Wyoming Landscape Conservation Initiative

"Conserving world-class wildlife resources. Facilitating responsible development."

Forecasting and Evaluating Patterns of Energy Development in Southwestern Wyoming

Southwestern Wyoming contains one of the Nation's largest oil and natural gas reserves, a significant portion of the remaining intact sagebrush steppe, and some of the largest populations of sagebrush-associated wildlife species in the United States. The recent rate of oil and natural gas development in southwestern Wyoming is unprecedented (12,140 new wells between 2000 and 2012 compared to 9,664 wells over the preceding 100 years—derived from Biewick and Wilson, 2014), and future development is expected at a similar rate (22,573 wells over the next 20–30 years [BLM, 2015]). The effects of this future development on wildlife populations are topical to conservation of the sagebrush steppe ecosystem. The physical footprint of well pads and roads results in the direct loss and fragmentation of species' habitat. Wildlife avoidance of wells and roads, increased predation, and other factors may extend the ecological footprint of energy infrastructure outward for up to 20 kilometers (Johnson and others, 2011). Comparisons of the physical and ecological footprint of proposed energy build-out designs and of alternative designs are increasingly important to identify design options that may minimize the effects to wildlife habitat and populations for specific energy production goals. The ability to perform these comparative assessments has been limited by the lack of spatially explicit simulation tools designed to forecast and evaluate patterns of energy development.

As part of the Wyoming Landscape Conservation Initiative (WLCI), the U.S. Geological Survey developed the Energy Footprint Model to simulate the future footprint of energy development under different assumptions of development rates, patterns, and densities. Integrated with the model are procedures to assess the potential effects of simulated footprints on wildlife. The footprint model uses energy build-out parameters and maps of existing oil and gas infrastructure, subsurface mineral rights, and development restrictions to simulate the annual establishment of new wells, pads, and roads on the landscape. Build-out parameters, such as the total number of oil and gas wells, well density (number of wells per Public Land Survey System section), and the number of wells per pad, may be from an approved energy-development plan or may be experimental to assess a range of alternative well and pad configurations. The primary model output is time-stamped maps of initial and simulated pads and roads. These maps are subsequently used to assess potential effects on wildlife using published relations of species' response to road, well, or pad densities. Measures of energy production (number of simulated wells), pad- and road-surface disturbance, and potential effects on wildlife are used to identify build-out designs that minimize the physical and ecological footprint of infrastructure for different levels of energy production and development costs.

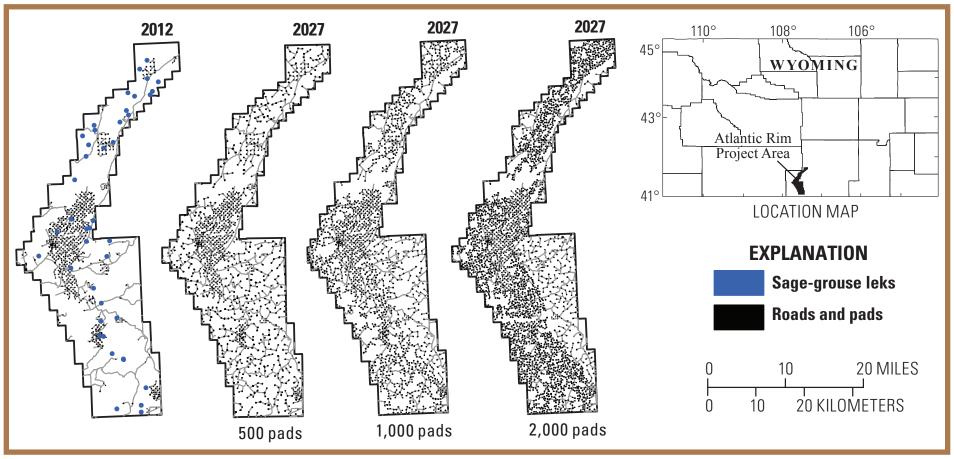

Figure 1. Energy infrastructure (roads and pads) in the Atlantic Rim Project Area at the start of the simulations (2012) and examples of simulated infrastructure patterns after 15 years (2027) using 500, 1,000, and 2,000 well pads.

A preliminary application of the footprint model evaluated the implications of using fewer well pads while maintaining the same level of energy production in the Atlantic Rim Project Area (ARPA) (fig. 1). The approved build-out design for the ARPA consists of 2,000 vertical wells, 1 well per pad (total of 2,000 pads), and a 32-hectare (ha) (80-acre) well spacing. The two alternative designs assumed that advances in directional drilling for coalbed methane would allow the use of multiple wells per pad. The alternative designs maintained the 32-ha spacing but established 2,000 wells using 2 wells per pad (1,000-pad design) and 4 wells per pad (500-pad design) (fig. 1). To accommodate four wells, average pad size was 1 ha

The WLCI is a long-term, science-based program to assess and enhance aquatic and terrestrial habitats at the landscape scale in southern Wyoming, while facilitating responsible development through local collaboration and partnerships.

