federal lands within the PACs have very low to low development potential.

- **The majority of federal lands and minerals identified as medium or high development potential for oil and gas, solar, and wind are located outside of the PACs.** For oil and gas, approximately 73% of federal lands and minerals within the study area with medium to high development potential are located outside of the PACs. For solar, approximately 81% of federal lands with medium to high development potential are located outside of the PACs. And for wind, approximately 75% of federal lands with medium to high development potential are located outside of the PACs.

REPORT REFERENCE

LeBeau C., J. Fruhwirth and J. Boehrs. 2014. Analysis of the Overlap between Priority Greater Sage-Grouse Habitats and Existing and Potential Energy Development Across the West. Final Report: October 16 2014. Prepared for Western Values Project, Bozeman, Montana. Prepared by Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

Greater sage-grouse (*Centrocercus urophasianus*) occur in California, Colorado, Idaho, Montana, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming, as well as Canada, and occupy about 56% of their historical pre-settlement range (Schroeder et al. 2004). Greater sage-grouse (hereafter sage-grouse) have experienced range-wide population declines, and many monitored populations have declined approximately 2% per year since 1965 (Connelly et al. 2004). Garton et al. (2011) projected that 75% of populations and 29% of the seven management zones in the United States are likely to decline below effective population sizes of 500 within 100 yrs if current conditions and trends persist.

The decline in sage-grouse populations has been attributed to degradation of sagebrush habitats (Knick et al. 2003 and Connelly et al. 2004) from disturbance factors, including agricultural conversion (Swenson et al. 1987, Connelly et al. 2004), invasions of exotic plants leading to increased fire frequencies (Knick et al. 2003, Connelly et al. 2004), and, more recently, energy exploration and development (Naugle et al. 2011, Gregory and Beck 2014, LeBeau et al. 2014). Sage-grouse are a sagebrush obligate species (Braun et al. 1977), entirely dependent on healthy, contiguous sagebrush habitats for successful reproduction and survival (Schroeder et al. 1999, Connelly et al. 2004). Fragmentation and degradation of sagebrush habitats inhibit sage-grouse productivity and survival, which have long-term impacts on affected sage-grouse populations. Understanding current threats and potential new threats to sage-grouse populations is imperative to the viability and conservation of this species.

Sage-grouse was proposed to be listed as an endangered or threatened species under the ESA of 1973, and in 2010 the USFWS found that the proposed listing was warranted but precluded by higher priority listing actions. Sage-grouse was designated a candidate species for listing under the ESA on March 23, 2010 (75 FR 13910). Currently, the USFWS is in the process of evaluating the status of sage-grouse to determine the need for potential listing as a threatened or endangered species under the ESA. The USFWS is required to issue its proposed listing decision in September 2015.

The impending listing decision of sage-grouse has prompted an inter-state, inter-agency planning effort by federal agencies, primarily BLM and FS, and states within the sage-grouse range. The USFWS has developed range-wide conservation objectives to define the degree to which threats need to be reduced or ameliorated to conserve sage-grouse across their entire range (USFWS 2013). As part of this effort, the USFWS identified PACs, which are based on key habitats mapped by individual states (USFWS 2013; Figure 1).

PACs are similar to preliminary priority habitat maps developed by the BLM for their range-wide Resource Management Plan (RMP) revisions. The BLM, along with the states, is currently developing conservation objectives and management standards for the PACs that will aim to reverse negative population trends and avoid the need to list the species. Those objectives and standards will be incorporated into the federal and state management plans, most of which are scheduled for release in late 2014/early 2015.

Loss of habitat as a result of further infrastructure development within the PACs, among other factors, would reduce long-term viability of sage-grouse populations (USFWS 2013). Accordingly, this study: (1) evaluates the overlap between the PACs and existing leases and ROWs for coal, oil and gas, solar, and wind energy development on federal lands and minerals; and (2) analyzes the development potential for oil and gas, solar, and wind energy on federal lands and minerals within the PACs and compares that to the development potential for lands and minerals outside of the PACs.[3] More specifically, we delineated active leases and ROWs, both those that are currently operational (e.g., operating coal facility) and those with no current development, and identified development potential to provide further insight into future development scenarios.

STUDY AREA

The PACs overlap 11 states and seven sage-grouse management zones. We restricted this analysis to states that encompassed 92% of the entire PACs: Colorado, Idaho, Montana, Nevada, Oregon, Utah, and Wyoming (hereafter study area; Figure 1). The largest percentage of the PACs occur in Nevada (26.6%), followed by Wyoming (19.9%; Table 1). For oil and gas and coal, we restricted the analysis to lands and minerals that were managed by the BLM and FS.[4] All other development types (e.g., solar and wind) were analyzed using federal surface lands only.

[3] Development potential for coal was not available.

[4] Federal mineral ownership data for Nevada was not available. Consequently, for Nevada only, we restricted the analysis for oil and gas and coal to federal lands.

Table 1. Distribution of sage-grouse PACs and federal lands and minerals within the range of sage-grouse.

State	Entire PACs		Federal Lands and Minerals Within PACs	
	Acres	**% of PACs**	**Acres**	**% PACs**
Colorado	2,366,865	3.1	1,669,814	3.1
Idaho	9,786,733	12.7	7,136,134	13.2
Montana	9,046,982	11.8	4,576,939	8.4
Nevada[1]	20,456,430	26.6	15,710,777	29.0
Utah	7,487,091	9.7	7,102,472	13.1
Oregon	6,565,533	8.5	4,901,892	9.0
Wyoming	15,293,850	19.9	11,465,893	21.2
Study Area Sub-Total	***71,003,484***	***92.3***	***52,563,921***	***97.0***
South Dakota[1]	621,308	0.8	87,733	0.2
California	2,145,652	2.8	1,427,630	2.6
North Dakota[1]	462,482	0.6	27,460	0.1
Washington	2,700,865	3.5	74,651	0.1
Total	**76,933,791**	**100.0**	**54,181,395**	**100.0**

