Agricultural Energy Management Plan

Joe Broiler
Drumstick Acres
100 Roaster Lane
Turkeytown, USA
Chicken County
(800) 123-4567

Primary Enterprise: Poultry
Acres: 40
Wednesday, November 25, 2015

EnSave

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(800) 732-1399

Wednesday, November 25, 2015

Joe Broiler
Drumstick Acres
100 Roaster Lane
Turkeytown, USA

Dear Mr. Broiler:

Enclosed is your completed Agricultural Energy Management Plan (AgEMP, or Plan). This Plan has been developed in accordance with Conservation Activity Plan Code 128 of the U.S. Department of Agriculture's Natural Resources Conservation Service (USDA NRCS).

Before moving forward with any recommendations in your plan, we encourage you to contact your local USDA NRCS and USDA Rural Development offices to ensure your farm is eligible to apply for any funding available through the NRCS Environmental Quality Incentives Program (EQIP) and the USDA Rural Development Rural Energy for America Program (REAP). Your local USDA NRCS and Rural Development representatives at the Bentonville Service Center (479-273-2622) can assist you with the application process for both programs. In the 'Resources' section of this Plan, we've also included some helpful information and websites that can lead you to local utility and state programs where additional funding might also be available.

On behalf of all of us at EnSave we want to thank you for the opportunity to help you evaluate your farm's energy consumption and energy saving opportunities. This Energy Management Plan will help you determine the best way for you to increase your farm's energy efficiency and profitability. Even if you are not able to implement all of the recommendations immediately, this report will serve as a useful guide for future decisions and improvements.

I will be calling you in a few weeks to discuss the Energy Plan with you, but in the meantime, please feel free to contact us if you have any questions.

Sincerely,

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SUMMARY

Overview

EnSave conducted an energy data collection at Drumstick Acres on Tuesday, November 3, 2015. This report has been developed with the use of FEAT™, a product of EnSave and provides a plan to increase the facility's energy efficiency. This Agricultural Energy Management Plan (AgEMP) covers the primary energy uses identified for this location.

This report is organized into several sections. The first section summarizes the state of the facility and the overall recommendations, followed by an explanation of the current energy use based on 12 months' usage. The report then provides a description of the equipment evaluated and recommendations for increased energy efficiency. CAP 128 requires a discussion of all energy-using equipment on the farm, even if no cost effective recommendations are found. Therefore your report may contain details about systems analyzed that did not result in energy savings opportunities. Finally, this report includes information sheets with more detail about recommended technologies for your farm, as well as links to various internet resources about funding sources and equipment information. Appendix A includes a summary table of all the recommendations made within the report.

An average electricity cost of $0.11 per kWh and an average cost of $1.63 per gallon of propane were used in this report; however, if Drumstick Acres' actual costs are different from these documented values, the energy cost savings in this report would vary accordingly.

The poultry facility at Drumstick Acres is approximately ten years old and has opportunity for energy efficiency improvements. Existing energy efficient equipment on the farm includes solid sidewall construction, recirculating cool cells, some roll seal end wall doors, insulated tunnel doors, the use of some stir fans, attic inlets, radiant heating, and some efficient lighting. The farmer stated concerns with the current insulation, lighting, end wall doors and overall air sealing. Energy efficient measures were reviewed and those found to be cost effective can be found in Table S.1.

Table O.1 provides flock information for the farm.

Table O.1. House Groups

House Group Identifier	# Houses	# Flocks per Year	Target Bird Weight at Catch (lbs)	# Birds / Flock / House	Total Days Birds in House
Houses 1-4	4	7	4.25	31,500	36
Houses 5-6	2	7	4.25	40,000	36

Recommended equipment or changes in management may be eligible for federal assistance through USDA NRCS and USDA Rural Development, as well as local assistance through your utility company or state government. The first step after deciding to move forward with any recommendations should be to explore these funding opportunities. Links to these resources are provided at the end of this report. For a current listing of eligible measures applicable to this plan, and to determine if any funding assistance is available, please contact your NRCS representative.

Aerial View

Figure AV.1 provides an aerial view of the farm. All associated buildings are labeled.

Figure AV.1. Aerial View

Significant Findings

This report focuses on opportunities for Drumstick Acres to improve its energy efficiency and prioritizes these opportunities based on simple payback period. Payback periods shown in our analysis may be reduced if financial assistance is obtained through USDA, energy utility rebate program, or other sources. The recommendations identified within the report are for sealing air leaks, lighting, brood curtains, attic inlets, insulation, and end wall doors.

Bottom Line: Installation of all the recommended energy efficient equipment identified within this report will result in annual energy cost savings of approximately $17,687. This represents about 27% of the baseline annual energy costs of $64,622.

ENERGY EFFICIENCY EVALUATION

Summary of Recommendations

Tables S.1, S.2, and S.3 summarize the benefits for all recommended measures. These tables are presented as required by *NRCS Conservation Activity Plan Code 128*. See Appendix A for a detailed listing of all measures recommended. Energy saving equipment lowers usage costs by performing the same or greater work with lower energy inputs. Detailed explanations of energy efficiency equipment are provided later in this report.

