

Farm Energy Efficiency Case Study

GDW Turkey Farms

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Background

GDW Turkey Farms is a large turkey raising operation located in Ottawa County, Michigan. The general manager of GDW is Jon Vanderkolk, the son-in-law of the original owner. Jon started his career as a salesman in the furniture industry, but was a silent partner in GDW for the first 15 years of its existence. Then, 3 years ago, he gave up his sales career to become GDW's general manager and sole owner. The GDW facilities can raise around 200,000 turkeys per year. They are currently adding more finishing barns to increase their production.

Most of the barns owned by GDW were built between 1976 and 1980 when energy was inexpensive. Since energy is now their fourth largest operating cost, Jon decided that improving energy efficiency within their operations would be a relatively easy way to increase profits, as well as keep the birds more comfortable. GDW started improving energy efficiency on their own by replacing box heaters with radiant tube heaters in a few of their turkey barns. This project alone eliminated 3 million BTUs of energy consumption.

GDW decided to have an energy audit conducted on their operation when they discovered that Consumer's Energy would pay for part of the associated costs. The audit was conducted through the Michigan Farm Energy Program (MFEP), and through the auditing process GDW found that there were financial incentives to improve energy efficiency. To start, they tried a relatively small \$15,000 project, and received \$3,000 back in rebates. After this, GDW decided to pursue much larger energy conservation measures (ECMs) as outlined in the MFEP audit report.

System Implementation

The focus of this study is two finisher barns: one that has been upgraded to be more energy efficient, and one control barn. GDW implemented 5 different ECM's that were outlined in the MFEP audit report. These included replacing high pressure sodium and fluorescent lights with LEDs, upgrading the insulating curtains, adding better insulated walls and doors on the ends of the barn, installing radiant heating, and mounting ceiling fans.



Figure 1: Finishing barns on the property of GDW Farms in Ottawa County, Michigan.

All high pressure sodium lights in the test barn were replaced with LEDs. LEDs not only last longer than high pressure sodium lights, they also consume less energy. This saves money since less maintenance is required, and less electricity is purchased. Also, the color spectrum can be easily altered with LEDs, which can be used to beneficially alter the behavior of the birds.

Most of the finishing barns are wood frames with roofs. The long sidewalls have insulating curtains that can be extended to conserve the heat in the barn during the winter months. The open style design for finishing barns is necessary for ventilation, but it is less efficient to heat in the winter. GDW replaced the energy curtains in the test barn to double-ply high thread count curtains to prevent excess heat loss.

The finishing barns are oriented east to west, since the prevailing winds are from the west. The ends of the finishers that face the wind are solid walls with doors. GDW replaced the east and west ends of the test barn with better insulated doors and walls.

GDW also replaced eight 225,000 BTU box heaters with fourteen 100,000 BTU radiant tube heaters in the test barn. Radiant tube heaters heat objects—in this case, turkeys and the bedding—instead of heating the air which then has to heat the objects. This results in less energy consumed since the air in the barn can be kept at a cooler temperature, minimizing the temperature gradient between the outside air and the air inside the barn, which reduces the heat loss to the atmosphere.

Finally, GDW installed new ceiling fans in one of their finishing barns. The purpose of the fans is to keep the bedding dry as well as keep the heat low in the barn rather than up by the ceiling. Dry bedding keeps the birds healthier by preventing the development of breast blister, resulting in less meat being discarded during processing.

Implementing these ECMs proved challenging for the turkey farm since the barns are occupied by turkeys for 14 week periods. The barn is only devoid of turkeys for one week at a time, and this time is used for cleaning, maintenance, and improvements. Therefore, all ECM implementation projects had to be completed in one week's time, since GDW cannot alter the delivery date of their poults (turkey chicks). While it was noted that the long, one week at a time production process was disruptive for the workers and hard on the birds, GDW minimized their interference by planning ahead and having all the materials ready for the contractors when the empty week came around. The GDW owners stress the importance of constant communication with contractors as well as ensuring potential contractors have enough manpower to complete the project in one week. GDW

also recommends that companies taking energy efficiency measures only hire a limited number of contractors, warning that too many workers involved in a project at once can pose scheduling challenges within small windows of time.

