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Executive Summary

ADVANTAGES OF WOOD HEAT FOR COMMERCIAL POULTRY PRODUCTION

This demonstration project, "Advantages of Wood Heat for Commercial Poultry Production," field-tested a 1.65 million Btu (British Thermal Unit) wood chip furnace in a live commercial poultry operation. The project, generously funded by the Minnesota Department of Agriculture's Agricultural Growth, Research and Innovation Program (AGRI) – with assistance is securing the funding from the University of Minnesota Extension's Clean Energy Resource Teams – spanned 23 months and 12 flock rotations. Viking Company of Albany, Minnesota, an experienced poultry growing operation, hosted and operated the wood furnace in its two-story broiler chicken barn. An identical barn[1] heated with liquid propane immediately adjacent to the test barn served as an experimental control to observe differences in operability, fuel costs, and flock production. The Agricultural Utilization Research Institute (AURI) provided ash analysis to assess the efficiency of the wood chip furnace as well as measurement equipment to collect data, humidity, ammonia and oxygen levels. AURI's Coproducts Utilization Lab in Waseca, Minn., provided additional analysis.

From Fall, 2015, through Summer, 2017, the wood furnace demonstrated considerable fuel cost savings against historically low liquid propane prices during that period. As expected, fuel cost savings from using woody biomass were highest in the colder months when thermal demand is greatest. **The fuel cost savings from this project averaged $8,029 per year**, with liquid propane prices fluctuating between $0.99 and $1.29 per gallon. Additionally, propane prices and supplies can be volatile: Propane accessibility and supply remain an agribusiness vulnerability.[2]

Payback scenarios for the added initial $129,955 investment in the wood furnace are consistently appealing. With the varying wood fuel costs and liquid propane prices specific to this project, the 1.65 MMBtu unit saved an estimated $16,057 in fuel costs over 12 flocks and 22 months, or $8,029 per year (six flocks in a year) with liquid propane prices fluctuating between $0.99 and $1.29 per gallon. This simple cost recovery excludes any price variations in liquid propane pricing, wood chip fuel pricing, equipment depreciation, the federal renewable energy business investment tax credit, impacts on livestock production, and the amount of liquid propane displaced with wood fuel during production.

The cost recovery drops to 6.3 years when including $2,095 per flock in estimated "effective cost" reduction from flock improvements by six flocks (observed but not part of this study), in addition to the $8,029 annual fuel savings.

Cost recovery can be as fast as 5.3 years.

In a "best case" scenario, including the $2,095 effective cost reduction, and the optimized fuel cost savings of $12,061 in the second year, the cost recovery becomes a rapid 5.3 years. Additionally, Viking Company has determined that a much less costly and smaller-sized furnace would provide most, if not all, of the same benefits at a lower capital cost.

Differences in air quality between the two barns were negligible. Samples were collected on April 1, 2016, and May 1, 2016, and submitted to third-party laboratory PACE Analytical. The samples were analyzed for ammonia (NH3), oxygen (O2), and carbon monoxide (CO) content. Since ammonia impacts flock production, the Project Team focused on ammonia to determine the presence and quantity in each barn. The project evaluated oxygen and carbon monoxide in order to identify heat source efficiency (combustion) and ventilation. The three air compounds have a direct impact on flock growth and overall production. The single air quality sampling showed a slight reduction in ammonia content in the Control Barn. Essentially, the barns were the same based on the low and single-instance ammonia readings. The Control and Test Barns showed a slight reduction in atmospheric oxygen compared to the control sample. The Test Barn showed a greater reduction in available oxygen, though not significant. Neither barn showed a difference in carbon monoxide presence. The proximate ash analysis served to evaluate the combustion efficiency of the wood furnace. The laboratory analysis showed the remaining energy content in the ash was less than 1 Btu/lb. This is indicative of highly efficient wood combustion.

Conclusion

The 1.65 MMBtu wood chip furnace was a very successful demonstration project. It provides detailed insight into the large market potential for meeting livestock thermal demands with woody biomass. Woody biomass is a viable, cost-effective fuel source for producers dependent on liquid propane. This project stands as a case study for livestock insurance companies that question the use of wood furnaces in a commercial operation. Though there is a need for more research to draw a scientific conclusion that wood heat provides a healthier air quality environment, the data collected includes several indicators that using a wood furnace in poultry production contributes to robust flocks and reduced costs for poultry growers and integrators.

This project provided detailed insight into the use of wood heat to meet the thermal needs of poultry production. The data collected demonstrates woody biomass is a viable, cost-effective fuel for producers looking for alternatives to liquid propane.

The full study report is available at www.auri.org/poultryheat.

[1] *The test barn required structural modifications to the control room in order to house the wood furnace. Modifications included concrete slab flooring, a firewall sealed with fireproof caulking between the control room and the barn extending to the roof steel and a fire door between the control room and entryway to the service room.*

[2] Shaffer, David "Propane industry scrambles to replace supply from major pipeline," Minneapolis *Star Tribune*, December 7, 2013. Available at http://www.startribune.com/propane-industry-scrambles-to-replace-supply-from-major-pipeline/234815871/.

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The University of Minnesota Extension's Clean Energy Resource Teams assisted in securing funding resources for the project.