Actual site specific cost quotations may affect payback period and eligibility for the *NRCS EQIP Program*.

Table S.1. Summary of Energy Improvements

	Estimated Reduction in Energy Use			Estimated Costs, Savings, Payback, and Prioritization for Implementation		
Measure	**Electricity Savings (kWh)**	**Propane Savings (gal)**	**Energy Savings (MMBtu)**	**Energy Cost Savings [b]**	**Implementation Cost [a]**	**Est. Payback in Years [a]/[b]**
Poultry House Lighting	55,188	0	188	$6,027	$6,360	1.1
General Lighting	804	0	3	$88	$180	2.1
Air Heating and Building Environment	0	7,109	651	$11,573	$75,524	6.5
Totals	**55,992**	**7,109**	**842**	**$17,687**	**$82,064**	**4.6**

Notes:

1. A portion of the benefits for some of the improvements offset the benefits of others; for example, insulating side walls will actually decrease air leaks and reduce heat load in the winter.
2. Estimated useful life for equipment can be seen in each respective section in the report and in the appendix.
3. Totals in the report are rounded after summations. Accuracy of the individual items is calculated to four decimal places and then rounded to the significant digits shown.

Table S.2. Overall Energy Savings of Recommendations

Resource Type	Current Use	Current Use (MMBtu)	Savings	Savings (MMBtu)	Savings (%)
Purchased Electricity (kWh)	175,259	598	55,992	191	32.0 %
Propane (gal)	27,942	2,559	7,109	651	25.4 %
Totals	**N/A**	**3,158**	**N/A**	**842**	**26.7 %**

Table S.3. Estimated Annual Reduction of Pollutants

		Greenhouse Gas (Estimated Values)			Air Pollutant Co-Benefits (Estimated Values)	
Measure	**Energy Savings (MMBtu)**	**CO_2 (lbs)**	**N_2O (lbs)**	**CH_4 (lbs)**	**SO_2 (lbs)**	**NO_x (lbs)**
Air Heating and Building Environment	651	89,965.1	2.8	14.2	0.7	71.1
Poultry House Lighting	188	76,667.2	1.2	1.0	181.3	62.9
General Lighting	3	1,116.5	0.0	0.0	2.6	0.9
Totals	**842**	**167,748.8**	**4.1**	**15.2**	**184.6**	**134.9**

Note:

1. Environmental Benefits are reduction estimates, values are as per http://cometfarm.nrel.colostate.edu/

The measures recommended in this report are based on energy savings analysis, related energy cost savings, and the estimated cost to implement. Simple payback periods (in years) are shown in the respective measure tables.

Simple payback period is equal to the estimated cost to implement ($) divided by the estimated annual cost of energy saved ($/year) and is expressed in number of years. This method does not account for more complex financial considerations such as loan interest and fees, tax rates, depreciation or any other potential cost impacts. When the payback period is less than or equal to the expected useful life (EUL) of the measure (in years), the measure is recommended. Estimated cost to implement an energy saving measure is based on market research; actual costs to your location may vary. The simple payback period can be re-calculated as needed to account for quoted project costs and/or financial assistance.

For the purposes of this report, the following terms are defined as:

- *Recommended* – a measure is recommended for implementation when the estimated energy savings over the expected useful life of the measure exceeds the estimated cost to install the measure.
- *Not recommended* – a measure is not recommended for implementation when the estimated energy cost savings over the expected useful life of the measure is less than the estimated cost to install the measure.
- *Expected Useful Life (EUL)* – the number of years that a measure is expected to remain in service. These values are taken from industry accepted standards such as the Database for Energy Efficient Resources, Technical Reference Manuals and other similar resources. The EUL of most energy efficiency measures ranges from 10 to 20 years.

There may be other factors to consider when making decisions to implement measures recommended or considered in this report. These may include aspects such as operational performance, through-put, operation and maintenance costs, labor costs, livestock productivity, etc. These considerations are beyond the scope of this energy audit. Any new equipment should be properly reviewed for site-specific needs, concerns and applicability.

Information on operational schedules and run times is based on input from the producer. Note that savings calculations are based upon on-farm conditions at the time of the site visit. Changes to farm equipment or operation following the time of the site visit are not reflected in this report.

Current vs. Projected Electricity Use

Figures EU.1 and EU.2 reflect on-site electricity use from September 2014 to August 2015. During the twelve month period evaluated, Drumstick Acres used approximately 175,259 kilowatt-hours (kWh) of electricity. The total cost of electricity was $19,136.

The peak months typically coincide with hot weather and are the result of increased ventilation loads. The actual monthly electricity use is depicted in Figure EU.1.