Get Involved!

The partnerships represented by the WLCI are most effective if they include the individuals and groups who live and work in southwest Wyoming. Three great ways to get involved are project development, information sharing, and making a contribution.

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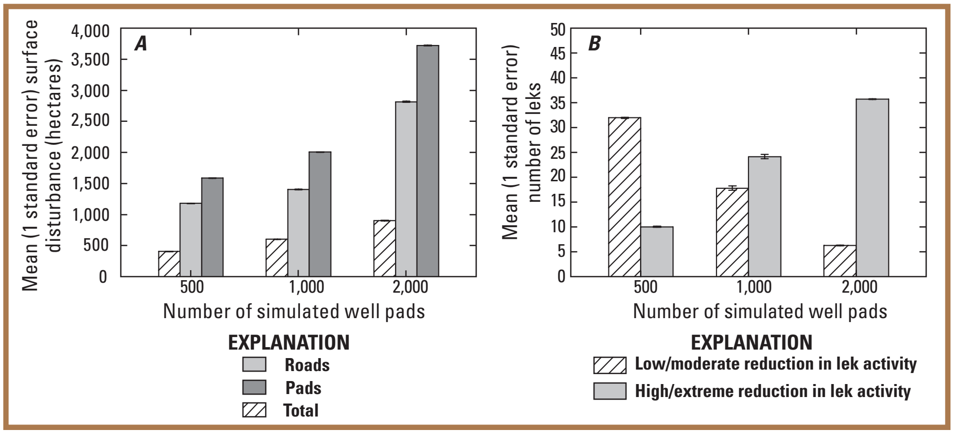

Figure 2. (*A*) Simulated amount of surface disturbance and (*B*) effects of simulated energy infrastructure on Greater Sage-Grouse lek activity after a 15-year development period (60 simulation replications). Low to moderate reduction in lek activity (less than a 27-percent reduction) occurs with less than 1.2 wells/km^2 (per square kilometer) and high to extreme reduction (greater than a 41-percent reduction) occurs with 1.2 or more wells/km^2 within 3.2 km of a lek (Wyoming Game and Fish Department, 2010). For all three designs, all 42 leks in the study area had at least 0.5 well/km^2 within 3.2 km.

larger for the 500-pad design compared to the other two designs. The amount of surface disturbance of simulated roads and pads was compared among the three build-out designs to assess differences in the physical footprint. Published relations between lek activity of Greater Sage-Grouse (*Centrocercus urophasianus)* and pad densities were used to illustrate the effects of the three build-out designs on a wildlife species.

Results of this initial model application provide important insights into the benefits of using fewer pads for energy production (fig. 2). Overall, decreasing the number of pads resulted in decreasing the physical and ecological footprint of energy production. Because pads accounted for the majority (69–75 percent) of the surface disturbance (fig. 2*A*) decreasing the number of well pads noticeably decreased total surface disturbance (for example, a 58-percent reduction in total surface disturbance between the 2,000 [3,722 ha] and 500 [1,587 ha] well-pad scenarios). Road-surface disturbance also declined with decreasing pad numbers, but differences among the three designs were not large. Using fewer well pads also was beneficial to lek activity. Although all designs may reduce activity on all leks, the number of leks likely to experience high to extreme reduction substantially declined with decreasing pad numbers (fig. 2*B*). The quantitative measures of the physical footprint and of wildlife effects provide critical information for determining conservation tradeoffs among the build-out designs that may differ in implementation costs. To help inform selection of a design, decision-makers may use these quantitative estimates to evaluate the gain or loss in conservation potential with the costs of the different energy-development strategies.

Assessments similar to the ARPA effort are planned for other energy fields in the WLCI study area. Infrastructure effects for additional species, such as sagebrush-obligate song birds, mule deer, elk, and pygmy rabbits, will be considered. Simulated alternative designs will explore tradeoffs among gradients of multiple wells per pad, pad spacing, and total pad numbers. To be practical, alternative designs will be constrained to what may be plausible with near-term technological advances in directional and horizontal drilling. The results of these assessments may assist land managers and planners in making decisions about the types of build-out designs that maximize resource conservation and energy production goals.

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Partnerships

The WLCI partnership formally includes the Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. Forest Service, Natural Resources Conservation Service, National Park Service, Wyoming Department of Agriculture, Wyoming Game and Fish Department, local conservation districts, and local county commissions. Additional groups and individuals participate as well.

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