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Short communication

Rural development opportunities in the bioeconomy

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ABSTRACT

In this paper we discuss the rural development implications of the bioeconomy. We define the bioeconomy broadly but dedicate much of the paper to the implications of bioenergy and how it will transform the economies of rural regions. We then conclude with three different bioenergy related concepts that will provide a broader framework for the development of the rural bioeconomy. These include the costs of bioenergy and especially transportation costs, the regional energy balance and the utilization of waste streams.

1. Introduction

On April 16, 2012, the Obama administration released the National Bioeconomy Blue Print [1] – a new policy directive designed to promote the growth of the US bioeconomy through basic and translational research, education, regulatory reform and public–private partnerships. The blue print does not explicitly define the bioeconomy but implies that it includes most biological based activities from genetic engineering to biofuel production. Others define the bioeconomy simply as an economy that is more dependent on renewable resources, which could include such sectors as non-biological sources of energy. In this paper we refer to the production, processing, marketing, transportation, and consumption of biologically derived products.

We suggest that the expansion of the bioeconomy is inevitable because of the limits on non-renewable resources, especially energy, and the increasing imperative that we reduce atmospheric carbon. Our key message, however, is that the bioeconomy will transform the economies of rural areas. The relatively high cost of biomass transport [2] means that the majority of the bioeconomy production, processing and transportation is likely to emerge in rural areas. In this article we consider the long term rural economic consequences of biomass industries in developed economies.

The bioeconomy is much more than bioenergy, but bioenergy will continue to be a key subsector. As we will see,

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bioenergy plays a special role in shaping rural economies. Therefore we dedicate the majority of this article to bioenergy and how it will transform the economies of rural regions. We then conclude with three different bioenergy related concepts that will provide a broader framework for the development of the rural bioeconomy.

2. Bioenergy and beyond

The bioeconomy refers to the production of a wide range of goods and services, from plant, animal and forest-based material. It is more than just grain based bio-fuels or bio-diesel. The term bio-economy includes counterparts for everything that petroleum is currently used for, and for other things as well. In the bioeconomy we will replace petroleum (as well as coal and natural gas) with biomass-based material. So plastics, nutriceuticals, pharmaceuticals, and all kinds of biomanufacturing will be part of the bioeconomy [2]. The bioeconomy is a transformation of our entire economy and perhaps even our social structure.

3. The rural economics of bioenergy

The fossil fuel sector has gone through cyclical booms and busts as it expanded to become the dominate source of energy. The bioenergy sector will be no different. The current bioenergy facilities have relatively small, direct employment effects on their local economies because of their high capital intensity. New high technology industries in the bioeconomy will likely have fairly low direct employment numbers as well. Partially offsetting the small direct effects, is the likelihood these industries have higher employment multipliers than other sectors, although many studies of this sector have vastly overstated their indirect effects of biofuels [3].

The main immediate economic impact of biofuels has been increases in the global prices of commodities (and local premiums near biofuel plants) and increased flow of money to farms and rural communities [4]. Farmers have responded by bidding up the prices for crop land (both rent and purchase prices), until they are again at their break-even point. The owners of farm land, whether they farm or not, have enjoyed a significant wealth effect from the new demand for grain.

Thus in the bioeconomy, the agricultural economics issues will be much the same as in the petro-economy. Because farmers tend to produce as much as they can justify on the basis of net earnings, the rising demand for biomass and renewable energy will be matched by expansion in production keeping long run average commodity prices low. Because farmers tend to capitalize net earning into land values average profits will be relatively low in the long run. In the bioeconomy as in the petro-economy, farmers will be squeezed between high costs and low revenues and there will be concerns about the economic viability of agriculture.

On the other hand, the bioeconomy is fundamentally different from the petro-economy in other important respects including its environmental, geopolitical, social and technological consequence. In this paper we are primarily interested in another significant difference and that is the distribution of the raw material over space. The most basic raw material in the bioeconomy is solar radiation. And solar radiation is more evenly distributed spatially compared to fossil fuels which are highly concentrated both spatially and in terms of energy density. Because solar radiation, and thus biomass is more evenly distributed, it favors a very different spatial production, processing and marketing system.

4. Bioenergy and rural areas

Transportation costs have always played an important role in the location of productive economic activities and thus in population. Transportation increases the costs of commodities to consumers and/or reduces the in situ value of commodities to producers. Higher transportation costs can offset economies of scale in production, leading to more distributed economic activity [5]. Rural areas are typically hampered by high transportation costs because their inputs must often be transported from centralized manufacturers or warehouses, and their own products must be transported long distances to a majority of their customers. One exception is when their raw materials are locally sourced which partially offsets costs on the input side but has no effect on the returns on the output side. The more remote a producer is, the farther it is from market, the lower its net earnings from the sale of its product, the lower its land values, and the lower the aggregate income in the region. At the same time, transportation costs increase the prices of consumer goods and inputs. The more remote a consumer is, the more isolated and farther he or she is from sellers, and the more it costs the consumer to get his or her consumption goods. As a result, rural and small towns, especially in lower populated and land locked areas, because of the greater distance to seaports, distribution centers, and population centers, are doubly disadvantaged by the high cost of transporting products to market and the high cost of transporting consumer goods back again. However, as we will see when the input is transportation fuel the situation takes an interesting twist.