[1]Federal lands do not include federal minerals

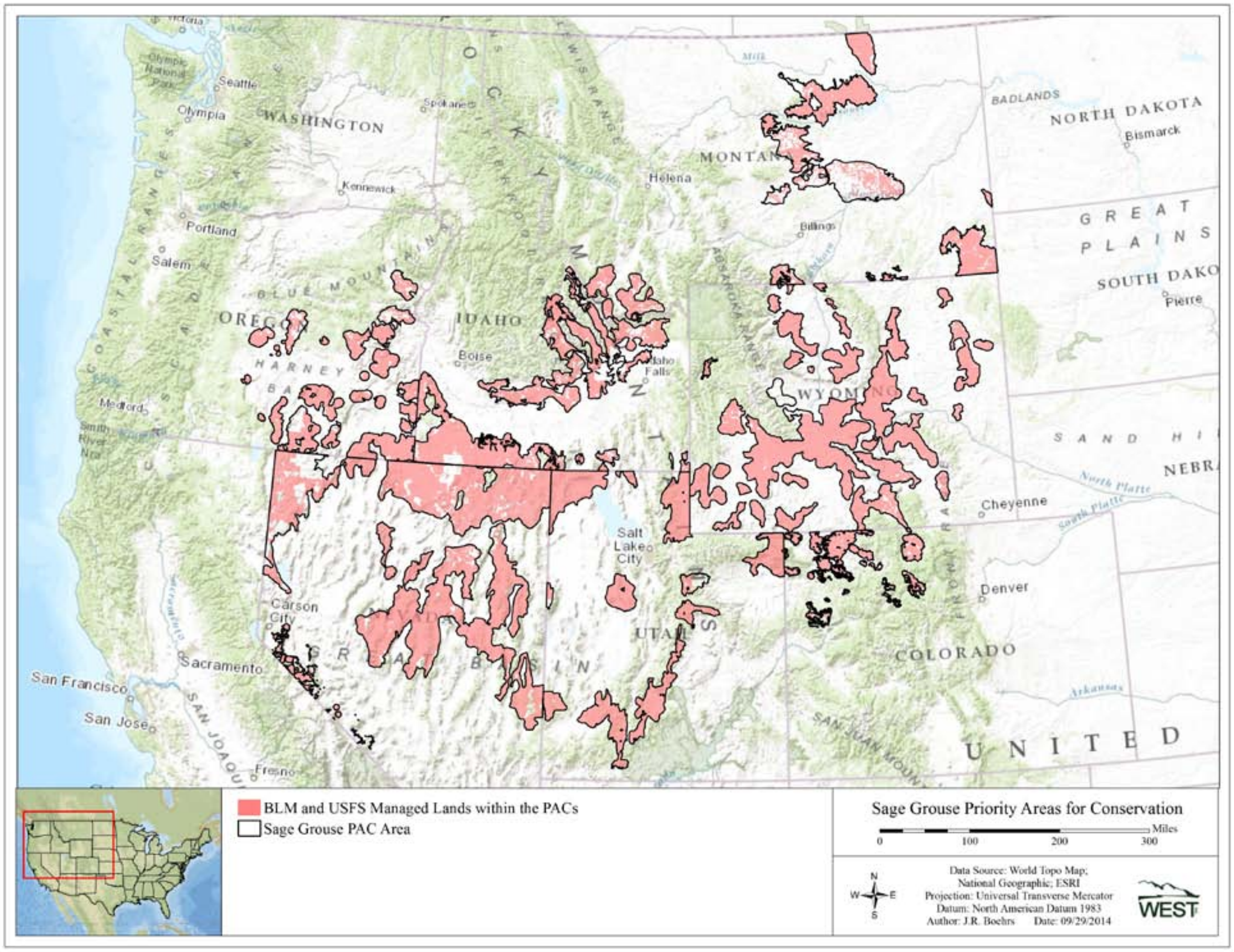

Figure 1. Sage-grouse PACs and federal lands and minerals within the study area.

METHODS

We acquired energy development leases and ROWs from the BLM's LR2000. The LR2000 is a searchable database for public reports on BLM land and mineral use authorizations, conveyances, mining claims, withdraws and classifications (BLM 2011). We also extracted Public Land Survey System (PLSS) data provided by the BLM for the study area. We then used this information to populate database queries within the LR2000.

Multiple queries were performed within the BLM's LR2000 database for each energy development type (e.g., solar, wind, coal, and oil & gas). We generated a geographic report to identify all federal leases and ROWs within the PACs, and then determined which of those leases and ROWs were operational. We obtained operating coal leases from individual state BLM offices. We exported lease and ROWs information from the LR2000 system in PLSS format, and then mapped those at three different PLSS levels: section, quarter-section, and quarter-quarter section. When quarter-section or quarter-quarter section level lease and ROWs data could not be identified from the LR2000 output, we used the section level.

In addition to identifying existing energy development leases and ROWs, we collected information on development potential within and outside of the PACs within the study area. It is difficult to predict where new development may occur; however, we utilized existing data sources to determine development potential for oil and gas, solar, and wind.[5] We created four categories to describe the potential for development across the PACs (very low, low, medium, and high). We obtained information regarding potential for oil and gas development from Copeland et al. (2009) where spatially-explicit predictive modeling techniques were used across parts of the intermountain west to develop oil and gas development potential. This data layer had model predictions scaled from 0 (low oil and gas potential) to 100 (high potential) (Copeland et al. 2009). We quantified the predictions into four development-potential categories: very low (0-25), low (26-50), medium (51-75), and high (76-100). We extracted these predictions within the PACs to estimate potential for oil and gas development within the PACs on federal lands and minerals. Areas within the PACs without any development potential had very low modeling predictability due to the lack of geological features important for oil and gas development (Copeland et al. 2009). This suggests that areas without predictions have zero potential for development.

We obtained information regarding solar and wind energy potential from the National Renewable Energy Laboratory. Solar-potential data provided annual average daily total solar resources at a 10 km scale (Perez et al. 2002). These values ranged from low (4.4) to high (8.4) within the PACs. Based on this data, we quantified the average daily total solar resources into four development potential categories: very low (4.4 – 5.4), low (5.41 – 6.4), medium (6.41 – 7.4), and high (7.41 – 8.4). In addition, we analyzed the priority development areas – called,

[5] We were unable to estimate coal development potential due to lack of publicly available data.

"solar energy zones" – for utility-scale solar energy facilities identified in BLM's Solar PEIS Record of Decision (BLM 2012).

Similar to solar, the wind energy development potential dataset provided the annual average wind resource potential at 50 meters (m) in height (NREL 2002). These values ranged from low = 1 to high = 7, and we further quantified the average wind resource potential into four categories: very low = 1, low = 2 – 3, medium = 4 – 5, and high = 6 – 7.

We calculated acres for each development type leases and ROWs and development potential type in ArcMap 10.1. We then calculated percentages by summing acres within the PACs by state and development type and then dividing by total acres of federal lands and minerals that exist within the PACs by state (ArcMap 2012).

RESULTS

Oil and Gas Development

Federal oil and gas leases occur within PACs in five of the seven states (Table 2, Figure 2). Idaho and Oregon have zero oil and gas leases within the PACs. Wyoming has the largest number of oil and gas leases on federal lands and minerals within the PACs (3,423), which cover 3,205,213 acres (27.95%) of the PACs within Wyoming (Table 2). Of Wyoming's active leases, 1,067 are producing or operational leases, for a total of 667,041 acres (5.82% of the PACs within Wyoming). Nevada has the second largest amount of leased acreage (1,459,729 acres) within the PACs, but this accounted for less than 10% of the PACs within Nevada. Colorado follows Nevada and Wyoming with 609,582 acres leased, but has the largest percentage of PACs with leased acres than any other state (36.51%). Colorado also has the largest producing acreage within the PACs (8.67%). Overall, 11.53% of federal lands and minerals within the PACs are leased for oil and gas development, and 1.79% of the PACs contain producing or operational oil and gas leases (Table 2).

Table 2. Oil and gas leases that occur on federal lands and minerals within the PACs within the study area (extracted from the LR2000 database August 2014).

State	Leased			Operational		
	Count	Acres	% of PACs	Count	Acres	% of PACs
Colorado	652	609,582	36.51	179	144,735	8.67
Idaho	0	0	NA	0	0	NA
Montana	422	404,561	8.84	146	87,449	1.91
Nevada[1]	727	1,459,729	9.29	2	1,633	0.01
Oregon	0	0	NA	0	0	NA
Utah	259	380,405	5.36	43	42,455	0.60
Wyoming	3,423	3,205,213	27.95	1,067	667,041	5.82
Overall	**5,483**	**6,059,490**	**11.53**	**1,437**	**943,313**	**1.79**