Figure EU.1. Twelve Month Electricity Use

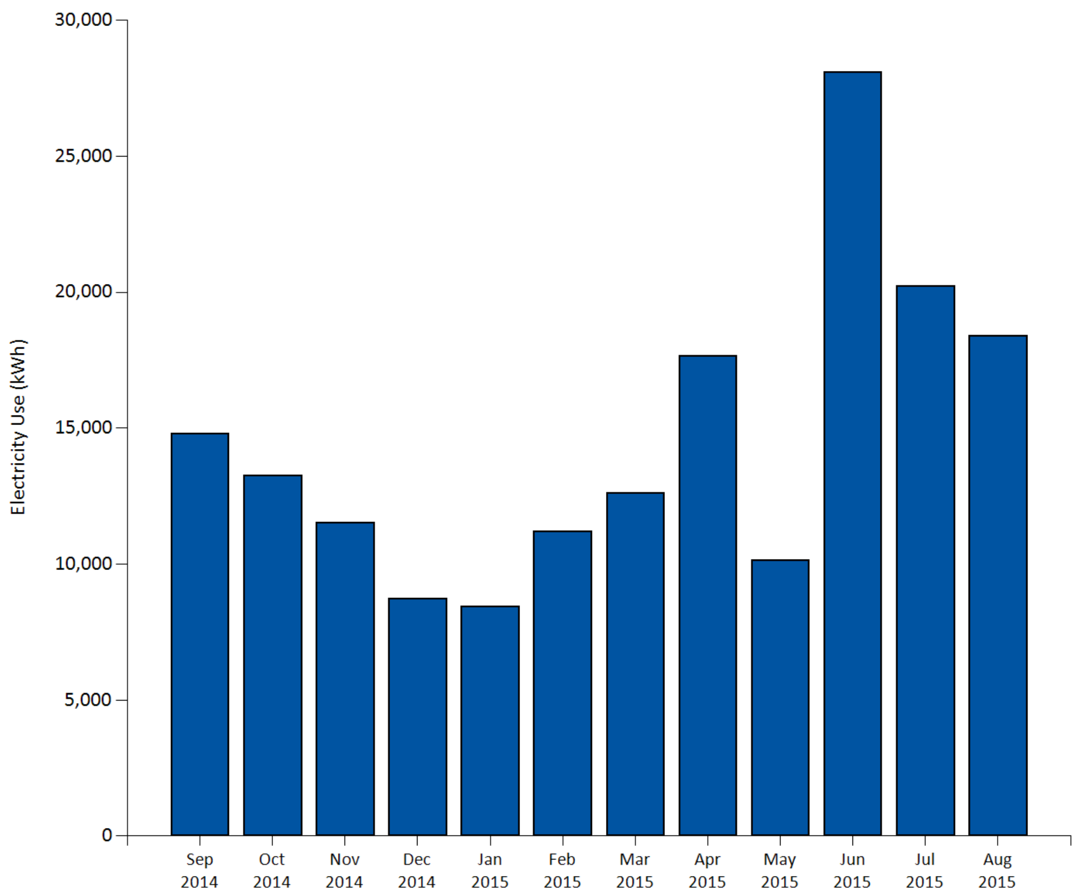
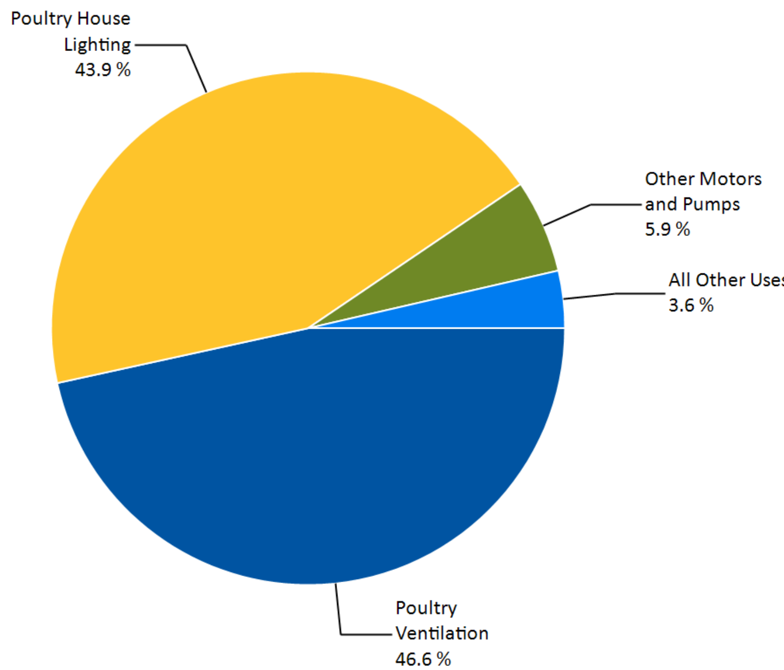


Figure EU.2 illustrates the end uses of electricity on the farm. Ventilation and poultry house lighting typically account for the largest portions of energy use. Other equipment includes feed-line motors and general lighting. Average poultry house farm miscellaneous use is 2%. Miscellaneous electrical use includes curtain motors, vent box motors and shop tools. For a detailed listing of equipment associated with each measure category, see the appropriate section of the report.

