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Technology and Sustainability: Two parts of a three-legged stool

David A. Schwerin, Ph.D.

There is a critical relationship between the health of the biosphere and the performance of the economy. Whether it is excessive flooding, droughts and hurricanes or worrisome ice pack melts, all have a connection, either directly or indirectly, to an ecosystem that is not functioning properly. Natural disasters produce severe property damage, farm dislocations, coastline erosion and species extinction. These disturbances impair the welfare of the business communities' employees, customers, suppliers, and investors. Despite the close connection between the ecosystem and the economy neither economists nor governments seem to appreciate the indispensable services nature provides - purifying water, cleaning the air, regenerating fossil fuels, regulating fiber and soil erosion and pollinating crops. With businesses so dependent on nature for its raw materials and the ecosystem struggling to supply the resources demanded, it is vitally important to adopt policies and take actions that respect and support the needs of the environment.

While most people acknowledge their obligation to be good stewards of nature, too few are willing to relinquish harmful habits to ensure the ecosystem thrives. To assuage guilt and shift responsibility, many conveniently assume that technological advances will solve all environmental issues; no personal or organizational changes are necessary. This article looks at the benefits and limitations of innovation and technology and what other actions must be taken to ensure the sustainability of the biosphere.

Energy: engine for growth and environmental culprit

Energy is a critical component of most economic activities. Oil, natural gas and coal are the three most widely used sources of energy today. Oil and coal are also major sources of pollution and emitters of greenhouse gases (CO₂) which leads to global climate change. The extremely long time needed to produce fossil fuels means they can't be regenerated as quickly as they are depleted. This presents a major sustainability concern.

No fossil fuel is as broadly distributed and comparatively inexpensive as coal. In addition to CO₂ emissions and other pollution concerns, some coal deposits are recklessly exploited by demolishing entire mountaintops. This technique destroys habitat and leaves behind severely damaged land that eventually has to be reclaimed at enormous cost. In some geographic regions, the acidic water from abandoned mines contaminates rivers. According to calculations by Greenpeace, the coal business causes around 500 billion dollars worth of damage each year. Nonetheless, coal is used extensively to generate electricity for billions of people and businesses and is, therefore, economically and politically hard to abandon. In fact, its use is likely to increase over the coming decades. The International Energy Agency (IEA) estimates that India and China alone will double their demand for coal by 2030.

Natural gas is much cleaner burning than either oil or coal. Almost one kilogram of carbon dioxide is released to generate one kilowatt-hour of electricity from black coal; even higher levels of emissions from burning lignite. A modern gas-powered plant, by comparison, emits about 350 grams of CO₂ per kilowatt-

hour. Oil's CO₂ emissions are about half way between the levels produced by coal and natural gas. Despite its relatively low greenhouse gas emissions, increased use of natural gas brings with it a number of challenges. Countries that need to import natural gas face the possibility of becoming dependent on temperamental or unreliable suppliers. All natural gas users are at risk if the pipeline that carries gas breaks or is vandalized. While some consider natural gas to be a bridge fuel that can be used until renewable forms of energy are economically available, supplies of natural gas found in conventional reservoirs are not unlimited and natural gas derived from unconventional sources have problems of their own, as we discuss in the next section.

Dwindling supplies of oil in easy-to-reach reservoirs has encouraged oil companies to exploit more technically challenging supplies so their businesses can continue to grow. While exploring for these harder to reach oil reserves has expanded the available supply, it has done so at a steep cost. Exploring deep below the surface, whether on land or sea, presents the daunting challenges of elevated pressures and high temperatures. The BP oil spill in the Gulf of Mexico highlights the risks involved and the billions of dollars of damage that can result when systems malfunction and poor decisions are made. In the absence of quick or easy solutions it is comforting to assume that, over time, innovation and technology will resolve all pollution and sustainability concerns. Let's examine the accuracy of this assessment.

Technology to the rescue

Ground-breaking discoveries and innovations offer both advantages and disadvantages. This holds true particularly when dealing with complicated technology. As stated by a U.S. Coast Guard inspector at a U.S. Congressional hearing, "The pace of technology has definitely outrun the regulations." Nevertheless, many continue to believe that future technological developments will solve fossil fuel depletion and environmental degradation problems in an equitable, sustainable manner. What are some of the potential consequences, intended or unintended, of deploying new technologies, particularly in the critical field of energy?