[1]Federal lands only

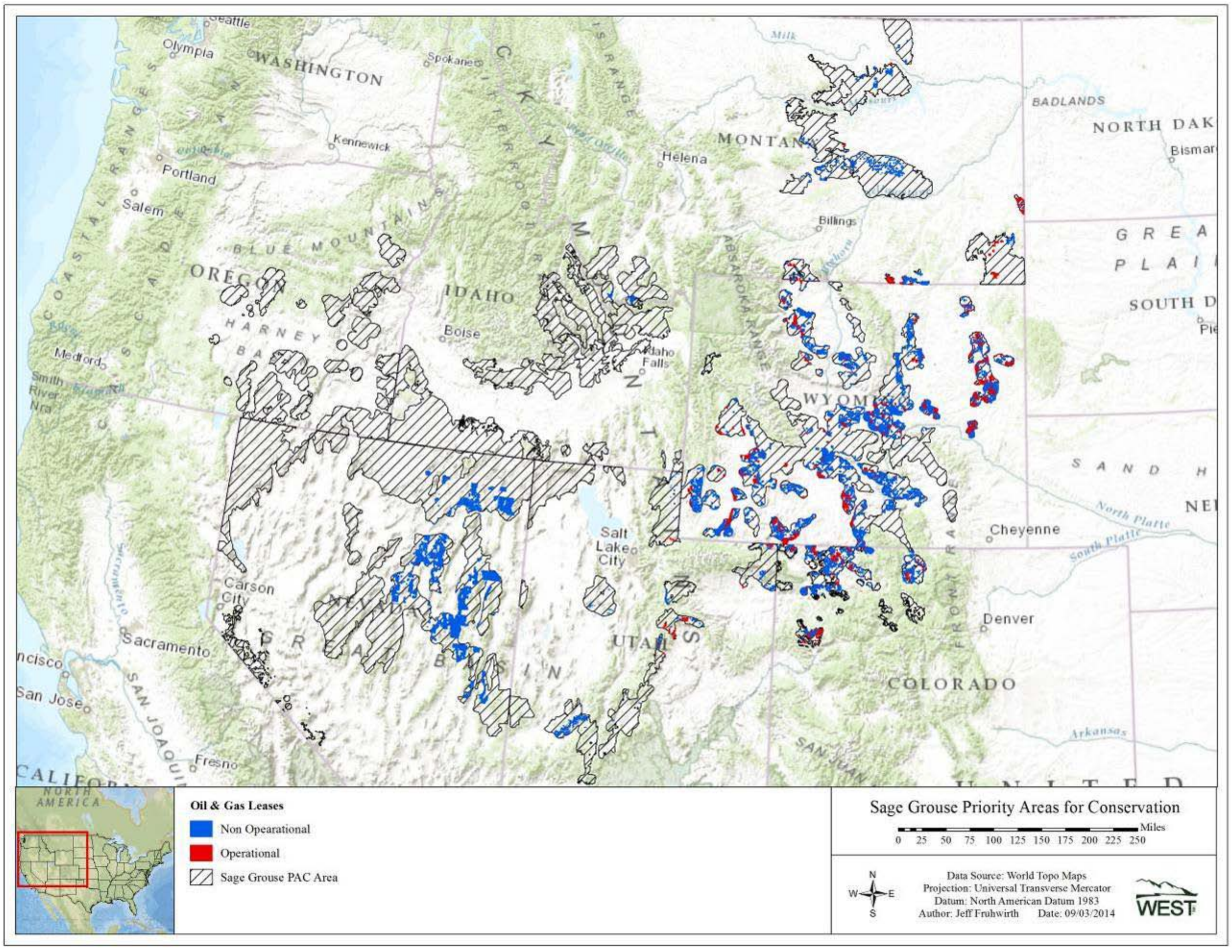

Figure 2. Oil and gas leases that occur on federal lands and minerals within the PACs within the study area (extracted from the LR2000 database August 2014).

The percentage of oil and gas development potential within the PACs is zero or very low in four states – Idaho (>99%), Nevada (>99%), Oregon (>99%), and Utah (>82%) – according to the model developed by Copeland et al. 2009 (Table 3, Figure 3). Colorado and Wyoming have the highest percentage of high oil and gas development potential within the PACs (33.61 and 31.42%, respectively; Table 3). Overall, 83.67% of federal lands and minerals occurring within the PACs have zero to low potential for oil and gas development (Table 3).

Table 3. Oil and gas development potential that occurs on federal lands and minerals within the PACs within the study area (Copeland et al. 2009).

State	Zero		Very Low		Low		Medium		High	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Colorado	17,245	1.03	623,906	37.36	170,866	10.23	296,630	17.76	561,168	33.61
Idaho	6,920,167	96.97	195,729	2.74	17,058	0.24	3,180	0.04	0	NA
Montana	551,043	12.04	2,105,609	46.00	614,654	13.43	848,546	18.54	457,087	9.99
Nevada[1]	1,971,267	12.55	13,659,137	86.94	16,479	0.10	63,894	0.41	0	NA
Oregon	2,828,376	57.70	2,065,711	42.14	3,180	0.06	4,625	0.09	0	NA
Utah	192,964	2.72	5,633,075	79.31	282,752	3.98	376,714	5.30	616,967	8.69
Wyoming	0	NA	4,244,466	37.02	1,871,717	16.32	1,970,015	17.18	3,602,346	31.42
Overall	12,481,061	23.74	28,527,632	54.27	2,976,706	5.66	3,563,605	6.78	5,237,568	9.96

[1]Federal lands only

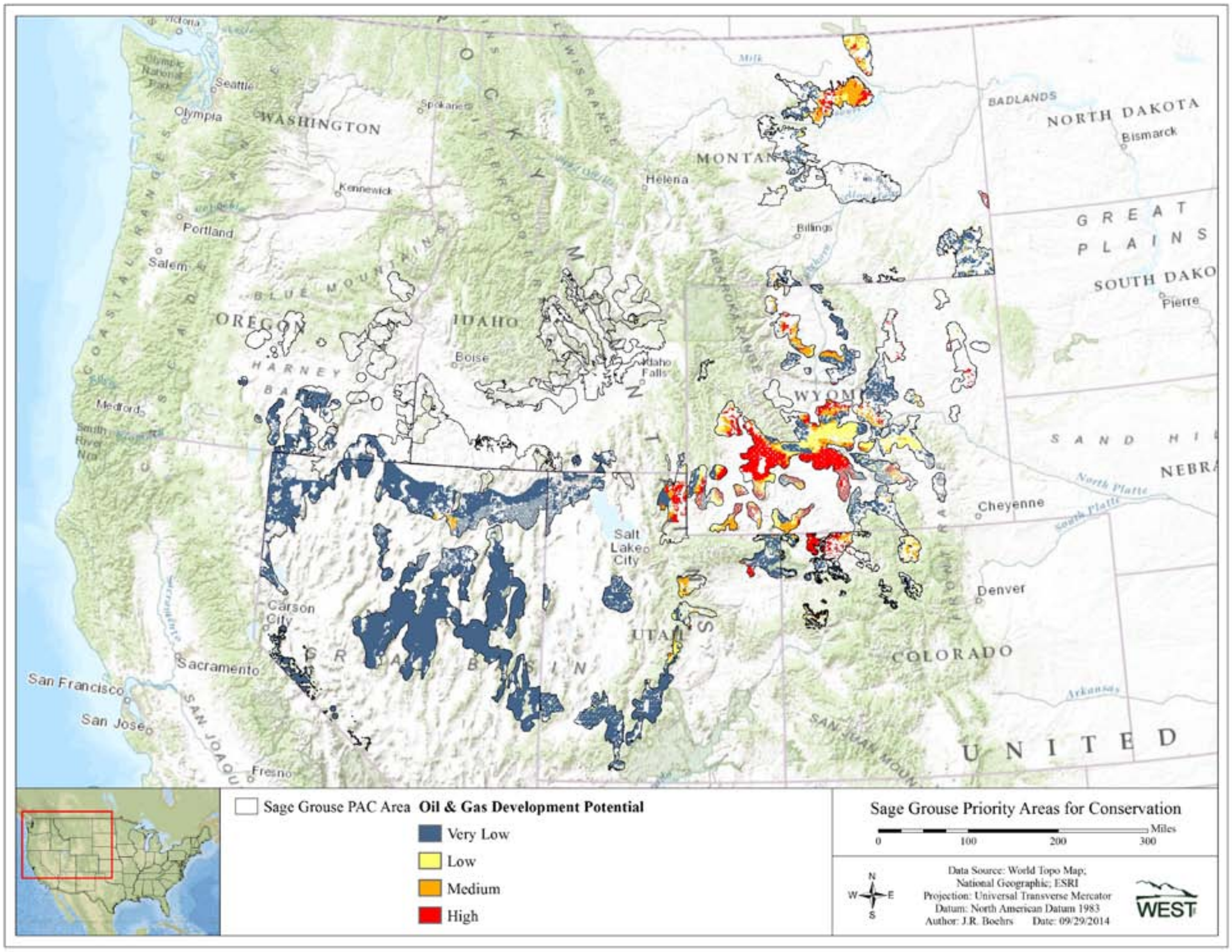

Figure 3. Oil and gas energy development potential that occur on federal lands and minerals within the PACs within the study area (Copeland et al. 2009).

Coal Mining

Four states analyzed have coal leases that occur on federal lands and minerals within the PACs (Table 4, Figure 4). Utah has the most acres leased on federal lands and minerals within PACs (91,184 acres), followed by Wyoming (35,236 acres) and Colorado (20,620 acres; Table 4). The percentage of PACs containing coal leases ranges from 0.27% (Montana) to 1.28% (Utah) within the study area (Table 4, Figure 4). Overall, 0.30% of the PACs contain coal leases, and 0.11% of PACs contain leases that were operational (Table 4).

Table 4. Coal leases that occur on federal lands and minerals within the PACs within the study area (extracted from the LR2000 database August 2014).