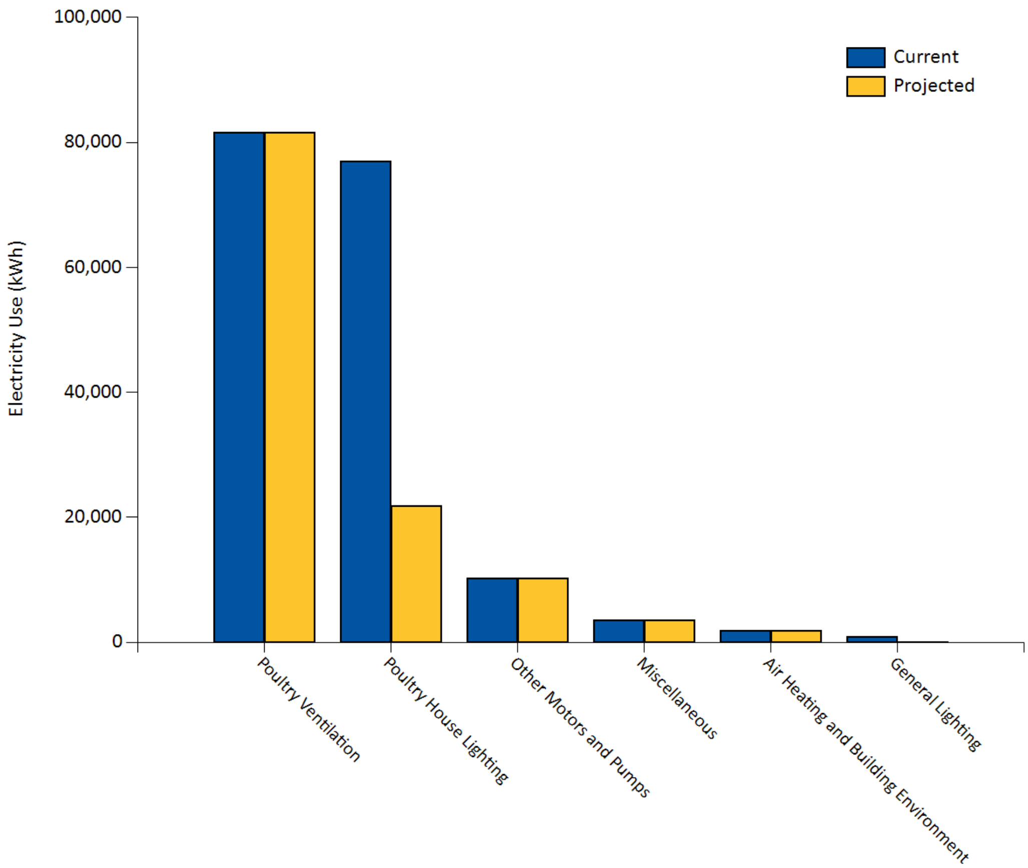
The electricity use breakdown by measure is depicted in Figure EU.2.

Figure EU.2. Electricity Use Breakdown



In Figure EU.3, calculated current electricity use is compared to projected use after the installation of all recommended electric energy efficiency equipment.

