View Point

Energy and Rangelands: A Perspective

By Jerry L. Holechek and Mohammed N. Sawalhah

On the Ground

- Depletion of conventional oil and natural gas reserves coupled to rising world demand for fossil fuels will have major impacts on US rangelands and ranches over the next 30 years.
- Shale oil and gas are unconventional fossil fuels now being aggressively developed on US rangelands. Their development involves a larger physical footprint in terms of roads, drill pads, mining pits, and water disposal ponds than conventional oil and gas development, but their development techniques are improving in terms of extraction efficiency and reduction of adverse environmental impacts. Groundwater contamination is the biggest potential threat to ranchers from shale oil and gas development.
- US ranchers will likely experience continued rising prices for their livestock due to world farmland loss, increased human population, and rising affluency in Asian countries, but their production costs will also rise due to higher energy costs. Implementing management practices involving risk aversion and minimization of fossil fuel use will be important for their future success.
- Basic principles of range management such as control of grazing intensity, grazing timing, animal distribution, and mix of animal species can be modified for management of energy developments on rangelands.

Keywords: rangeland, fossil fuels, renewable energy, nuclear power, fracking, meat production.

Rangelands 36(6):36–43
doi: 10.2111/RANGELANDS-D-14-00033

As we move into the 21st century, the biggest challenge confronting rangeland managers in the United States may be adjusting to rapidly rising energy costs and amelioration of adverse environmental impacts from energy developments. The United States has depleted its conventional or easy-to-extract oil and natural gas but has large reserves of unconventional fossil fuels (shale oil and gas) that are more difficult and costly to extract. Therefore it must and is aggressively developing both its renewable energy and its nonconventional fossil fuel resources that occur primarily on rangelands. The United States presently depends on fossil fuel (oil, natural gas, coal) for 83% of its energy and will still depend on fossil fuels for around 80% of its energy demand by 2040 according to projections by the US Energy Information Administration (USEIA).[1] Between now and 2040 world energy consumption is projected to grow 44% while US energy consumption is projected to grow 7%.[1,2] Even though there has been much hype regarding renewable energy sources (wind, solar, biomass), the USEIA projects they will only provide 12% of US and 15% of world energy needs by 2040 while nuclear power might provide another 8–10%.[1,2] The USEIA projects the United States in the best case will probably still be importing 30–35% of its oil in 2040 even if shale oil and gas resources can be fully developed.[1,2] The capability of shale resources to meet future energy demand has been contentious due to environmental concerns and uncertainty over their economic viability. However, out of necessity, the shale energy resources will be developed and this may have greater impact on rangelands than any other human activity. Unlike conventional oil and gas, shale reserves have low net energy yields and require a much larger and more invasive scale of extraction methods.[3] In terms of land, the physical footprint of drill pads, roads, mining pits, water disposal ponds, and pipelines will likely be expanded many times over present levels (Fig. 1).[3] Half or more of the shale energy resources in the United States occur on rangelands. This also applies to renewable energy sources such as wind, solar, and biomass. Aggressive development of shale and renewable energy sources in the United States necessitates that range managers and ranchers develop an understanding of both the economic and environmental aspects of this rapidly expanding rangeland use. Our objective in this article will be to examine present and future energy development approaches in the United States with implications for rangelands, range managers, and ranchers, with an emphasis on shale oil and gas resources.

History of Energy Use

Abundant, low-cost energy provides the foundation for our modern heavily industrialized, globalized world economy.[4–7]

Figure 1. Rangeland in southeastern New Mexico impacted by roads, pipelines, and pumping stations from oil and gas development.