State	Leased			Operational		
	Count	Acres	% of PACs	Count	Acres	% of PACs
Colorado	12	20,620	1.23	4	10,371	0.62
Idaho	0	0	NA	0	0	NA
Montana	12	12,231	0.27	2	2,563	0.06
Nevada[1]	0	0	NA	0	0	NA
Oregon	0	0	NA	0	0	NA
Utah	37	91,184	1.28	21	35,887	0.51
Wyoming	20	35,236	0.31	7	10,883	0.09
Overall	**81**	**159,271**	**0.30**	**34**	**59,704**	**0.11**

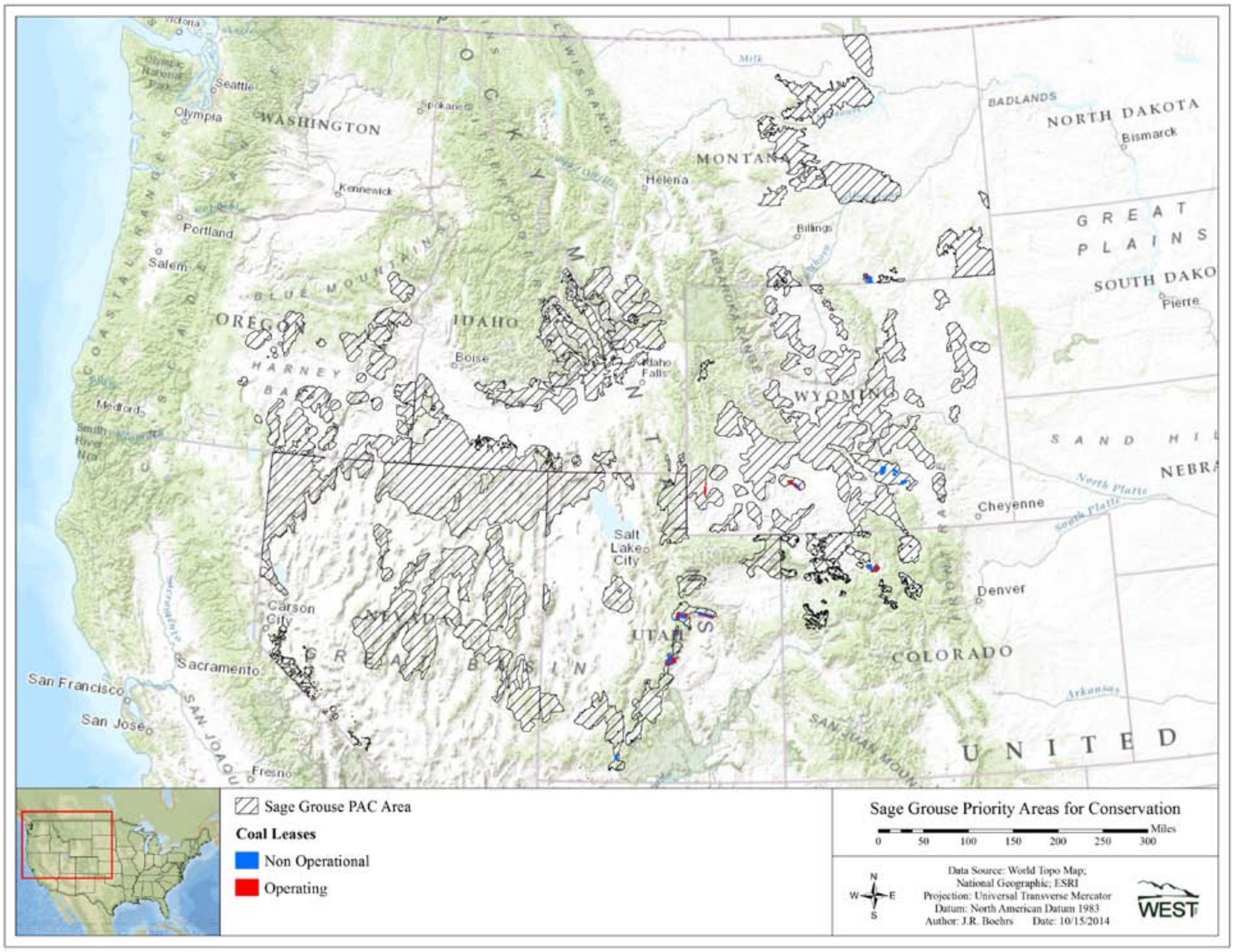

Figure 4. Coal leases that occur on federal lands and minerals within the PACs within the study area (extracted from the LR2000 database August 2014).

Solar Energy

There are no existing solar energy ROWs within the PACs of the states analyzed. The majority of federal lands within the PACs have very low to low solar energy development potential. Colorado, Idaho, Montana, Oregon, and Wyoming's percentages of federal lands within the PACs that have very low and low solar energy development potential ranging from 99 to 100% (Table 5, Figure 5). Nevada and Utah have the majority of federal lands within the PACs designated as medium and high potential for solar energy development (Table 5). A small portion of one "solar energy zone" (180 acres) overlaps the PACs in southern Utah.

Table 5. Solar energy development potential that occurs on federal lands within the PACs within the study area (Perez et al. 2002).

State	Very Low		Low		Medium		High	
	Acres	%	Acres	%	Acres	%	Acres	%
Colorado	95,803	10.77	784,456	88.23	8,876	1	0	0
Idaho	969,783	14.68	5,637,107	85.32	0	0	0	0
Montana	2,889,448	98.99	29,419	1.01	0	0	0	0
Nevada	10,779	0.07	5,343,578	34.01	9,129,264	58.11	1,227,002	7.81
Oregon	31,788	0.89	3,535,977	99.01	3,727	0.1	0	0
Utah	21,947	0.5	2,057,821	47.17	2,234,926	51.22	48,327	1.11
Wyoming	312,971	4.08	7,303,698	95.13	60,685	0.79	0	0
Overall	**4,332,518**	**10.38**	**24,692,056**	**59.16**	**11,437,478**	**27.4**	**1,275,329**	**3.06**

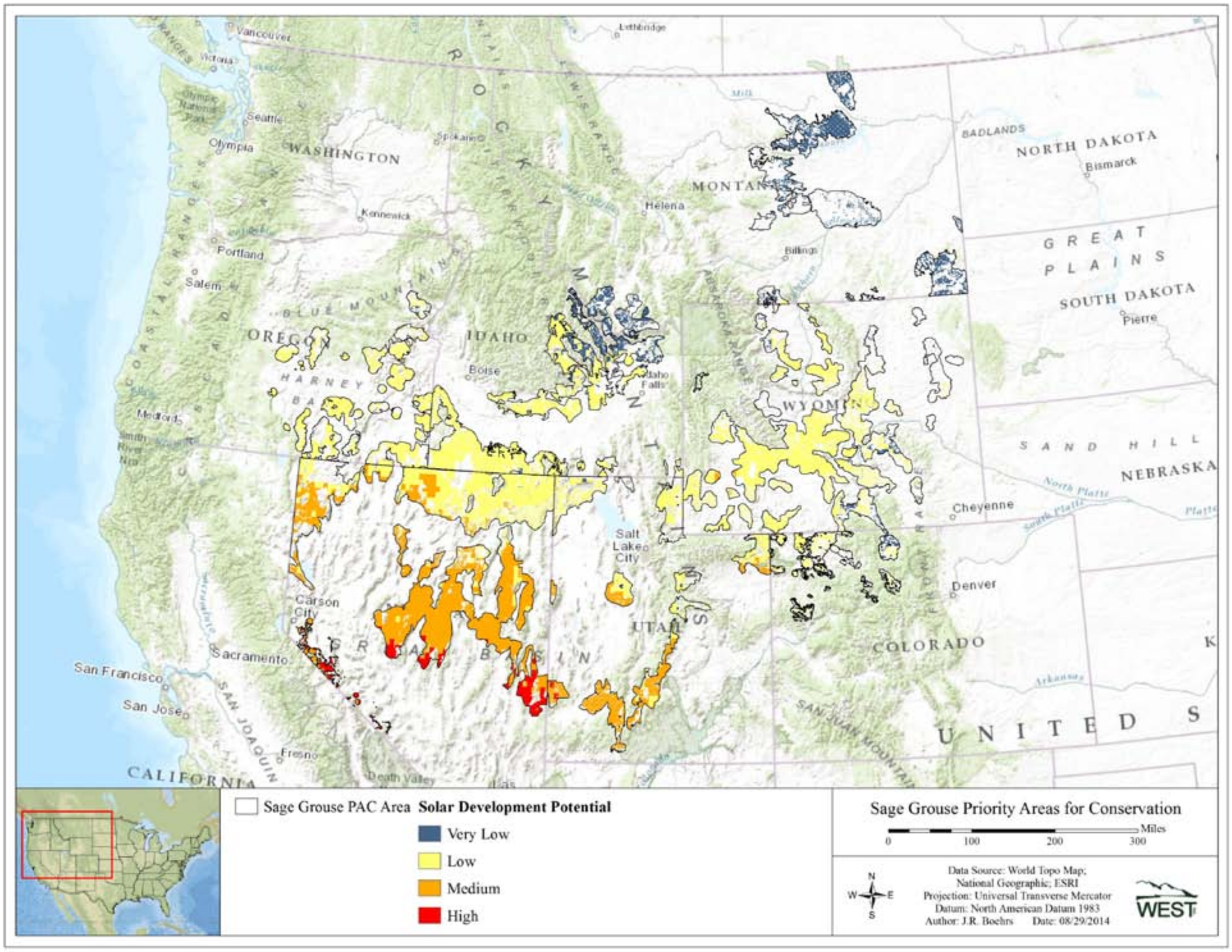

Figure 5. Solar energy development potential that occurs on federal lands within the PACs within the study area (Perez et al. 2002).