Figure EU.3. Comparison of Annual Current and Projected Electricity Use

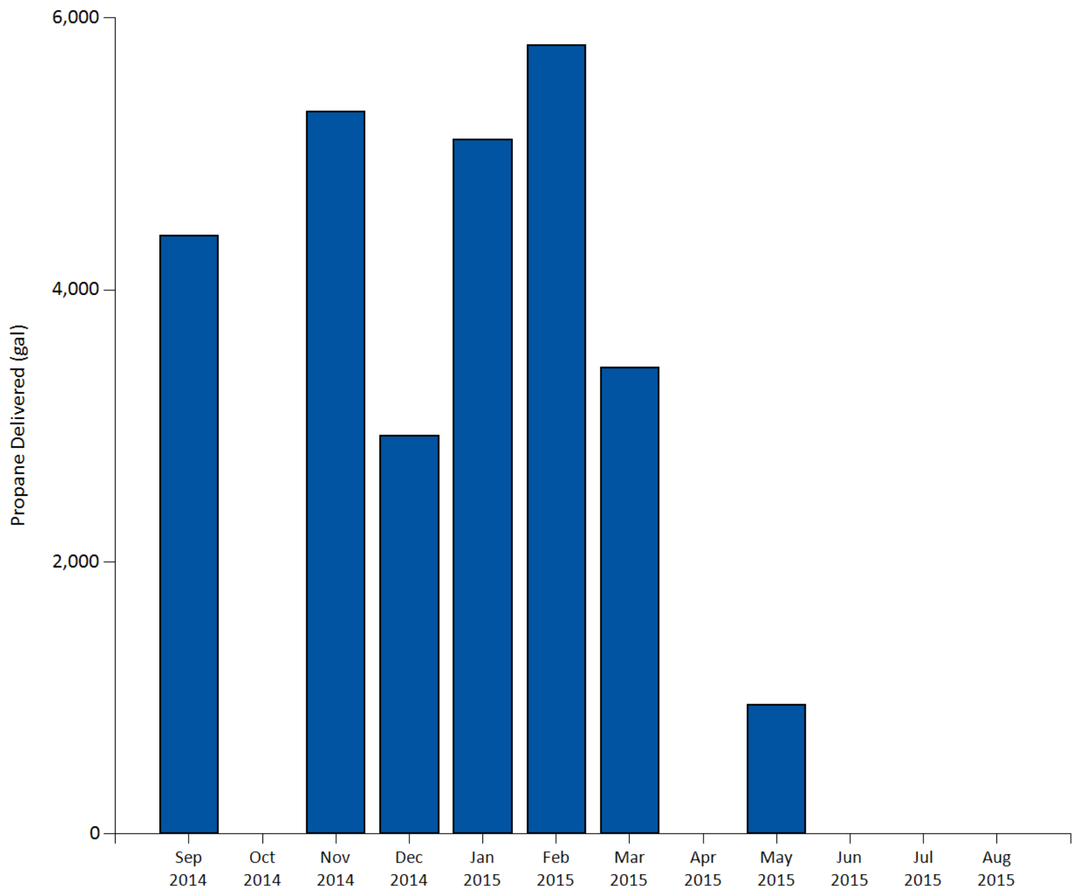


Current vs. Projected Propane Use

Figure PU.1 reflects on-site propane use from September 2014 to August 2015. During the twelve month period evaluated, Drumstick Acres used approximately 27,942 gallons (gal) of propane. The total cost of propane was $45,486.

The peak months typically coincide with cold weather and are the result of increased heating loads. The twelve-month history of propane deliveries are depicted in Figure PU.1. Monthly propane deliveries may not reflect actual monthly propane usage.

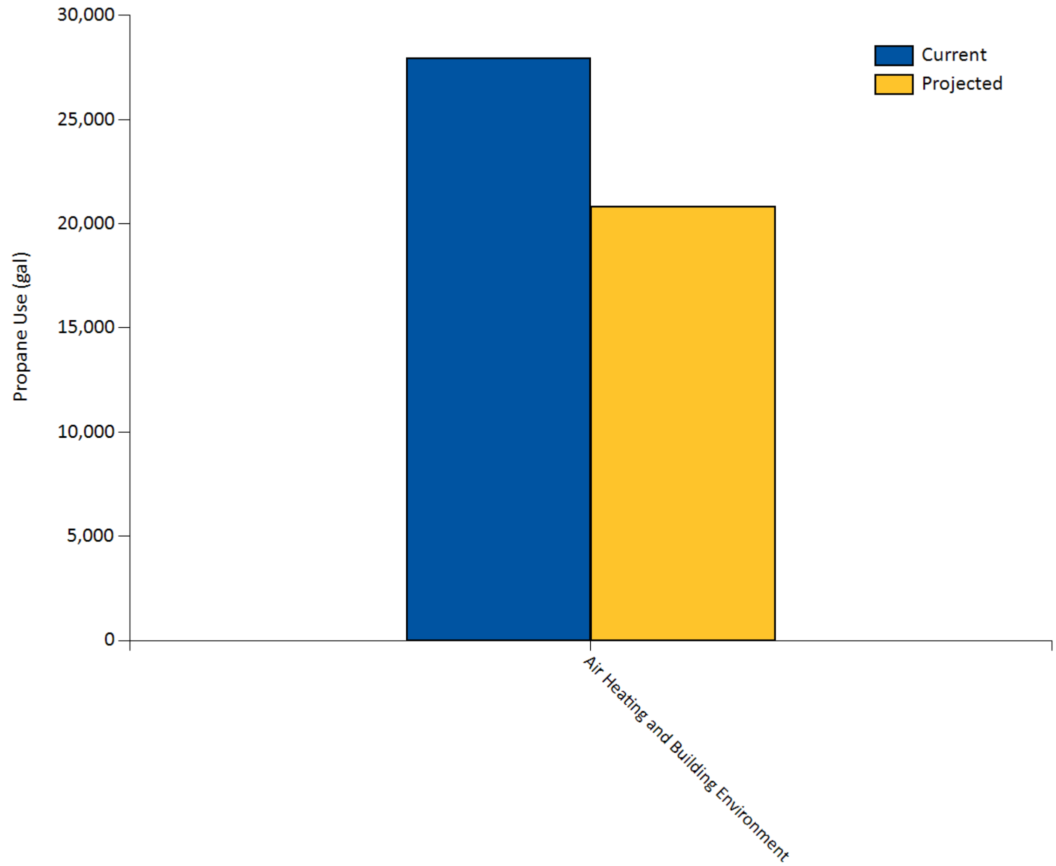
Figure PU.1. Twelve Month Propane Deliveries



Propane is only used for Air Heating and Building Environment at this location.

In Figure PU.2, calculated current propane use is compared to projected use after the installation of all recommended energy efficient equipment.

