allocated, so existing uses for other crops would have to be reallocated to support biomass farming—raising the issue of "food versus fuel" from yet a different angle. The water problems, however, promise only to intensify with global warming as California's winter snowpack fades and runoff to support summer agriculture declines.

Considering just the processing stage, biomass and unconventional fossil-fuel energy also often require much greater water usage than the 2.5 gallons of water required per gallon of gasoline produced. Coal-to-liquids production consumes 8 to 11 gallons of water per gallon of output, corn ethanol requires 4 to 6 gallons, and cellulosic ethanol needs 11 gallons. In the United States, Montana has looked into becoming a leader in coal-to-liquids production, yet Montana's dry climate suggests that water could be a limiting factor.

8. THE LAW OF RECEDING HORIZONS

An often-cited metric of the viability of alternatives is the expected breakeven cost of the alternative with oil, or the price that crude oil would have to be to make the alternative cost competitive. Underlying this calculation, however, is an assumption that the input costs to alternative energy production would remain static as oil prices rise, thereby providing the economic incentive to development. This assumption, however, has not always proved to be the case, particularly for those alternatives for which energy itself is a major input. Because of price linkages in the energy (and now energy and biomass) markets, rising oil prices tend to push up the price of natural gas as well as coal; for processes that are heavily dependent on these fuels, higher oil prices also bring higher production costs.

A good example of this phenomenon is the assessment of the economics of production from oil shale (kerogen-rich marlstone), found in vast quantities in Colorado, Utah, and Wyoming. In the early 1970s, shale oil was expected to flood the market if the price of crude oil were to rise above $2 per barrel. "When world oil prices had shot up to $35 per barrel by 1979, oil-shale production still required federal government assistance, and when oil prices fell in the mid-1980s, development and production were abandoned. Fast-forward to 2008 when oil prices moved above $100 per barrel—oil shale was then expected to be economic at $80 to $90 per barrel, and the U.S. government again provided incentives to explore production in the area. This ratcheting up of oil-shale economics with the price of oil reflects in part the high energy-input requirement to the production process.

Similarly, the corn ethanol industry has recently been subject to the same dynamic step-up in costs as the price of oil has risen. Two major input costs to the industry are the processing fuel (usually natural gas) and the corn feedstock itself. Rising oil prices after 2004 pulled natural gas prices up as well, increasing the processing energy costs for ethanol. At the same time, higher fuel prices made cultivating corn more expensive because of higher costs for operating farm machinery; this, together with the additional demand for corn created by the growing ethanol industry, helped push corn prices up even further. So, although the record-high oil prices of 2008 increased demand for ethanol, some ethanol producers were operating with minimal or no profit because they had to pay more for both their processing fuel and their corn feedstock.

Ultimately, the "law of receding horizons" is a phenomenon reflective of the general orientation toward financial and economic accounting to gauge project viability and prospects.[9] Physical accounting—that is, analyzing the material and energy inputs to a process—would help in better understanding the degree to which an alternative energy production process is vulnerable to the rise in energy costs.

9. ENERGY RETURN ON INVESTMENT

The complexity of our economy and society is a function of the amount of net energy we have available. "Net energy" is, simply, the amount of energy remaining after we consume energy to produce energy. Consuming energy to produce