Wind Energy[6]

There were no wind energy development ROWs that occur in Montana and Utah within the PACs (Table 6, Figure 6). Oregon had the largest amount of wind ROWs on federal lands within the PACs (82,680 acres), which accounted for 2.32% of the PACs within the state. Wind ROWs on federal lands in Colorado, Idaho, Nevada, and Wyoming covered less than 1% of the PACs within each of those states. There were no operating wind ROWs within the PACs (Table 6). Overall, wind ROWs overlap with less than 1% of federal lands within the PACs.

Table 6. Wind energy ROWs that occur on federal lands within the PACs within the study area (extracted from the LR2000 database August 2014).

State	Leased			Producing		
	Count	Acres	% of PACs	Count	Acres	% of PACs
Colorado	1	2,794	0.31	0	0	NA
Idaho	1	4	<0.001	0	0	NA
Montana	0	0	NA	0	0	NA
Nevada	7	54,495	0.35	0	0	NA
Oregon	6	82,680	2.32	0	0	NA
Utah	0	0	NA	0	0	NA
Wyoming	20	39,688	0.52	0	0	NA
Overall	**35**	**179,661**	**0.35**	**0**	**0**	**NA**

[6] This study evaluates wind energy in order to present a complete picture of the major energy development activities that are occurring (or might occur) within the PACs. However, the USFWS has determined that wind energy development, absent new research or mitigation measures, may not be compatible with the conservation of priority habitats (e.g., PACs and state core areas) for sage-grouse (USFWS 2009, Appendix B).

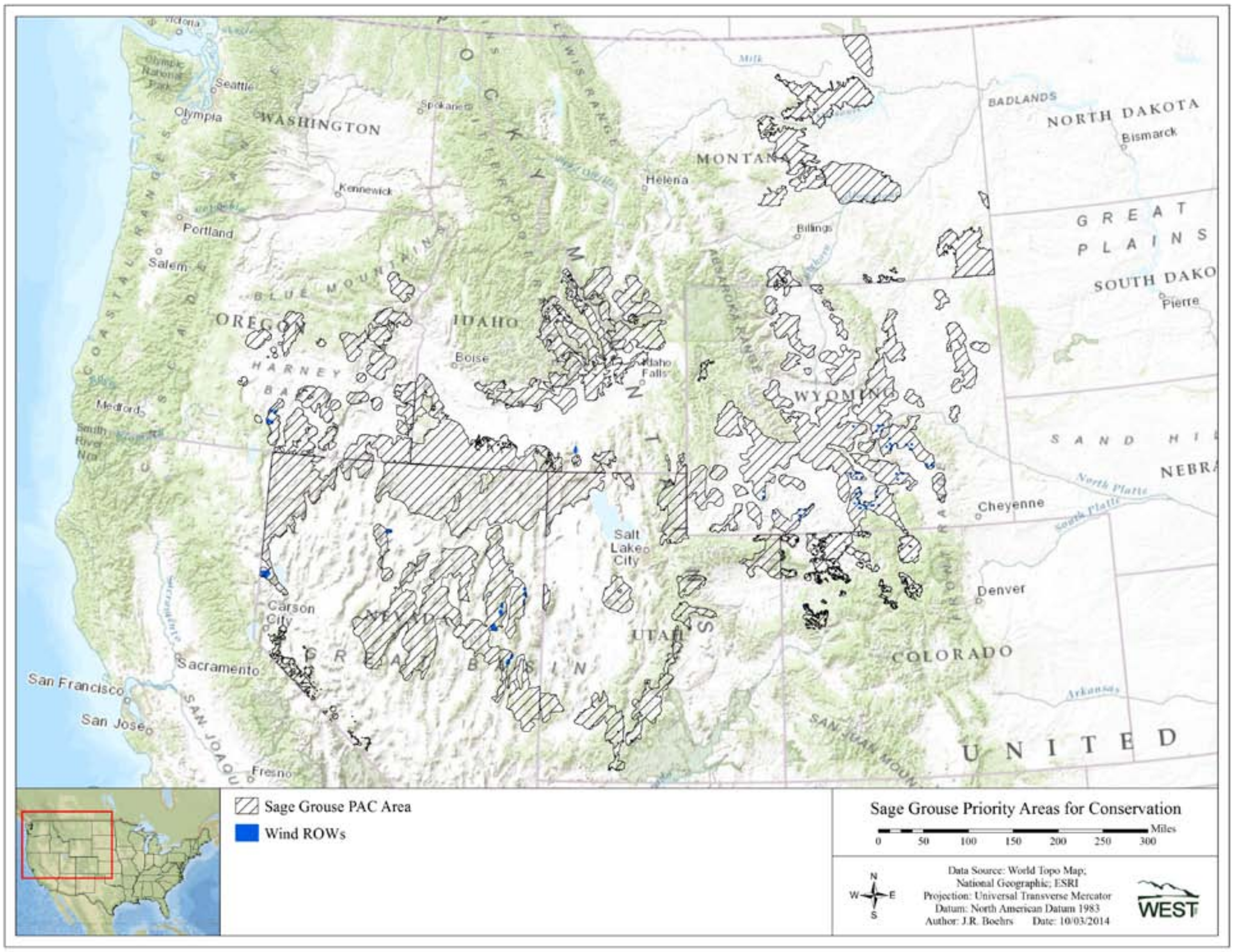

Figure 6. Wind energy ROWs on federal lands within the PACs within the study area (extracted from LR2000 August 2014).

Wyoming has the highest wind energy development potential within the PACs, as 24.12% of all federal lands within the Wyoming PACs were designated as medium or high potential for wind energy development (Table 7, Figure 7). Less than 7% of federal lands within the PACs for all seven of the states analyzed have medium or high potential for wind energy development (Table 7). Overall, 93.67% of all federal lands within the PACs have a very low or low potential for wind energy development (Table 7).

Table 7. Wind energy development potential that occur on federal lands within the PACs for the states analyzed (NREL 2002).

State	Very Low		Low		Medium		High	
	Acres	%	Acres	%	Acres	%	Acres	%
Colorado	675,743	76.01	207,045	23.29	5,308	0.60	951	0.11
Idaho	3,244,618	49.12	3,246,432	49.15	104,197	1.58	10,551	0.16
Montana	359,228	12.31	2,232,345	76.48	325,079	11.14	2,125	0.07
Nevada	13,381,404	85.18	2,122,394	13.51	164,158	1.04	42,111	0.27
Oregon	1,112,448	31.15	2,377,185	66.56	78,159	2.19	3,695	0.10
Utah	3,507,812	80.4	801,515	18.37	41,871	0.96	11,752	0.27
Wyoming	1,867,935	24.33	3,957,266	51.55	1,620,552	21.11	231,395	3.01
Overall	**24,149,190**	**57.86**	**14,944,182**	**35.81**	**2,339,324**	**5.61**	**302,580**	**0.72**