According to Dr. Tad W. Patzek, chairman of the Petroleum and Geosystems Engineering (PGE) Department at the University of Texas, "I argue that organizational structures and human behavior have not kept pace with the complex technologies we – the engineers and scientists – have created." He goes on to say, "Complexity is an essential feature of deepwater petroleum and natural gas production systems." "Our ability to predict the future behavior of complex living and inanimate systems is never perfect or complete." Dr. Edward Anderson, a professor in systems dynamics modeling at the same university echoes Dr. Patzek's views, "In a complex system a small disturbance or misstep can have huge, game-changing consequences." To illustrate this phenomenon, Professor Lorenz, a climatologist at the Massachusetts Institute of Technology, postulated some time ago that "the flap of a butterfly's wings in Brazil can set off a tornado in Texas." This is the source of the term "butterfly effect," a concept which has now become widely accepted. "A nasty corollary of the butterfly effect, repeatedly shown to be true, is that the behavior of complex systems is difficult for the human mind to predict," according to Dr. Anderson.

Carbon Capture and Storage (CCS) is a new technology now being used experimentally by some pilot electrical generating plants. It involves capturing CO₂ during the coal burning process, so it doesn't escape into the atmosphere, and then permanently storing it underground. Developing the technologies needed to facilitate widespread use of CCS is crucial to coal's long term viability. But there are also serious problems that need to be overcome. Many people fear living near a storage site; a gas leak can be quite hazardous particularly in high concentrations. And CCS will come with a high price tag. Retrofitting power plants, transporting CO₂ through pipelines and compressing it underground will affect the cost of electricity significantly. Current estimates are that CCS technology will reduce power plants' efficiency by about 10% as additional coal is consumed in the carbon capture process. Experts think it will take at

least 10 years before the new technology can be available on a large scale. And no one can be certain that the carbon that is stored underground will not adversely affect the surrounding area or leak back into the atmosphere. Even the proponents of CCS concede that successful implementation requires that the geologic formations used for the sequestration must be properly selected and carefully monitored. This presupposes that regulatory agencies are adequately funded and their employees are sufficiently knowledgeable. It is a huge gamble that could have serious unintended consequences. Nonetheless, the current consensus seems to be that until we are no longer dependent on fossil fuel combustion for power production and other industrial activities, there are few other choices.

As supplies of natural gas from easy-to-reach reservoirs are being depleted, energy companies are beginning to extract large gas deposits buried in specific geological formations of shale. There are significant difficulties associated with extracting gas from shale using the technology known as hydraulic fracturing (fracking). The relationship between fracking fluids (chemical thickeners, lubricants and other compounds) and groundwater contamination has not been fully determined but many believe the risks are significant. In addition, the design and integrity of well casings, the ever present possibility of spilling hazardous chemicals and the large quantity of water required for a single fracking job, are legitimate causes for concern.

Sophisticated technology and new innovations are urgently needed to make renewable energy more cost effective and fossil fuels more environmentally friendly. But new developments create new problems. Despite the best of intentions, employing new discoveries before we fully understand their effects can come back to haunt us in unpredictable ways. In addition, serious errors can occur when innovations are applied without sufficient awareness and appreciation of the interrelatedness of all things.

A more balanced approach

It is much easier to assume that technological advances will solve all sustainability issues (and other troubles as well) so that we don't have to change the underlying behavior that created the problems. A "business as usual" approach toward sustainability challenges carries several risks. First, there is a reasonable chance that future developments will be ineffective or disappointing. Second, businesses that take a passive approach miss the opportunity to reduce costs or generate new sources of revenue. Forward-looking executives, for example are becoming aware of the cost saving available from keeping their environmental footprint as low as possible. Wal-Mart has moved from being a laggard in this movement to being at the forefront resulting in substantial cost savings and an enhanced reputation. On a similar track, pioneering work by William McDonough and Michael Braungart is transforming enterprises who adopt eco-sensitive design concepts. Such businesses are creating products, industrial systems and buildings that enable commerce and nature to work harmoniously together while saving costs and scarce resources in the process. Conversely, companies that engage in environmentally destructive activities are being penalized through higher insurance premiums and lower stock valuations. In an attempt to make business successes and failures more transparent, the Carbon Disclosure Project (CDP) requests carbon emissions data from companies on behalf of over 500 institutional investors. Since 2003, the number of companies disclosing their data to CDP has grown ten-fold to 2500 organizations in 60 countries. Companies refusing to disclose their data are assumed to have a higher environmental risks and their cost of capital and insurance expenses are likely to be commensurately higher.

