

Bioeconomy Perspectives

Talk for Teddy Roosevelt Conservation Partnership (TRCP) Board of Directors

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The bio-economy and all of its buzzwords seems to have sprung up like mushrooms after a spring rain. As one Iowa farmer so eloquently put it, "I couldn't even spell *bioeconomy* until about a year ago, but now I am educated."

It took about 20 years—from the early 1950s to the early '70s, for most to realize that we were no longer living in an industrial economy. When we finally figured out the old economy had exited, there seemed to be a question about what to call the new one. Post-industrial? Service? *Shopping and gathering?* Eventually, *Information economy* won the title.

So, our country began with an agrarian economy that was transformed into the industrial age, which is most of our lifetimes, but now we are in the information age, where the knowledge capital of the citizens of a state, region, or country will be the deciding factor on the economic success of that state, region, or country.

These days, the economy cycle is getting shorter and shorter. We are already seeing the end of the Information economy, not because it's petering out, but because a challenger has supplanted it.

The plain fact is that the bioeconomy opened for business in 1953, when Francis Crick and James Watson identified the double-helix structure of DNA, the effects of which can be seen easily in the many genomic institutes found today on university campuses and the worldwide use of GMOs in our crop and livestock production.

During the next two decades, organic biotech will overlap with inorganic silicon infotech and inorganic composite materials and nanotechnologies. All this will make us baby boomers a unique generation. We will be the first in history to span three distinct economies. Born at the end of the industrial period, we will spend most of our careers in the information age and will end our days watching our grandchildren negotiate the bioeconomy.

Today, across the globe, countries and regions are looking to the "bioeconomy" as an economic Second Coming. Admittedly, the bioeconomy presents a compelling short-term economic development opportunity because it focuses on turning a region's existing crops and waste streams into higher-value products, rather than on bringing a host of entirely new industries into the region.

This type of economic development strategy has tangible benefits for the farmers and foresters, who grow the biomass, but also for those involved in the biomass processing (such as turning corn into ethanol) and product development (such as creating solvents and plastics from biobased, rather than petroleum-based, chemicals). The economic ripple effects of a bioeconomy can reach even further, to a host of support industries such as construction, transportation, and manufacturing, and even to incidental industries in the retail and service sectors.

These economic opportunities are only part of the picture, however. The vision of a bioeconomy is based on a fundamental shift away from fossil fuels and toward USA-grown biomass as the raw material for energy, fuel, and chemical production. Although it is hotly debated among scientists, this shift touts dramatic environmental benefits to regions that pursue bioindustry development, theoretically because it will reduce the greenhouse gas emissions endemic to oil and gas combustion, and also because it will supposedly funnel resources toward developing more energy-efficient and sustainable feedstocks.

Tonight we will take a serious look at our potential to participate and become competitive in the emerging bioeconomy. I will first provide an overview of the bioeconomy to include a discussion of the mix of environmental, economic, and equity factors that make up a successful bioeconomy. Finally, I will discuss the bio-economy as it relates to conservation and TRCP's three main initiatives.

What Is the Bioeconomy?

Essentially, a bioeconomy is an economy made up of industries that rely on renewable biobased feedstocks as their raw material. Just as the fossil fuel economy — including oil and gas extractive industries, petrochemical industries, transport of oil and gas in liquid form, transmission of coal energy through power lines, etc. — relies on the raw materials of coal, oil, and natural gas, so does the bioeconomy rely on the raw materials of plants, crops, wood waste, and animal waste.

Like the fossil fuel economy, the bioeconomy has many facets and many potential industry offshoots. It is perhaps best understood by looking at the three stages of industry development: the raw product, or the biomass feedstocks themselves; the processes used to convert the feedstocks into a higher value-added product; and the final products produced by those processes.

At the root of the bioeconomy lies the raw material: biomass feedstocks. The sugars, starches, oils, fibers, and other organic materials that are produced by living plants and animals can be transformed into higher value products such as energy, fuels, and biobased products such as chemicals and plastics. Feedstocks include crops such as alfalfa, soybeans, and corn; perennials such as trees and switchgrass or miscanthus; crop and forest residues; and animal wastes such as manure from cows, pigs, and poultry. Secondary feedstocks — those that are produced as waste matter when a primary feedstock is processed — can also sometimes be used as raw materials in the bioeconomy: these include, for example, pulp and paper mill

waste, food and meat processing waste, brewery waste such as spent grains and hops, and municipal solid wastes.