During most of the past 10,000 years leading to modern civilization, humans depended heavily on renewable energy in the forms of wood, wind, waterfalls, dams, human labor, and draft animals to meet basic energy needs. Human numbers were suppressed to well under a billion people compared to 7.2 billion people now because only a low level of productivity was possible from the renewable energy sources that were in use. The major improvement in human living conditions, increased life expectancies, and rapid population growth that have occurred over the last 200 years are closely tied to discoveries and inventions that enabled switching from renewable energy sources (biomass, wind, water) to fossil fuels, beginning with coal. Although coal has received limited use as an energy source for over 2,000 years, a technological breakthrough in 1712 caused its relative importance to rapidly increase. This involved development of the first successful steam engine by Thomas Newcomen in Great Britain for pumping water out of coal mines, which drastically increased coal accessibility.[8] The steam engine could also be powered by coal. Rapid refinements in the steam engine during the late 1700s lead to development and use of steamboats and locomotives, first in Britain followed by the United States in the 1815–1830 period that revolutionized world transportation. Long-distance travel times were cut by 70% to 80% and much larger quantities of goods could be transported.

The next major energy advance involved the internal combustion engine. Various forms of internal combustion engines had been invented prior to the 1800s but a well-suited fuel source was lacking. This changed in the 1870s when kerosene refined from oil became the primary fuel for lamps. It was soon recognized that gasoline, a dangerous, volatile byproduct of oil refinement for kerosene, was the ideal fuel for internal combustion engines.[8] Automobiles powered by internal combustion engines using gasoline quickly became a common form of transportation after 1910. Henry Ford's automobile refinements and his development of mass production assembly line manufacturing techniques in 1908 played a key role in the conversion from horses to cars for individual transportation in the 1910–1920 period. In the 1920s tractors replaced draft animals on American farms as a power source to pull implements such as plows, disks, harrows, and combines. The US economy converted from using primarily renewable energy and coal to being based on oil as the primary energy sources in the 1920s.[8] Both worldwide and in the United States, oil is still the primary energy source. In the United States, oil provides about 37% of our energy compared to 34% worldwide.[1,2] Natural gas (25%) followed by coal (21%) are our second and third most important energy sources. Worldwide, coal is second in importance (27%) and natural gas is third (21%).

The most disturbing aspect of our modern highly complex, industrialized, globalized society is that it depends so heavily on oil, a nonrenewable resource that will be greatly diminished within 40 years. We recognize global warming as a secondary major problem tied to fossil fuel use. Oil is not only the primary energy source for our transportation system but it also is the key component of plastics, pesticides, herbicides, asphalt, pharmaceuticals, lubricants, waxes, and petrochemicals that are now essential in our everyday life.[9] Some other products incorporating oil include detergents, paint, shoes, tires, computers, diapers, and fertilizers. Without oil the unprecedented increase in human population, lifespan, material comfort, and ease of transportation never would have occurred.

Oil Is the Superior Energy Source

Because of its potency, ease of handling, ease of transport, and ease of extraction, oil is an overwhelmingly superior source of energy, with coal and natural gas in second and third place.[5,6,10] From a practical standpoint, a horse laboring a standard 40-hour week would have to labor for more than a year to produce the energy in a barrel of oil.[10] A fit human can do about one-tenth the labor of a horse. Through use of oil, it is estimated Americans on average have the equivalent of 80 slaves working 24/7.[8]

The EROI Concept

The most commonly used and easily understood comparative measure of energy potency is the energy output to input ratio. Commonly referred to as the energy return on investment (EROI), it is the ratio of the amount of usable energy acquired from a particular energy source to the amount of energy expended to obtain that energy resource.[6] If an energy resource has an EROI of one or less, it is not economically viable as there is no net energy gain from its extraction. Historically human societies have tried to maximize their energy gain using minimal expenditure of effort. In other words, the more potent, easily harvested or extracted energy sources are almost always used first rather than conserved. In the case of fossil fuels (oil, coal, natural gas), this has been especially true. Depletion of the more easily extracted conventional oil is the reason why oil prices have been in an uptrend since 2000 and will likely rise much more quickly during the next 30 years than any time in the past.[5,6]