In the petro-economy, transportation costs reduce the net value of products and income of producers. Small agricultural based communities in rural America for example, primarily produce commodities that must be transported long distances to markets. In the bioeconomy, things are potentially quite different. Local production of energy reduces the need to transport energy in and the need to transport all products (biomass) out. To the extent that rural areas become producers of their own bioenergy, they save in both directions. Rural residents no longer need to pay for the transportation of petroleum from Venezuela or Saudi Arabia and no longer need to pay for the transport for as much of their commodities to export destinations. Of course, the production of bioenergy must still be economically feasible. It must be possible to produce bioenergy at a cost which is competitive with petroleum but once this is achieved, rural communities will benefit disproportionately.

As rural areas become net bioenergy producers, they will realize other advantages. First, local transportation costs are lower than in regions that must import transportation fuels providing local businesses with an advantage over urban

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centers. More importantly, major consumers of processed energy (certain manufacturers, server farms, and firms with large air conditioning needs for example) will find rural areas more attractive than they did in the petro-economy because of their lower prices for energy.

Thus with respect to spatial economic advantage the bioeconomy is qualitatively different from the petro-economy because of its distributed nature. This feature generates the double dividend of distributed energy – reduced cost of production and higher valued products in rural areas. The bioeconomy turns remoteness at least partially on its head.

5. Rural regions and their energy balance

Every product requires energy – energy to produce, energy to transport it to market, and even energy to purchase and to use. Thus each good and service has an embedded or implied amount of energy in it. This is also true for energy. Energy costs, no matter what the source, are increasing relative to other commodities. Growth in the global economy, declining reserves of fossil fuels, and the rising use of energy by industry and communications, makes it likely that for a, long time to come, the real price of energy will rise relative to most other products[1] [6].

Those activities and places that produce more energy than they consume will thus be better off relative to other activities and places. In the petro-economy, most rural areas (especially agricultural areas) used more energy than they produced, and rising energy costs hurt them. In the bioeconomy, where rural areas will produce more energy than they consume, they become the beneficiaries. In the bioeconomy, rural areas have an opportunity for continued economic growth, because they are producing something that will become relatively more valuable over time.

This viewpoint underscores the importance of making a region's energy balance as positive as possible. Small towns and rural regions have a potential advantage, but must do everything possible to capture the full extent of this potential. To do this they must find ways to reduce the energy that they use and increase the energy that they produce, and to find economically feasible ways of substituting locally produced fuels for imported fuels.

6. Waste streams

A region's energy balance is made even more positive if we can more fully utilize waste streams in our biomass processes. There are significant waste streams in rural areas – crop residues, forest residues, animal manure, and chicken litter to name just a few. Our research on the economics of waste-to-energy almost always finds them more feasible than using valuable commodities as feed stock [7].

In addition to the raw economics, conversion of waste to energy generally offers more environmental benefits than converting food to fuel. We are still not sure what the net environmental effects of our current biofuel technologies will be but we do know that converting waste streams into energy is much more likely to bring about positive environmental benefits.

7. A cautionary note

An important lesson can be learned from regions of the world that have served as the source of non-renewable energy and resources. In many (perhaps most) of these regions the costs of exploiting in situ resources is ultimately borne by the place and its residents. The wealth of the place is temporary and if this wealth is not reinvested locally both the place and those unfortunate enough to reside there are impoverished by the mining and environmental degradation. In the bioeconomy, similar impoverishment will occur if the renewable resource base is not protected and if the returns from the resource are not reinvested in the people and places.

8. Conclusions

In summary, we stress three points. First rural regions can benefit economically as the costs of remoteness in the centralized petro-economy are replaced by the benefits of space in the distributed bioeconomy. This is no assurance that farms will be more profitable, or less risky, or that all economic problems will be solved. Instead it means that the economic penalty for remoteness will be partially erased. Rural areas will have certain advantages that they have not had in an economy dependent on coal and petroleum.

Second, a region's current energy balance determines the degree to which it is exploiting the advantages of the bioeconomy. Key to a strong energy balance is the economic production of energy, of course. But another important variable is energy consumption. Even though locally sourced energy may be less expensive than imported energy, efficient use and conservation of energy still support the local economy by improving the energy balance and increasing the region's income. A significant part of every region's energy balance will be determined by the degree to which they can capture the energy in their waste streams.

Third, the potential benefits identified in this paper will be realized only if the bioeconomy includes safeguards for renewable resources, mechanisms that ensure an equitable distribution of the rewards from investing, and if the bioeconomy is allowed to develop in an efficient and optimally distributed fashion.

The above conditions are unlikely to occur without clearly articulated goals coupled with strategic guidance from policy. There should be an integration of policy and programs, community leaders, rural entrepreneurs and economic developers or practitioners who act as a conduit between entrepreneurs and policy. In order to grow the bioeconomy the goals of these actors should be aligned.

[1] The US Energy Information Agency (2012) projects prices of energy to continue rising through 2035 at annual rates between 1.0% for natural gas, and 2.4% for jet fuel. Overall the rate of increase is about 1.5%.

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