Most of these feedstocks have only minimal value on their own, so a major goal of the bioeconomy is to find processes that transform them into something of higher value, such as energy or fuel. These processes can range from the very simple (e.g., burning wood to create heat energy) to the very complex (e.g., processes used to create chemicals and plastics from biomass, such as pyrolysis and thermochemical liquefaction).

The products created through these processes fall into three groups: bioenergy, biofuels, and bioproducts. "Bioenergy" refers to the process of converting biomass into electricity and heat, or "energy," sources. For instance, plant matter and woody waste can be cofired with coal in traditional power plants, and anaerobic digestion can produce a biogas that acts similarly to natural gas. "Biofuels" are renewable fuels intended to displace transportation fuels, and include ethanol and biodiesel. Ethanol is generally made from corn and other sugar crops, though new processes are being developed to produce ethanol from the cellulose found in switchgrass, woody waste, and wheat straw. Biodiesel generally is made from oils found in soybeans and canola seed.

Potential Impact of the Bioeconomy on the Fossil Fuel-Based Economy

The case for moving away from a petroleum economy is clear; the question remains whether investing in the bioeconomy will really allow the United States, as a whole, to gain any actual independence from fossil fuels. *In short, how much of the enormous, growing fossil fuel economy can be displaced realistically by bioindustry?*

A recent study from the U.S. Department of Energy and the Department of Agriculture attempts to answer this question.

The study authors found that to displace 60 percent of current U.S. petroleum use in energy, fuel, and other products — the country as a whole would need to produce 1.3 billion dry tons of biomass per year. Current cropland and forests, excluding environmentally sensitive and roadless areas, have the potential to produce this much biomass, but this would require a seven-fold increase in production, some changes from annual crops toward more efficient perennial energy crops, and more efficient harvesting of waste. Additionally, transforming the biomass into useable energy, fuel, and other products would require a massive increase in bioenergy and biorefinery facilities across the country.

Unfortunately, the study says nothing about the impacts of such production, especially on surface and groundwater systems. Sure, it CAN be done, but not without massive shifts in water priorities. We already have water wars going on in the West and this scenario would only add to the strain. Further, the long-term consequences of such massive water usage are unknown.

What Are the Elements of a Successful Bioeconomy?

To frame these issues, it is useful to consider what a successful US bioeconomy might look like. Beyond moving this state toward a more energy independent future, a successful bioeconomy should produce the following tangible benefits.

- **Strengthen existing industries:** A successful bioeconomy will take advantage of and build upon existing resources and industries, including those that produce primary and secondary feedstocks (agricultural, forestry, food and meat processing, municipal waste management, etc.), those involved in biomass processing (ethanol plants, digesters, co-firing plants, etc.), and those involved in manufacturing and distributing final products (manufacturing facilities, utilities, fuel distributors, etc.).
- **Generate new industries:** A successful bioeconomy will create a market for bioenergy, biofuels, and bioproducts that draws new industry to a region to meet demand in these areas.
- **Strengthen and develop links among industries:** The bioeconomy depends on a range of industries that run the gamut from farming to manufacturing to education. A successful bioeconomy will depend on strong linkages among these industries, which span the most rural and the most urban parts of a region.
- **Generate private investment in new industries:** The emerging biobased market will generate private capital investment in new ventures, especially in research and development of new, better technologies to convert biomass into viable products.
- **Create high-quality jobs:** In strengthening existing industries, generating new industries, and generating capital investment, the bioeconomy will create jobs at every level of the production chain—research and development, biomass production, biomass processing, and product development and sales.
- **Generate wealth and provide ownership opportunities for rural communities:** A successful bioeconomy must provide rural economies with more than the basic cost of the feedstocks harvested from their lands. It must provide rural landowners with opportunities to add value to these feedstocks through a variety of processing technologies, as well as some share of the resulting energy, fuel, and products.
- **Improve the environment:** Because the bioeconomy has its roots literally in the land, a successful bioeconomy must ensure that the land is productive for generations to come. Thus a successful bioeconomy must balance raw material demand with long-term land conservation — including preservation and protection of the wildlife, water, and air that work together to support and enhance that land. Indeed, conservation is much more than just protecting the agricultural productivity of the land. It's also about protecting the waters that flow from that land and the quality of life—human and others—that are supported by it. With these benefits in mind, let me now turn to some frequently asked questions about the bio-economy.

U.S. Bioindustry Policies and Incentives Affecting Conservation

The Federal government can heavily influence a country's bioeconomy by providing economic stimulus to the feedstock growers, processors, and sellers. When the U.S. government decides to go in a particular direction on bioeconomy development, massive amounts of federal financial and research support flow in that direction. In the United States, two large federal bills clearly affect this country's bioindustry potential: the Farm Bill and the Energy Bill. The United States also has many incentive programs, some authorized under one or the other of these bills, to encourage specific research and development of bioenergy, biofuels, and bioproduct technologies. The actions United States takes in the next few years will affect greatly the economic and environmental character of our country for many years to come.