If we are to be successful in reducing environmental problems, technological advances are vitally important. But that is not enough. Business leaders must become environmental role models; relentlessly reducing waste and energy consumption, championing sustainable innovation and willingly offering a transparent view of the progress they have made and the challenges that remain.

Not only do we need more visionary business leaders, we also need more citizens to take personal responsibility for the welfare of the biosphere. Too many people avoid doing even little tasks – renewing, recycling and reusing products – either out of ignorance or laziness. Changing habits, particularly those we know are counterproductive, may require short term discomfort or sacrifice, but they are invariably beneficial in the long run. The best way to have both a prosperous economy and a sustainable ecosystem and is to make sustainability a top priority. Sustainable living is a state of mind; an attitude requiring a long-term perspective and respect for nature’s needs and limitations.

Many people in the developed world have acquired material goods in excess of what a healthy, enjoyable life style requires; overcoming this addiction will not be easy. The recent economic crisis has had at least one positive affect; a heightened awareness of the developed world’s over-spending and under-saving. For those living in the developing world, the task to reduce consumption may be a good bit harder. The majority of citizens in developing countries does not consume nearly as much as their counterparts in the West and may feel deprived if coerced into reducing their desire for material possessions. The problems in Asia, however, are compounded by rapid economic growth that accelerates urbanization and generates an enormous appetite for natural resources. Some two billion people may enter already burgeoning Asian cities by 2050. Increased demand for health services, transportation, energy, housing, sanitation, food and water are inevitable. Nine countries including India and China are considered “water stressed” because there is less than 1700 cubic meters of water per person per year. Greater demand from industry and agriculture, plus the unknown affects of climate change, will make the situation even more precarious. Without significant changes, current patterns of growth may lead to environmental disasters and social unrest. Noeleen Heyzer, head of the UN’s economic and social commission for Asia and the Pacific, believes governments in Asia, “simply do not have the luxury of growing first and cleaning up later.”

The urgent change in attitude that will be required was beautifully captured in a letter written by Mark Mykleby, an unheralded employee of the U.S. Government. The letter, which was sent to his hometown paper, The Beaufort Gazette in South Carolina, revealed his reaction to the environmental tragedy in the Gulf of Mexico oil spill. “I’d like to join in on the blame game that has come to define our national approach to the ongoing environmental disaster in the Gulf of Mexico. This isn’t BP’s or Transocean’s fault. It’s not the government’s fault. It’s my fault. I’m the one to blame and I’m sorry. It’s my fault because I haven’t digested the world’s in-your-face hints that maybe I ought to think about the future and change the unsustainable way I live my life. If the geopolitical, economic, and technological shifts of the 1990s didn’t do it; if the terrorist attacks of September 11 didn’t do it; if the current economic crisis didn’t do it; perhaps this oil spill will be the catalyst for me, as a citizen, to wean myself off of my petroleum-based lifestyle. ‘Citizen’ is the key word. It’s what we do as individuals that count. For those on the left, government regulation will not solve this problem. Government’s role should be to create an environment of opportunity that taps into the innovation and entrepreneurialism that define us as Americans. For those on the right, if you want less government and taxes, then decide what you’ll give up and what you’ll contribute. Here’s the bottom line: If we want to end our oil addiction, we, as citizens, need to pony up: bike to work, plant a garden, do something. So again, the oil spill is my fault. I’m sorry. I haven’t done my part.”

Sustainable living can be thought of as the seat of a stool; the sturdy foundation for life. We have described the three legs supporting the stool as visionary business leadership, individual discipline and ingenuity and technological advances. When the three legs of the stool are performing their vital functions, we create a sound foundation for an enduring and fulfilling future.