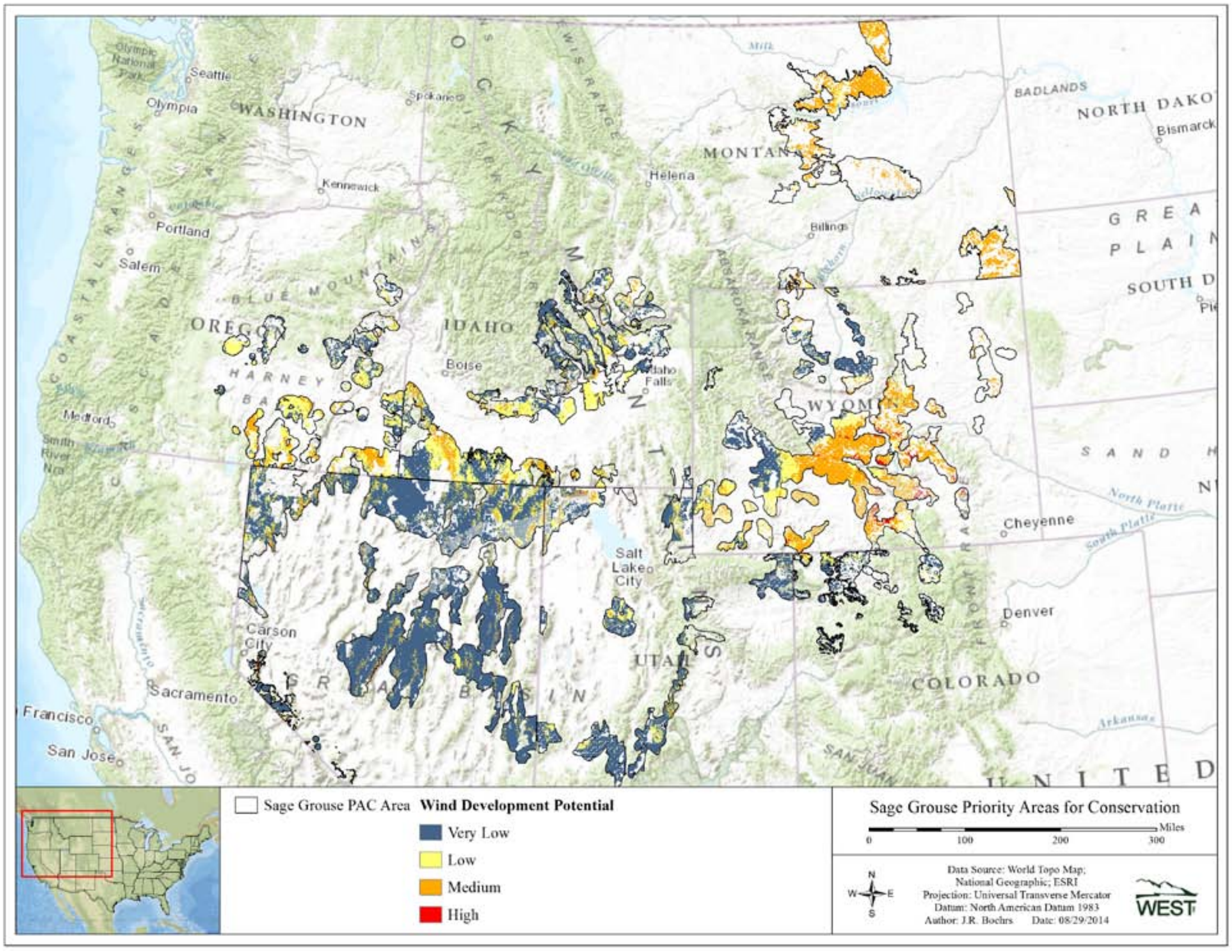

Figure 7. Wind energy development potential that occurs on federal lands within the PACs within the study area (NREL 2002).

Cumulative Assessment

Overall, approximately 88% of federal lands and minerals within the PACs are not leased or have existing ROWs established for coal, oil and gas, solar, and wind (Table 8; Figure 8). Approximately 73 to 81% of federal lands and minerals with medium and high potential for oil and gas, solar, and wind energy development occurs outside of the PACs within the study area (Table 9, Appendix A).

Table 8. Cumulative assessment of coal, oil and gas, solar and wind leases and ROWs that occur on federal lands and minerals within the PACs within the study area (extracted from the LR2000 database August 2014).

Energy Development	Leases or ROWs	
	Acres	% of PACs
Oil and Gas	6,059,490	11.53
Coal	159,271	0.30
Wind[1]	179,661	0.35[1]
Solar	0	NA
Total[2]	**6,357,911**	**12.10**

[1]Federal lands only
[2]Total acres excluding overlapping energy development leases or ROWs

Table 9. Cumulative assessment of energy development potential (medium and high) for federal lands and minerals within and outside of the PACs within the study area.

Energy Development	Outside PACs (Medium and High)		Within PACs (Medium and High)	
	Acres	%	Acres	%
Oil and Gas	23,372,461	72.64	8,801,173	27.36
Solar[1]	54,006,565	80.95	12,712,807	19.05
Wind[1]	7,945,904	75.05	2,641,904	24.95

[1]Federal lands only

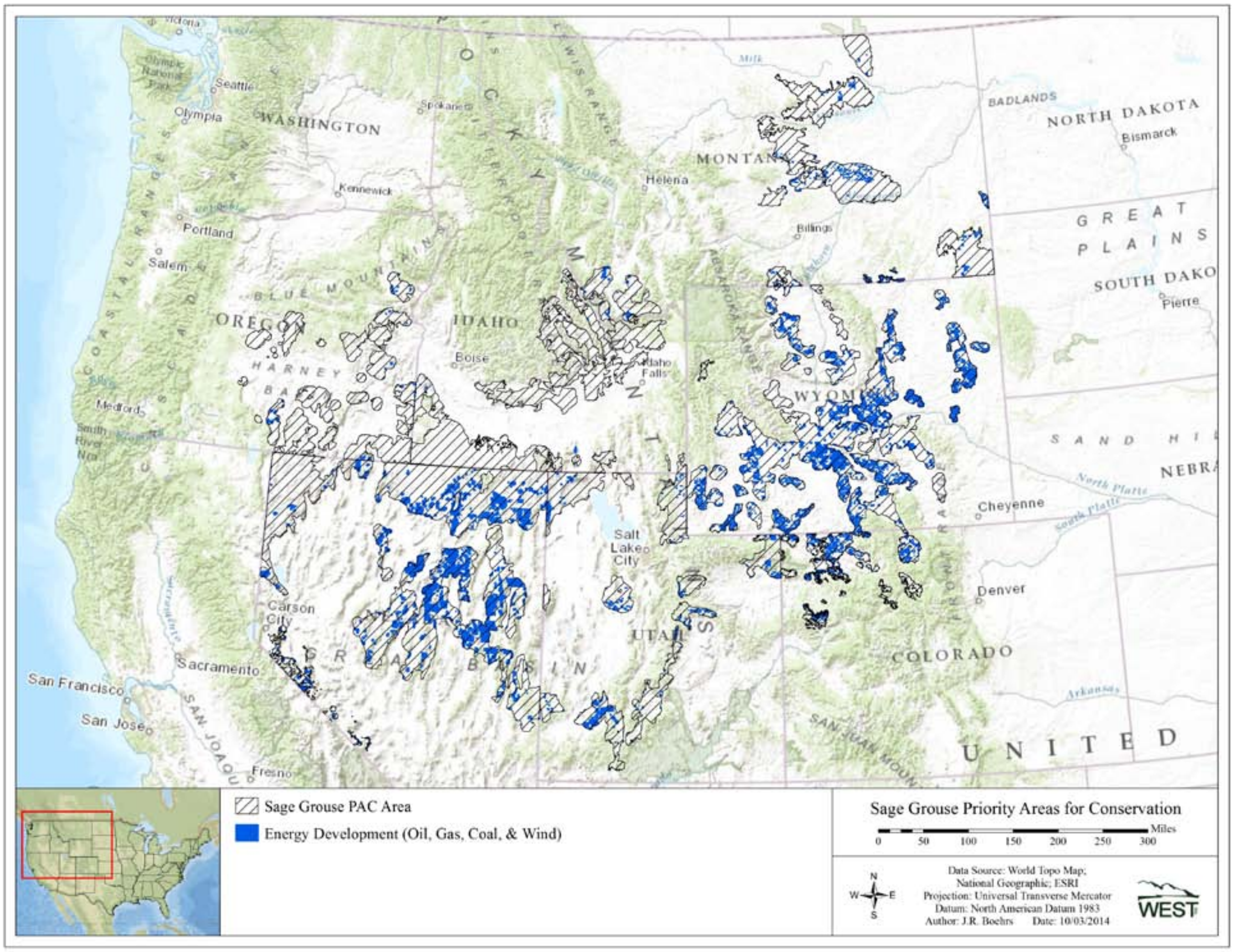

Figure 8. Oil and gas and coal leases and wind ROWs that occur on federal lands and minerals within the PACs within the study area (extracted from the LR2000 database August 2014).

