ENVIRONMENTAL AND ECONOMIC RESEARCH AND DEVELOPMENT PROGRAM

Farm-based Bioenergy Infrastructure for Wisconsin: Too Big, Too Little or Just Right?

Executive Summary
December 2013

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This report was funded through the Environmental and Economic Research and Development Program of Wisconsin's Focus on Energy.

EXECUTIVE SUMMARY

This report assesses the relative importance of infrastructure and logistic factors in the potential feasibility of Wisconsin's farm-based biomass production for heat and power. In particular, effects of infrastructure (including equipment) and logistics are compared to the influence of fossil energy prices on bioenergy feasibility. The analyses described here also highlight the new infrastructure needed for optimal development of bioheat and power in Wisconsin at the farm scale (small), the municipal / commercial scale (medium), and the industrial / power plant scale (large).

The biomass production, logistics and energy conversion analyses in this project expand and update the work done in our prior Focus on Energy project (# 09-01). Smaller, more realistic areas of currently idle farmland are assumed to be available for biomass production in these simulations, which give a state median biomass production cost of 192 $/Mg, more than double our previous result and most estimates in the literature. In terms of production equipment, specialized harvesters could dramatically reduce biomass losses (i.e. from 30% to 5%), but are not justified due to the capital expense. Production costs decrease proportionally to the extent that such equipment costs can be shared or allocated to other activities on the farm. A biomass supply curve for Wisconsin indicates that 547,000 Mg of biomass could be produced on otherwise idle cropland, if market prices reach 220 $/Mg.

The Wisconsin Cropland Data Layer (CDL) and other digital maps of roadways and agricultural co-ops were used to calculate transportation costs, via shortest routes from current idle cropland areas to the nearest co-op. Using farm-owned trucks and full allocation of capital costs to biomass transport, the state median biomass transportation cost is 7 $/Mg. This result is robust to diesel fuel price, but sensitive to truck capital total costs and allocation. Self-transportation cost is also sensitive to the amount of biomass produced (therefore sensitive to both yield and area cultivated), which varies across the state. After scaling production land areas down to more realistic levels using USDA Census data, self-transport costs rise to 159 $/Mg, and then fall again to 18 $/Mg with 10% allocation of truck costs to biomass. With these assumptions, the largest farms reach minimum transport costs of 10 $/Mg. However, the custom hauling cost is ~ 4 $/Mg at the distances calculated here, and will almost always be the most economical option.

On-farm biomass pelletization (i.e. densification) is analyzed as a means to cut shipping and storage costs. Pelletization (204 $/Mg) costs roughly as much as production and thus far more than transport or storage (14 $/Mg). Sharing equipment among co-op members reduces costs to 61 $/Mg, but pelletization is still not an economical means of reducing storage or transport costs. It is necessary, however, to provide fuel for pellet stoves. Labor cost constitutes the majority of pelletization costs in this analysis.

Biomass conversion to energy is economically favorable only if it replaces propane heat, not natural gas or coal. This means that electricity production with biomass, even co-firing at modest rates, is not feasible without huge public investment in incentives. Replacing propane can be economical, but is sensitive to several factors, including propane price, biomass yield, financing arrangements, and labor costs. However, even the most favorable combination of factors does not yield the return on land use that farmers can expect from crop production. This means that in the near future, the total biomass production for energy in the state is unlikely to increase beyond the relatively small levels possible on idle land.

ACKNOWLEDGEMENTS

The investigators would like to thank Bob Battaglia of the Wisconsin Agricultural Statistics Service for assistance and access to USDA Census of Agriculture data, and William Fannucchi of the Public Service Commission of Wisconsin for access to natural gas service maps.

The investigators would also like to thank Mary Sternitzky and George Allez for their assistance in preparation of this report, and Martina Gross for administrative support.

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