Feedstocks Logistics

Sustainability, Input Requirements – Jon Van Gerpen

Define sustainability for feedstock logistics and how does this connect with the general issue of feedstock sustainability?

In practice, sustainability has come to mean avoiding consumption of finite resources such as minerals or fossil fuels and minimizing emissions of greenhouse gases. Feedstock logistics is the activity which ensures that adequate feedstock will be available to a production facility at the time it is needed. While logistics includes actions to ensure supply of feedstock such as research on yield improvement or new variety trials, in the current discussion these are better left to the "Feedstock Availability" group. Sustainable logistics would involve cultivation, harvesting, transporting, and processing of feedstocks in a manner that minimizes fossil fuel consumption, depletion of irrigation water aquifers, and greenhouse gas release.

In his critique of current responses to global climate change Bjorn Lomborg makes a valid point that when balancing the needs of the present against the needs of the future, we should be aware that the future is likely to be in a better position to respond to environmental challenges than the present. In particular, if past trends of increasing wealth and education in developing countries continue, then these countries will be better able to invest in technology development to adapt to resource shortages and climatic changes. In many cases, it may be more sustainable to use finite resources to build current wealth in developing countries so that these countries can respond to future resource shortages in a manner that sustains the quality of life of their citizens. This approach may also be more ethical than policies that seek to limit the ability of developing countries to use their resources to raise the quality of life of their people.

How does feedstock logistics impact sustainability?

The manner in which feedstock is supplied to produce a biofuel can have a major impact on the sustainability of that biofuel. If the land used to produce future supplies of feedstock is currently used for other purposes, then this triggers concerns for both direct and indirect land use changes. Direct land use changes are most frequently associated with converting rangeland, forest, or desert to cropland. This conversion may involve the release of large amounts of stored CO_2 or cause damage to an existing ecosystem. This is a particular concern when land currently in the Conservation Reserve Program (CRP) is considered as a source of land to produce biofuel feedstock. Indirect land use changes occur in other countries that are motivated by international commodity price increases caused by policies that incentivize biofuel production in the United States. As with direct land use changes, indirect land use changes can cause release of stored CO_2 and ecosystem damage. Deforestation in Brazil and Indonesia is being attributed to this effect, although logging and cattle ranching also appear to be important factors. International land use changes may also be an issue if biofuel feedstocks are imported. For example, if ethanol is imported from Brazil or palm oil from Indonesia, then the sustainability of that practice needs to be evaluated on a world basis.

The manner in which energy crops are cultivated and harvested will also impact sustainability. If financial incentives encourage inappropriate crop rotation practices, then some farmers will need to use excessive amounts of pesticides and fertilizers to control insects, diseases, and soil fertility levels. These may contaminate streams, lakes, and underground aquifers. In many parts of the country, especially the West, irrigation is needed to produce crops and this may come from aquifers at a higher rate than they can be recharged. Most aquifers are now monitored carefully and water is allocated based on models that seek to maintain aquifer health but there is much research needed to ensure the long term viability of these water sources. This is a particular concern for algae projects in the southwestern desert.

Another aspect of logistics related to crop cultivation and harvesting is whether the infrastructure is available to plant, harvest and store the crops. For example, jatropha could probably be grown in some parts of the southern United States as a source of oil for biodiesel, but we don't know what pests and plant diseases will be encountered in the high density cultivation of this plant in that location. We also need to develop equipment to mechanically harvest the seeds. Most existing jatropha projects assume that inexpensive hand labor will be available for harvesting, something that is unlikely in the U.S. We also need to develop the technology to store the seeds with minimal damage (moisture level, insect protection, etc.).

Finally, there is a question about whether we currently have the infrastructure needed to sustainably transport the crops to the processing facilities and the finished fuels from the plant to retail stations. Currently, this is done by a combination of pipeline, rail, barge, and trucks. The most energy-efficient option is probably barge, but this involves managing river flows for barge access which usually has negative implications for fish and other aquatic animals. Pipelines are also energy-efficient but many pipelines are operating at capacity and there is great resistance from that industry to introduce new products like ethanol and biodiesel because of concerns about cross-contamination of products.

How does feedstocks logistics vary between oilseeds, starch products and forest products?

Fats and oils are more energy dense than starch and forest products, with about 17,250 Btu/lb and 8,000 Btu/lb, respectively. Transportation concerns are more significant for starch and forest products. This means that biofuel production plants using fats and oils can draw from a larger geographic area than starch and forest products. On the other hand, the amount of fuel that can be produced per acre tends to be higher for starch and forest products so the total amount of energy needed for collection and transport may be similar for these feedstocks.

A major limitation of forest products is the current ban on using products from national forests to produce fuels needed for the Renewable Fuel Standard. Low-grade wood products such as saw mill waste and chipped logging waste are highly sought after as fuel sources for the saw mills themselves as well as other commercial and utility consumers. If new sources of lignocellulosic material are needed, they will either need to come from agricultural crop residues or by opening the national forests to allow some biomass removal for fuel use.

Another important distinction between these feedstock sources is the current market for the products. Starch (mainly corn) is currently used for animal feed so the impact on human food is indirect and somewhat tempered by substitute sources of feed. Fats and oils in the U.S. are mostly byproducts of the protein production industry (either meat or soybean meal). The quantities of fats and oils that are available have historically been determined by the production levels of protein products. With the increase in the price for vegetable oils, we are likely to see increases in production of crops grown specifically for oil, such as canola. A similar argument could be made that crops which enable greater ethanol production could become important but corn appears to be such a good match for the highly productive agricultural regions of the central U.S. that new crops do not seem to attract much interest. Forestry products currently have many alternative uses such as building materials, paper, and direct combustion for energy production. Those who use these products consider the current supply to be very tight.