Figure PU.2. Comparison of Annual Current and Projected Propane Use



On-Site Energy Generation

Drumstick Acres currently operates two diesel generators for back up and emergency purposes, and are only run otherwise for testing, upkeep, and maintenance purposes. The generators serve as emergency power supplies and were not in operation for a significant period of time during the twelve month period assessed for the farm. The generators were not evaluated for energy saving opportunities due to low run-time. Energy saving measures are calculated based on purchased electricity cost.

Table EGEN.1 contains the existing generator details.

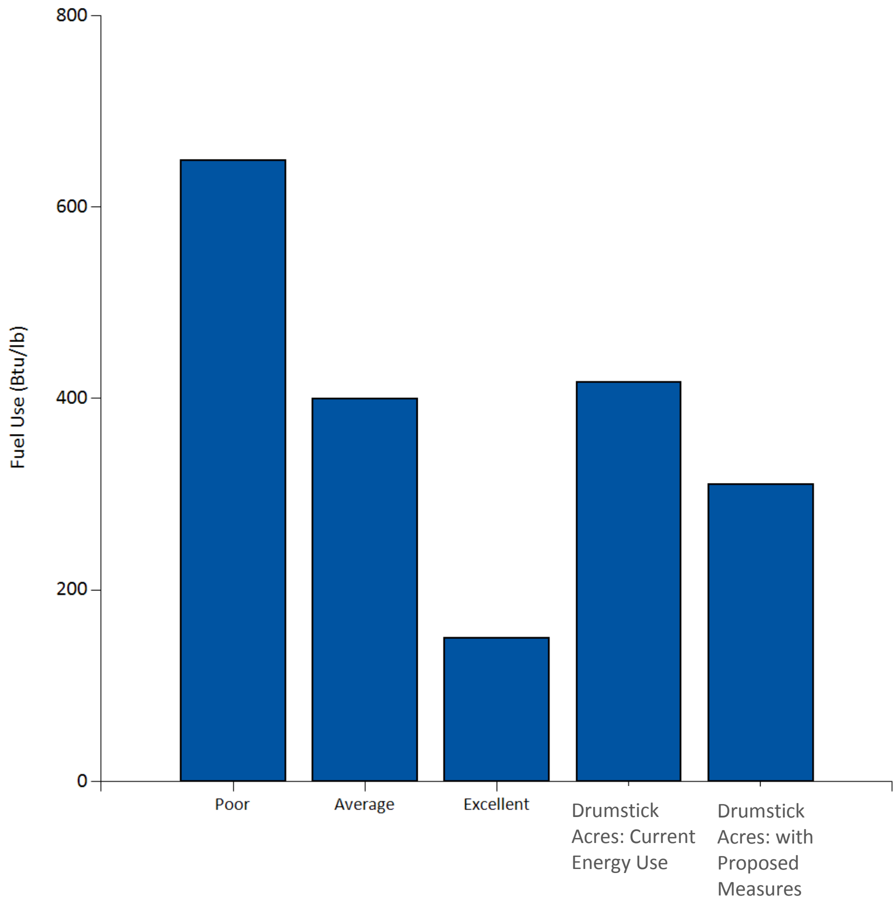
Table EGEN.1. Current Generator Inventory

Equipment Description	Manufacturer / Model	# Generators	Resource Type	Output (kW)
Generator (Houses 1-4)	Taylor Power Systems / Perkins Engine YD37531	1	Diesel (gal)	130
Generator (Houses 5-6)	Taylor Power Systems	1	Diesel (gal)	80

Comparison of Heating Fuel Use with Similar Producers

Figure CS.1 shows how your propane fuel use compares with similar broiler farms that have been evaluated across the United States.

Figure CS.1. Heating Fuel Use: Similar Producers



Drumstick Acres used 27,942 gallons of propane. Given that there are approximately 92,000 Btus of energy in every gallon of propane, this translates to an annual use rate of 417 Btus of energy for every pound of bird produced. This calculation does not account for bird mortality.

Note that this figure is included only for general information and that all calculations for energy savings are carried out specifically for your farm. The comparative operations of other locations have no bearing on the energy savings opportunities on your farm.

RECOMMENDATIONS

Poultry House Lighting Efficiency Recommendations

The farm is currently using:

- Thirty-three 42 watt compact fluorescent (CFL) fixtures in the brood section and fifty 100 watt standard incandescent fixtures per house in Houses 1-4
- Thirty-eight 10 watt light emitting diode (LED) fixtures in the brood section and one-hundred and fourteen 10 watt LED fixtures per house in Houses 5-6

We analyzed the energy and cost saving benefits for replacing the current 100 watt standard incandescent fixtures with 10 watt LED fixtures. We recommend replacing the incandescent fixtures with LEDs.

We analyzed the energy and cost saving benefits for replacing the current 42 watt CFLs with 25 watt LED fixtures. We do not recommend replacing these fixtures due to the long payback period.