System Impacts

Replacing the high-pressure sodium lights with LEDs in the test barn cut the electricity usage in that barn by 360 kWh/month, yielding an annual energy savings of 4320 kWh and an annual cost savings of \$518. Besides the energy savings, there were many other additional benefits to using LEDs. Since the color output of the LEDs can be adjusted, GDW can now expose the birds to red light when they are young, which makes them eat more, increasing the rate of gain. When the birds get older and become more aggressive, the LEDs can be adjusted to emit blue light to calm the birds. This results in less pecking and breast blisters, and the birds are cleaner, calmer, and more comfortable. Raising healthier birds increases farm profits by minimizing the amount of meat condemned at processing plants.

GDW found that the rate of gain for the turkeys in the barns equipped with LEDs was 0.337 lbs/day, whereas the average rate of gain for the turkeys in the other barns without LED lighting was 0.307 lbs/day. Due to the more comfortable conditions, the turkeys in the LED lit barns also had a lower feed conversion—the amount of feed it takes for a turkey to gain one pound. The feed conversion for the turkeys in the LED lit barns was 2.32 lb feed/lb growth, compared to a feed conversion of 2.45 lb feed/lb growth for the birds not exposed to LED lights.

Replacing the box heaters with radiant heaters had additional benefits besides energy savings. The two primary products of natural gas combustion are carbon dioxide and water. Since the radiant heaters are consuming less energy, they are producing less of these products. This results in much drier bedding since the heaters are adding much less moisture to the interior of the barn. Similar to the results of installing ceiling fans, the use of radiant heaters decreases the occurrence of breast blister on the turkeys, ultimately increasing profits. The increased insulation and new radiant heaters have reduced the test barn's natural gas consumption by 24%, resulting in an annual cost savings of \$8,650.

In addition to energy cost savings, there have been other benefits from the implementation of the above ECMs. The test barn has experienced an average 0.002 lb/bird reduction in condemned meat, and the turkeys in the test barn weighed an average of 0.25 lb more than those in the control barn. This resulted in 5,687 lb of additional meat produced each year and \$1,194 in additional revenue.

The manager of GDW Farms believes that his employees are his customers, and that the ECMs the farm have implemented make the employees' jobs easier and more enjoyable. The improvements require very little maintenance compared to the parts they replaced, which allows the employees to spend more time with the turkeys and less time repairing or

replacing heaters, lights, broken doors, and curtains. Mr. Vanderkolk estimated a labor savings of \$300 per flock in the test barn, which results in an annual labor savings of \$975.

To finance these energy efficiency initiatives, GDW took advantage of three different funding opportunities. These included utility company rebates, REAP grants from the USDA, and MSU Farm Energy Implementation Project grants, receiving a total of \$25,000. To obtain funding, Jon stresses the importance of following the directions provided by the agency issuing the funds, and to ensure the paperwork is done correctly. For example, if a utility company is giving project grants, they must be contacted before the start of the project, or they will not pay for the improvements. In addition, a Type 2 energy audit must be completed. After an audit has been conducted, utility companies can help the operation manager with the calculations and paperwork necessary to obtain funding.

The estimated cost per finisher in the audit report was estimated to be \$69,719. The actual cost of the project was \$89,387, but with funding the cost to GDW was \$64,387. The audit report estimated the total cost of replacing lighting in each finisher to be \$2,578 and the total annual electricity cost savings to be \$279 with a 9.2-year payback period. Using the audit report's estimated cost of lighting, which should be reasonably accurate since GDW installs their own lighting and the LEDs used are readily available and easy to price, and the actual annual electricity cost savings of \$518, the actual payback period on the lighting was 5 years. The actual annual natural gas cost savings was \$8,650, which resulted in a payback period of 7.1 years. The estimated payback for natural gas ECMs on the finishing barns in the audit report was 3.6 years. The reasons for this large difference between estimated and actual payback periods can be diverse, but include varying estimates on the implementation costs, the energy usage of existing equipment, and the energy savings. The largest variable is the usage of each piece of equipment, which operation management provides the auditor. This information is usually an estimate and not measured. The implementation costs for natural gas ECMs were also difficult to estimate in the initial audit report, since GDW hires a contractor to purchase and install the equipment and prices are not as readily available compared to lighting.

In total, the benefits of this project add up to \$11,337: annual energy savings of \$9,168, annual labor savings of \$975, and \$1,194 in additional revenue. The payback period for the whole project calculated with the total benefits was 5.7 years. This is slightly higher than the payback of 4.5 years that was estimated in the initial audit report. The audit report calculated the payback period with just energy cost savings but, as shown above, some of the estimated energy savings and equipment costs were significantly different than the actual costs and savings. It is important to note that once additional non-energy cost benefits are added to the total annual benefits, the actual payback period is much closer to the estimated payback period on the audit report.