CONCLUSION

PACs were identified to assist the BLM, FS and states in prioritizing areas for the protection, conservation, and enhancement of sage-grouse habitat. Based on our analysis, oil and gas development appears to be the most widespread energy development activity within the PACs, due to its large spatial distribution. However, less than 12% of federal lands and minerals within the PACs contain oil and gas leases. The number of producing or operating leases and ROWs are also low throughout the PACs. Overall, less than 13% of the federal lands and minerals within the PACs have been leased or ROWs established for oil and gas, coal, wind, and solar energy development.

Similarly, most of the federal lands and minerals within the PACs have zero or very low potential for oil and gas, coal, wind, and solar energy development. Seventy percent of federal lands within the PACs are categorized as very low to low potential for solar development. Similarly, 94% of federal lands within the PACs are categorized as very low to low potential for wind energy development. Oil and gas development potential is also relatively low throughout the PACs, as 84% of the federal lands and minerals within the PACs were categorized as zero, very low, or low. Finally, there is a higher percentage of federal lands and minerals with medium and high development potential for oil and gas, solar, and wind outside of the PACs than within the PACs.

The energy development potential data provides an estimate or index for future energy development and does not account for other factors that might influence that development, such as supporting infrastructure (e.g., transmission lines). We attempted to retrieve the most detailed PLSS leasing and ROWs information from the LR2000 database, but, in some cases, were unable to resolve cases with unknown PLSS site descriptions. For these cases the scale was reduced to quarter-section level and, sometimes, section level. Thus, the results presented here likely overestimate the actual leased acres recorded by the BLM, because some of the fine-scale PLSS data was not captured in the LR2000 query output.

REFERENCES

ArcMAP. 2012. ESRI GIS Software. ArcMAP 10.1. ESRI, Redlands, California. ESRI homepage at: http://www.esri.com/software/arcgis/arcgis-for-desktop/index.html

Braun, C. E., T. Britt, and R. O. Wallestad. 1977. Guidelines for maintenance of sage-grouse habitats. Wildlife Society Bulletin 5:99–106.

Bureau of Land Management (BLM). 2011. About LR2000. BLM Legacy Rehost System. Last updated May 16, 2014. Information available online at: http://www.blm.gov/lr2000/about.htm.

Bureau of Land Management (BLM). 2012. Approved Resource Management Plan Amendments/Record of Decision (Rod) for Solar Energy Development in Six Southwestern States. October 2012. US Department of the Interior (USDI) BLM. Available online at:http://solareis.anl.gov/documents/docs/Solar_PEIS_ROD.pdf.

Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation assessment of greater sage-grouse and sagebrush habitats. Western Association of Fish and Wildlife Agencies. Cheyenne, Wyoming, USA.

Copeland, H. E., K. E. Doherty, D. E. Naugle, A. Pocewicz, J. M. Kiesecker. 2009. Mapping Oil and Gas Development Potential in the US Intermountain West and Estimating Impacts to Species. PLoS ONE 4(10): e7400. doi:10.1371/journal.pone.0007400.

Garton, E. O., J. W. Connelly, J. S. Horne, C. A. Hagen, A. Moser, and M. Schroeder. 2011. Greater sage-grouse population dynamics and probability of persistence. Pages 293-383 in S. T. Knick and J. W. Connelly, editors. Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology Series. Volume 38. University of California Press, Berkeley, California, USA.

Gregory, A. J. and J. L. Beck. 2014. Spatial heterogeneity in response of male greater sage-grouse lek attendance to energy development. PLoS ONE 9(6):e97132. doi:10.1371/journal.pone.0097132.

Knick, S. T., D. S. Dobkin, J. T. Rotenberry, M. S. Schroeder, W. M. Vander Hagen, and C. V. Riper III. 2003. Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. Condor 105:611–634.

LeBeau, C., J. L. Beck, G. D. Johnson, and M. J. Holloran. 2014. Short-term impacts of wind energy development on greater sage-grouse fitness. Journal of Wildlife Management 78:522-530.

National Renewable Energy Laboratory (NREL). 2002. Dynamic Maps, GIS Data, & Analysis Tools. Last updated June 16, 2014. Information available online at: http://www.nrel.gov/gis/data_wind.html.

Naugle, D. E., K. E. Doherty, B. L. Walker, M. J. Holloran, and H. E. Copeland. 2011. Energy development and greater sage-grouse. Pages 489-505 in S. T. Knick and J. W. Connelly, editors. Greater Sage-Grouse: Ecology and conservation of a landscape species and its habitats. Studies in Avian Biology Series. Volume 38. University of California Press, Berkeley, California, USA.

Perez R., P. Ineichen, M. Kmiecik, K. Moore, R. George, and D. Renne, (2004). Producing satellite-derived irradiances in complex arid terrain. Solar Energy 77 363-370.

Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage grouse (Centrocercus urophasianus). Pages 1-28 in A. Pool and F. Gill, editors. The Birds of North America. The Birds of North America, Inc, Philadelphia, Pennsylvania, USA.

Schroeder, M. A., C. L. Aldridge, A. D. Apa, J. R. Bohne, C. E. Braun, S. D. Bunnell, J. W. Connelly, P. A. Deibert, S. C. Gardner, M. A. Hilliard, G. D. Kobriger, C. W. McCarthy, J. J. McCarthy, D. L. Mitchell, E. V. Rickerson, and S. J. Stiver. 2004. Distribution of sage-grouse in North America. Condor 106:363–373.

Swenson, J. E., C. A. Simmons, and C. D. Eustace. 1987. Decrease in sage grouse *Centrocercus urophasianus* after ploughing of sagebrush steppe. Biological Conservation 41:125-132.

US Fish and Wildlife Service (USFWS). 2013. Greater sage-grouse (*Centrocercus urophasianus*) Conservation Objectives: Final Report. U.S. Fish and Wildlife Service, Denver, CO. February 2013.

US Fish and Wildlife Service (USFWS). 2009. Letter to Director Steve Ferrell of the Wyoming Game and Fish Department, Cheyenne, Wyoming, from Brian Kelly, Field Supervisor of the US Department of the Interior USFWS Ecological Services Wyoming Field Office, Cheyenne Wyoming. Regarding the endorsement of the State of Wyoming's greater-sage grouse Core Population Area Strategy (Strategy; Executive Order 2008-2). Dated July 7, 2009. 3 pp.

Appendix A. Energy development potential outside of the PACs occurring on federal lands and minerals within the study area

Appendix A-1. Oil and gas energy development potential outside of the PACs within the study area (Copeland et al. 2009).

State	Zero		Very Low		Low		Medium		High	
	acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Colorado	1,141,680	3.81	23,794,277	79.35	1,672,807	5.58	1,749,133	5.83	1,629,151	5.43
Idaho	20,248,104	87.08	2,995,787	12.88	6,360	0.03	1,446	0.01	0	NA
Montana	18,042,164	48.35	11,696,349	31.35	3,272,468	8.77	2,002,974	5.37	2,299,025	6.16
Nevada	1,471,401	4.47	31,163,185	94.57	79,795	0.24	236,205	0.72	1,735	0.01
Oregon	22,194,106	82.01	4,459,566	16.48	34,404	0.13	375,558	1.39	0	NA
Utah	1,335,817	3.29	33,448,044	82.28	1,594,746	3.92	2,259,128	5.56	2,012,804	4.95
Wyoming	0	NA	18,357,220	57.52	2,753,800	8.63	2,742,235	8.59	8,063,068	25.26
Overall	**64,433,271**	**28.88**	**125,914,428**	**56.43**	**9,414,382**	**4.22**	**9,366,678**	**4.20**	**14,005,783**	**6.28**

Appendix A-2. Solar energy development potential outside of the PACs within the study area (Perez et al. 2004).

State	Very Low		Low		Medium		High	
	Acres	%	Acres	%	Acres	%	Acres	%
Colorado	1,455,195	7.97	9,634,310	52.77	6,988,422	38.28	178,157	0.98
Idaho	10,352,864	50.06	10,327,032	49.94	0	NA	0	NA
Montana	19,291,626	99.16	163,638	0.84	0	NA	0	NA
Nevada	15,764	0.05	2,854,479	8.69	14,467,062	44.06	15,498,276	47.20
Oregon	9,295,536	39.14	14,452,592	60.86	636	0.00	0	NA
Utah	230,826	1.01	5,874,709	25.74	14,475,649	63.44	2,237,778	9.81
Wyoming	3,956,749	25.49	11,407,825	73.48	160,585	1.03	0	NA
Overall	**44,598,561**	**29.09**	**54,714,585**	**35.69**	**36,092,354**	**23.54**	**17,914,211**	**11.68**

Appendix A-3. Wind energy development potential outside of the PACs within the study area (NREL 2002).