There are no recommendations to replace the current LED fixtures in Houses 5-6 because they are considered energy efficient.

We evaluate installing the LED bulbs because they save more energy, have a longer rated life, have a payback period within the rated life, and they do not contain mercury like CFLs. Before installing the energy efficiency considerations above, we recommend checking with your integrator to insure their policies allow for the use of LED technology. Many integrators allow the use of LED lighting as long as minimum lighting levels are being met. The American Society of Agricultural and Biological Engineers (ASABE) publish a standard with recommended illumination levels in Agricultural Facilities - ASAE EP344.3 “Lighting Systems for Agricultural Facilities.” This standard specifies the minimum lighting level recommended for different types and ages of poultry. It is recommended that you consult with your electrician and your integrator to ensure that recommended lighting levels are maintained.

The energy and cost savings calculations are based on a one-for-one lighting retrofit. If the number of bulbs needed to meet lighting requirements differs from the one-to-one replacement analyzed, the savings and cost estimates would vary accordingly.

When purchasing LEDs for poultry applications, it is recommended that you select models that have been designed for the poultry industry. Some considerations include selecting LED bulbs that:

- Are specifically designed for poultry houses.
- Have a color temperature in the range of 3,500-6,400 Kelvin.
- Have been tested by an independent third party to perform well in poultry houses.
- Are fully dimmable.
- Protect against the intrusion of dust and moisture.
- Come with a warrantee (a three year warrantee is typical).
- See the *Resources* section for additional information.

The estimated installation cost for LEDs includes one new dimmer per house. Most dimmers for incandescent bulbs work by turning the power on and off very quickly. This happens so fast most people cannot detect it. LEDs require specific power levels to operate and often the drivers and ballasts that regulate power to the bulb cannot withstand the pulsating power. Another reason existing dimmers may need to be replaced is that many require a minimum load to operate. Switching to LEDs will drastically reduce the load and may go below the minimum load threshold.

Figure PL.2 and Tables PL.1, PL.3 and PL.4 provide an analysis of energy savings associated with this recommendation.

Table PL.1. Current Lighting Schedule

Location	Area	# Houses	Start Day #	End Day #	Hours / Day On	Fixture Type	# Fixtures / House	Bulb Wattage	Light Intensity % (Dimming)	Total Fixture Wattage	Est. Annual Use (kWh)
Houses 1-4	Brood	4	1	7	24	Compact Fluorescent	33	42	100	42	6,520
Houses 1-4	Grow Out	4	1	7	23	Standard Incandescent	25	100	100	100	11,270
Houses 1-4	Whole House	4	8	12	22	Standard Incandescent	50	100	100	100	15,400
Houses 1-4	Whole House	4	13	15	22	Standard Incandescent	50	100	60	100	5,544
Houses 1-4	Whole House	4	16	36	22	Standard Incandescent	50	100	45	100	29,106
Houses 5-6	Brood	2	1	7	24	Light Emitting Diode	38	10	100	10	894
Houses 5-6	Grow Out	2	1	7	23	Light Emitting Diode	114	10	100	10	2,570
Houses 5-6	Whole House	2	8	12	22	Light Emitting Diode	114	10	100	10	1,756
Houses 5-6	Whole House	2	13	15	22	Light Emitting Diode	114	10	60	10	632
Houses 5-6	Whole House	2	16	36	22	Light Emitting Diode	114	10	45	10	3,318