Next Steps/Conclusions

In conclusion, Jon asserts that the ECMs GDW implemented trim costs, increase production, and provide better living conditions for the birds. He suggests other farms consider more energy efficiency initiatives to meet the same goals. Jon also states that an energy audit would be a great investment for any company to begin increasing their energy efficiency. On this topic, Jon said, “After you have the audit you have a clear idea of what could be improved. Even if you choose not to change things, it points out many things that we look at every day and do not know what the cost of these things are.”

Given the success of the energy efficiency upgrades in the single finisher barn covered in this study, GDW has already begun implementing the same ECMs on more of their finisher barns. Jon says he plans to continue investing in ECMs, since reducing the cost of utilities has become part of his management strategy. In the future, he plans to look into renewable energy options, such as solar. He would like to build an extremely energy efficient farm that utilizes renewable energy as well as energy efficiency strategies, such as those outlined in farm energy audits.

Attachment #1

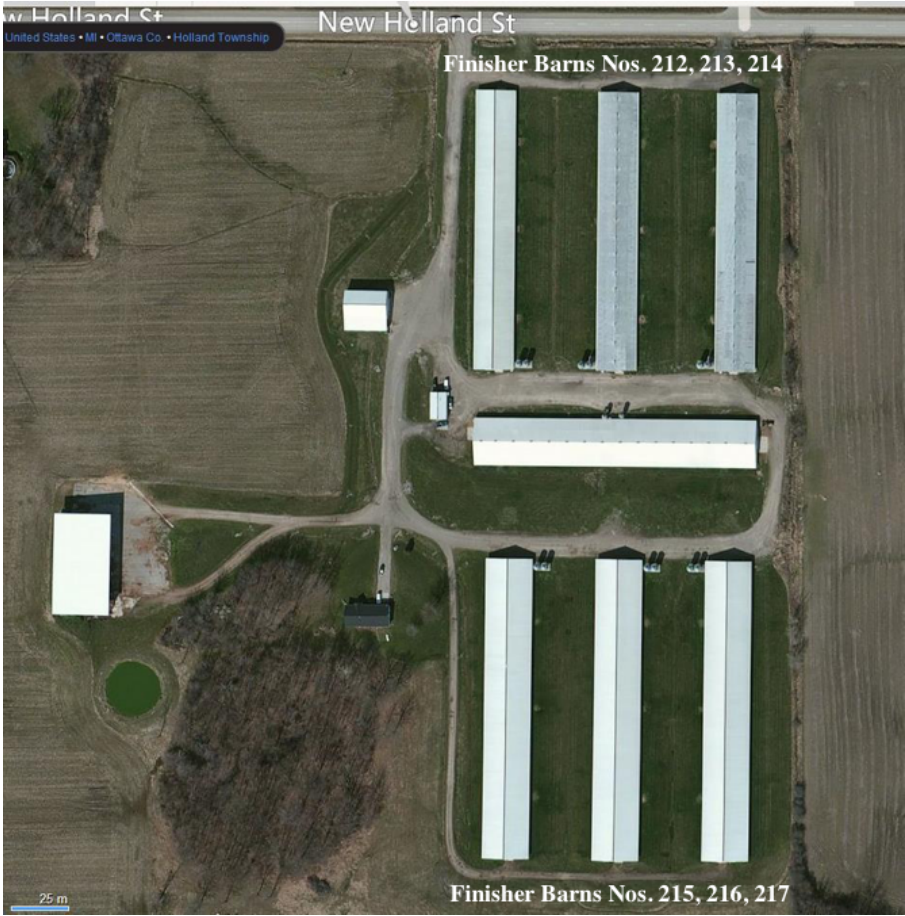


Figure 2: Aerial view of the property including finisher barns.

Attachment #2

Table 1: Monetary savings resulting from the energy conservation measures implemented at GDW Farms.

ANNUAL BENEFIT	MONETARY SAVINGS
ENERGY SAVINGS	\$9,168
LABOR SAVINGS	\$975
ADDITIONAL REVENUE	\$1,194
TOTAL	\$11,337
PAYBACK PERIOD	5.7 years