The burning policy question is whether the long list of positives associated with the expansion of bio-industry is sufficient to offset the list of environmental negatives.

The data that are used currently to espouse the bioeconomy barely touches on potential impacts on our soil, water, and wildlife resources. If we aren't diligent, we will be starting the new bioeconomy with the same old thinking that has cost us more than half our topsoil and has given us some of the foulest water in history.

A soil scientist at Iowa State University has called Iowa potentially the world's largest, shallowest strip mine. He's right. Unless we thoroughly transform our thinking about our natural resources and make sustaining them our first and primary consideration, the bioeconomy will be no more sustainable and renewable, in the long run, than the petroleum economy and will occur at the further expense of some of the richest land in the world.

United State's economic and environmental future depends very substantially on how we manage our land and water assets. A comprehensive strategy can attract business development, promote efficient use of government resources, and provide for a high-quality environment that saves farmland, promotes nature-based recreation and tourism, and helps to protect land, water, and wildlife resources.

The decisions we make regarding our land and how it is used will be critical to our success. The power of the economic impact the bioeconomy can have depends on the preservation of the resources base and open spaces that our country offers.

Let's take a look where the bioeconomy stands relative to TRCP's mission-critical initiatives:

Expanding Public Access for Hunting and Fishing

A major concern of Midwest hunters is the loss of CRP and other habitat lands that are important wildlife habitat, to new acres of corn planting. The Iowa Farm

Bureau already has developed a legislative policy favoring use of CRP lands for cultivation. As corn approaches \$4.00/bushel, farmers will be planting new acres in corn. Economists at ISU estimate that this planting season will see an increase of 1.3-1.8 million MORE corn acres in Iowa alone. Additionally, there are estimates that over the next 3-4 crop seasons we'll see a 70-75% increase in corn acres, mostly at the expense of soybeans, which means that wildlife acres will be "squeezed."

Conserving and Enhancing Fish and Wildlife Habitat

Continuing to use Iowa as an example, there also is a drive to increase the yield per acre, and some test plots are planned this Spring in Iowa for 300 bushel per acre corn. These intensive cultivations will require more pesticides and more fertilizers providing an increasing degradation to watersheds. The opportunity to restore wetlands in marginal farmlands also may be lost to the desire for additional corn land. If above estimates are even close to correct, Iowa's present bad water quality problems will only multiply. The ability of the state to attract other businesses and people is largely dependent upon quality of life concerns. Taking Iowa's abundant water resources from "bad" to "worse" will not help in that regard. The additional nitrogen—also a petroleum product—required to get to 300 bushel corn will result in additional run-off into our surface waters (it's water soluble) and increase the already large contribution we are making to hypoxia in the Gulf of Mexico. Also, there are additional concerns about increasing pesticide use on corn-after-corn acres. The simple corn-soybean rotation alleviates some of the use, particularly of insecticides. That won't be the case in corn-after-corn. The potential implications for wildlife have not been calculated.

Here are some additional points to consider:

- Whether from corn, switchgrass, wood chips, or other bioproducts, production of bioproducts will impact the landscape and, therefore, the diversity of plants and animals that live here with us.
- Agricultural monocultures, by definition, limit the diversity of plant species and, as a direct result, subsequent insect, bird, mammal, amphibian, and reptile species.
- Increased row-crop acreage will limit abilities of wild species to expand current ranges as habitat becomes more compressed.
- As row-crop acreages increase, so does the potential for soil erosion. In turn, streams and rivers subsequently may become clogged with eroded soils and limit the ability of many aquatic species to survive.
- Too rapid expansion of biofuel crops without regard for biodiversity consequences would negatively impact Iowans' quality of life.
- Water quality and quantity impact wild populations, especially in critical seasons. Insofar as biofuel production and subsequent waste management

impacts these water resources, there may be substantial impacts on wild biodiversity.