State	Very Low		Low		Medium		High	
	Acres	%	Acres	%	Acres	%	Acres	%
Colorado	15,018,770	82.30	2,384,484	13.07	505,151	2.77	341,377	1.87
Idaho	15,236,533	73.68	4,852,079	23.46	442,776	2.14	147,890	0.72
Montana	9,888,393	50.83	6,957,964	35.77	1,776,552	9.13	830,010	4.27
Nevada	16,910,464	71.26	6,228,279	26.25	463,849	1.95	126,515	0.53
Oregon	17,814,925	78.12	4,755,966	20.85	197,735	0.87	37,143	0.16
Utah	27,534,277	83.92	5,013,168	15.28	215,905	0.66	47,376	0.14
Wyoming	5,702,083	36.73	7,007,627	45.14	1,795,001	11.56	1,018,624	6.56
Overall	**108,105,445**	**70.54**	**37,199,567**	**24.27**	**5,396,970**	**3.52**	**2,548,934**	**1.66**

Appendix B. Letter to Director Steve Ferrell of the Wyoming Game and Fish Department, Cheyenne, Wyoming, from Brian Kelly, Field Supervisor of the US Department of the Interior USFWS Ecological Services Wyoming Field Office, Cheyenne Wyoming

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

JUL 0 7 2009

Mr. Steve Ferrell
Director, Wyoming Game and Fish Department
5400 Bishop Blvd
Cheyenne, WY 82006

STEVE
Dear Director ~~Ferrell~~:

Thank you for your letter of July 7, 2009, regarding the State of Wyoming's Greater sage-grouse "Core Population Area Strategy" (Strategy) (Executive Order 2008-2). Your letter requests clarification from the U.S. Fish and Wildlife Service (Service) regarding our endorsement of the Strategy. Specifically, you would like our view of whether wind power can be developed in core areas in a way that the Wyoming Game and Fish Department and the State of Wyoming would maintain our endorsement. This letter is responsive to your request and provides an explanation of our concern about wind development in core areas. In summary, constructing wind farms in core areas, even for research purposes, prior to demonstrating it can be done with no impact to sage-grouse, negates the usefulness of the core area concept as a conservation strategy and brings into question whether adequate regulatory mechanisms are in place to protect the species. Both of these factors are critical in the Endangered Species Act (ESA) listing decision currently facing the Service.

Following are some specific reasons why we endorsed the Strategy when asked by the Governor's Office in 2008:

A. In a general conservation context the Strategy is a science-driven, outcome-based and adaptive approach to the conservation of a species and its habitat. The Service is in the process of adopting a similar approach, currently called Strategic Habitat Conservation (SHC) for much of our conservation work. Therefore, as a general conservation paradigm we support such an approach.

B. In the context of a potential listing under the ESA, the State's sage-grouse Strategy provides a useful framework to show how the threats to the species are being managed; and if the Strategy is adopted across different land ownerships in the state, could provide an important regulatory mechanism as well. As you know, to preclude listing under ESA, we must be able to show that threats to the species are effectively addressed by science-based conservation measures, and that adequate regulatory mechanisms are in place to ensure those actions occur. In regard to the latter, the actions of the State Board of Land Commissioners to adopt a process that ensures sage-grouse conservation measures are implemented on state land within core areas, and the regulatory authority of the Department of Environmental Quality Industrial Sighting Council (ISC) are noteworthy.

C. The Strategy provides the mechanism by which the state can be the most flexible in the application of the Statewide Candidate Conservation Agreement with Assurances (CCAA) that is currently being developed. The CCAA tool is important for private landowners in the state both for the conservation of the species and its habitat, and the assurances it provides the landowner if the species is ever listed.

In short, if implemented as envisioned by the State Sage-grouse Implementation Team (SGIT) and Governor's Executive Order, the Strategy is the type of action the Service looks for, both in conservation measures and regulatory process, to preclude listing a species under the ESA. However, it is important that I point out that these potential benefits of the Strategy will only be realized if the integrity of the core area approach is maintained. The Service feels that the greatest threats to the integrity of the core areas are: (1) not adhering to science-based conservation measures associated with development, and (2) allowing mitigation for impacts to core population areas as an option if the proposed development is counter to accepted conservation measures or when impacts are not known.

The foundation of the Strategy from the Service point of view is that development in the most important sage-grouse habitats (core areas and associated seasonal habitats) is done only when no impact to the species can be demonstrated. In essence, ensuring the conservation of sage-grouse in the core areas is mitigation for the greater development flexibility outside core areas provided for by the Strategy. Therefore, allowing impacts within core areas, for research or other reasons, destroys the function and value of the Strategy.

With respect to wind power development, your letter referenced the SGIT recommendations that were adopted by the State Board of Land Commissioners. Specifically, you asked whether we thought the reference in those recommendations to a "no impact/mitigation plan" as you termed it, was possible for wind power development. Your question is an excellent one, but the context of the SGIT's recommendations is critical to our answer to this question. The SGIT's recommendations, as noted in your letter, began by stating: *"Proposals to deviate from **standard stipulations** (emphasis added) will be considered by a team..."* Your letter appropriately raises questions about whether there is a scientific basis for standard stipulations for wind development different from other road-and-pad development on which the SGIT's recommendations are based, and therefore whether the ability to develop a mitigation plan even exists. In our judgment, we agree, no such data currently exist.

To the Service, the recommendations of the SGIT and Executive Order 2008-2 are clear with respect to deviation from standard stipulations. That is, the burden of proof that development does not affect sage-grouse rests with the industry or proponent in question, and any research they feel is necessary to convey this, should be conducted outside of core areas. This burden of proof to show that development in core areas can be done consistent with conserving sage-grouse underlies <u>all</u> forms of development—not just wind-power. The Strategy is clear on this point and is one of the key reasons for our endorsement.

In assessing the threats to sage-grouse to determine whether the species warrants listing under ESA, we view the science on the impacts of wind development on sage-grouse as being clearer than is being conveyed by some in the wind industry. While there is no doubt that we have more to learn, there exists a large body of empirical, peer reviewed, and published science on the negative impacts of road-and-pad based development on the behavior, movements, survival and productivity of this species. The Service in our 2005 decision to not list the species found that these developments, their associated infrastructure, and the fact such development enhanced the spread of invasive species were among the primary threats to the species. In the past 4 years, since our 2005 finding, we have seen no science to change this view, only more science affirming it, while at the same time witnessing a significant increase in this type of potential development.

Regarding your second specific question on development levels outside core areas, the March 25, 2008 letter from the SGIT to the Governor states development should attempt to maintain populations, habitats and essential migration routes outside core areas wherever possible. How low lek persistence or population numbers can decline outside of core areas needs to be consistent with the recommendations of the SGIT. We encourage you to direct your request for specific numbers to the Governor's SGIT (of which the Service is a member) and species experts. Having said this, the Service has been developing, and will continue to develop, means by which we can provide for more strategic conservation of our trust species (e.g., migratory birds) outside of core areas to help meet the intent of item #6 in Executive Order 2008-2. Item #6 as you note, states that incentives to develop outside of core areas are an important component of the Strategy. Some of the flexibility resulting from our efforts we feel will be helpful to the energy industry and other development in the State.

Wyoming has set a national example by signing a Memorandum of Agreement (MOA) between your department, my agency and the Governor's Office to work together to conserve species in a manner that hopefully precludes the need for Federal listing. The approach taken to develop and implement the core area Strategy to date exemplifies the vision shared among us in signing the MOA. However, constructing wind farms in core areas, even for research purposes, prior to demonstrating it can be done with no impact to sage-grouse, negates the usefulness of the core area concept as a conservation strategy and brings into question whether adequate regulatory mechanisms are in place to protect the species.

Please know that my office remains committed to playing our role in helping to implement the sage-grouse core areas strategy as envisioned by the SGIT and the Executive Order and to work within our authorities to collaborate with you and others in helping to develop an environmentally-responsible wind industry and other development in Wyoming.

Sincerely,

B. T. Kelly

Brian T. Kelly
Field Supervisor
Wyoming Field Office

cc: Deputy Chief of Staff, Wyoming Governor's Office (R. Lance)
Chair, Wyoming Sage-grouse Implementation Team (B. Budd)