- Finding a balanced approach that incorporates thoughtful approaches to ecological, economic, and social impacts of biofuel production will be more sustainable for a state that has seen dramatic recoveries of species in the last 50 years.
- Careful planning and management of the growth and harvest of cellulosic crops (i.e., trees, switchgrass) could potentially provide valuable winter cover for wild species, though nesting and brood-rearing cover functions would be limited. Depending on when these crops are harvested, however, there may be little or no over-winter cover. Contrary to popular thinking, cellulosic crops are not a panacea. Cellulose species like switchgrass, if grown as monoculture crops, will end up using fertilizer and pesticides. And if we harvest them to the ground, year after year, and also keep growing row crops the way we are now, our soil and water won't hold out. And if most of our pastures and woodlands became cellulose monocultures, that would be a wildlife habitat disaster. [See bullets above.]
- Water is the potential Achilles Heel of the bioeconomy. There are both water quantity and water quality concerns. At the present, it takes 4.1 gallons of water for every gallon of ethanol produced. How much of that can be cleaned and recycled within the plant? What happens to that water if it cannot? What are the water quality/stream/wetland implications of that wastewater discharge to fish and wildlife? What structural changes (wetlands, etc.) might be made to mitigate these impacts? All tough and not-yet-answered questions.

Increasing Funding for Fish and Wildlife Management

With the advent of a new Farm Bill coinciding with the advent of the bioeconomy, we have an important opportunity to address these conservation concerns. Programs need to be designed that will protect the impact of this emerging economy on our soil, water, and wildlife. And I am sure that TRCP as well as the conservation groups that make up its board membership will be fully engaged in the discussion.

This is the policy portion of the debate, which, to my knowledge, has not yet been resolved in the upcoming Farm Bill. As was pointed out at the discussion at Pheasant Fest, even IF more conservation funding becomes available in the 2007 Farm Bill, farmers may not take advantage of it when land rental rates are so high and corn is at \$4/bu. Policy that relies solely on the carrot and not on any sticks (like HEL, etc.) will not help us much, I fear. Some opportunities for the Farm Bill could include:

- Development and delivery of producer friendly (meaning that producers could implement) models that allow producers to determine how much crop residue can be collected for feedstock without impacting/degrading soil quality.

- Accelerate research for development on one-pass harvesting equipment.
- Conservation programs that assist producers to transition to no-till practices.
- Research and demonstration efforts that help producers identify and grow the most suitable crops for both food production and biomass production for their soils, topography, and climate.
- Research and demonstration initiatives that address some of the cellulosic conversion technologies.

Sustainable bio-economic development will require:

- A profitable agriculture with areas of contiguous, high-quality farmland along with a strong and growing recreation sector.
- A strong business climate that emphasizes high-paying cutting edge jobs in biotechnology and the knowledge worker economy, which will require high “quality-of-life” features that include easy access to scenic views and open spaces and outdoor recreational activities that are valued by highly mobile companies seeking to attract and retain knowledge workers.
- Fully realizing the value of our urban areas and making better use of existing infrastructure to lessen the development pressure on our undeveloped lands.
- Efficient infrastructure and government services which result from developing and executing vision of “how” we grow. It is the absence of such vision—uncontrolled sprawl—that results in inefficient provision of infrastructure and government services such as sewer and water services, roads and road maintenance, public transport systems and public safety services.
- Environmental stewardship of our land and water is not only essential to our health and wellbeing, but for the sustainability of our agriculture and forestry, our parks and recreation, and our wildlife. Being good stewards is also an integral part of United State’s culture and identity.

But not all land will remain undeveloped or in forest or agriculture. Where do we devote our efforts and resources? Environmental stewardship of which lands? Of which waters? Answering these questions requires good science, comprehensive planning, and organizations such as the Teddy Roosevelt Conservation Partnership.

CONCLUSION

I set out to explore the question of whether the United States has many of the elements necessary to build a strong, vibrant economy based on bioindustry. I believe the answer to that question to be a qualified yes. We have a diverse mix of the ingredients necessary to build such an economy: raw materials, both in

agriculture and forestry; a strong manufacturing infrastructure, including facilities and highly-skilled labor; a strong university and technical college system, including internationally-known research facilities; and a strong workforce development system with the capacity to train workers in the new skills necessary to any emerging industry. We also already have industry concentrations in many of the primary and secondary industries that will make up a biobased sector, including not only the biomass growers and producers, but also the manufacturing facilities, processors, and potential end users of various byproducts. These elements could combine to make the United States very competitive in the bioindustry arena.

To create the bioeconomy, however, we need more than our existing resources and the will to move forward. To pursue a successful bioeconomy, one that includes a range of rural and urban jobs, entrepreneurship opportunities, ownership opportunities for rural landowners, and economic incentives balanced with environmental protections will require that major institutions – government, academia, business, labor, and community – to work together and mutually reinforce one another. It is indeed an exciting time for all of us, fraught with both opportunity and challenge.

Thank you for your time.