Figure PL.2. Poultry House Lighting: Comparison of Annual Electricity Use

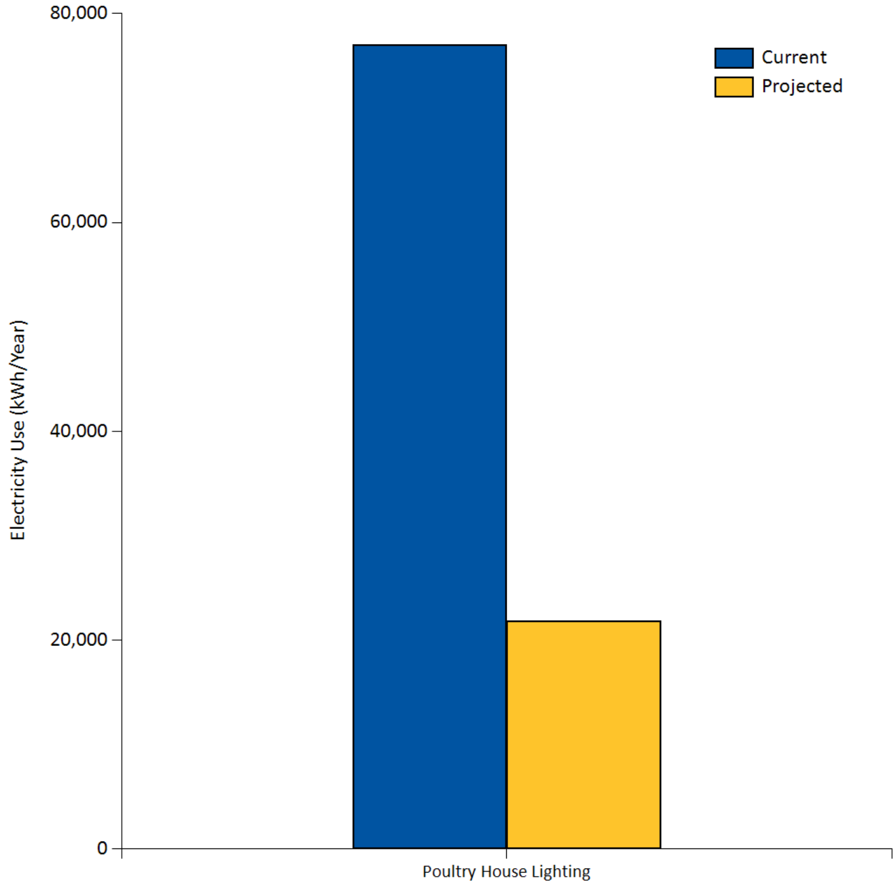


Table PL.3. Poultry House Lighting: Recommended Energy Saving Equipment

Location	Current Equipment	Recommended Equipment	# to Install	Est. Annual Electricity Savings (kWh)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
Houses 1-4	100W Standard Incandescent (100 Total Input Watts)	10W Light Emitting Diode (10W Total Input Watts) with Dimmer Controls	200	55,188	$6,027	$6,360	1.1	10.0

Table PL.4. Poultry House Lighting: Evaluated Equipment Not Recommended

Location	Current Equipment	Considered Equipment	# to Install	Est. Annual Electricity Savings (kWh)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
Houses 1-4 Brood	42W Compact Fluorescent (42 Total Input Watts)	25W Light Emitting Diode (25 Total Input Watts)	132	2,639	$288	$9,042	31.4	10.0
Houses 5-6 Brood	10W Light Emitting Diode (10 Total Input Watts)	No Recommendation	76	0	$0	$0	N/A	10.0
Houses 5-6	10W Light Emitting Diode (10 Total Input Watts)	No Recommendation	228	0	$0	$0	N/A	10.0

Note:

1. The current LED fixtures are considered energy efficient.

General Lighting Efficiency Recommendations

Table L.1 contains the current lighting inventory.

Table L.1. Current Lighting Inventory

Location / Equipment Description	# Fixtures	Fixture Type	Bulb Wattage	Annual Run Hours	Total Fixture Wattage	Est. Annual Use (kWh)
Security Lights	2	Mercury Vapor	75	4,368	93	812
Control Room Lights (Houses 1-4)	2	Standard Incandescent	60	364	60	44
Generator Room Lights (Houses 1-4)	2	Standard Incandescent	60	364	60	44
Control Room Lights (Houses 5-6)	2	Light Emitting Diode	10	364	10	7
Generator Room Lights (Houses 5-6)	2	Light Emitting Diode	10	364	10	7

Drumstick Acres has an opportunity to improve the energy efficiency of its lighting system. See *General Lighting: Recommended Energy Saving Equipment* tables for details on fixture types and wattages. Recommended fixtures are sized to provide equivalent lighting levels to the existing fixtures.

We recommend replacing the existing 75 watt mercury vapor fixtures and the 60 watt standard incandescent fixtures with LED fixtures. LEDs are semiconductor light sources that utilize solid state technology to emit light. LEDs have a longer lifespan than most other lighting technologies on the market, have among the highest luminous efficacy ratings, and do not contain mercury.

We do not recommend replacing the current LED fixtures because they are considered energy efficient.

Due to the wide range of light efficacies in the LED industry, an average light efficacy of 65 lumens/watt is used for fixtures under 30 watts and an average light efficacy of 100 lumens/watt is used for fixtures 30 watts and greater to calculate the mean lumen output of the proposed LED fixtures.

Due to the lack of wattage uniformity and a wide range of wattages for LED products, the recommended LED fixtures have a wattage range of +/- 3 watts. This range should be considered when selecting specific LED fixtures for your site in order to meet the estimated energy savings within this evaluation. Most LED fixtures are dust and moisture resistant, and therefore there is generally no need to enclose them in vapor proof enclosures. The dust and moisture resistance of the particular fixture selected and installed should be verified with the equipment dealer.

We recommend choosing LED fixtures that are listed on the DesignLights™ Consortium (DLC) Qualified Product List. All lights on the list have met quality standards set by the DLC. The DLC Qualified Product List can be found here: http://www.designlights.org/qpl.

Estimated installed cost for the exterior LEDs assumes replacing the entire fixture and includes labor. Although retrofit kits are available for converting exterior lights to LEDs, we recommend replacing the entire fixture. This will ensure that the fixture will not fail prematurely due to degraded existing fixture components or compatibility issues.

Figure L.2 shows a comparison of the estimated current and projected lighting electricity use. Table L.3 provides economic details for each lighting upgrade recommendation.

Figure L.2. General Lighting: Comparison of Annual Electricity Use

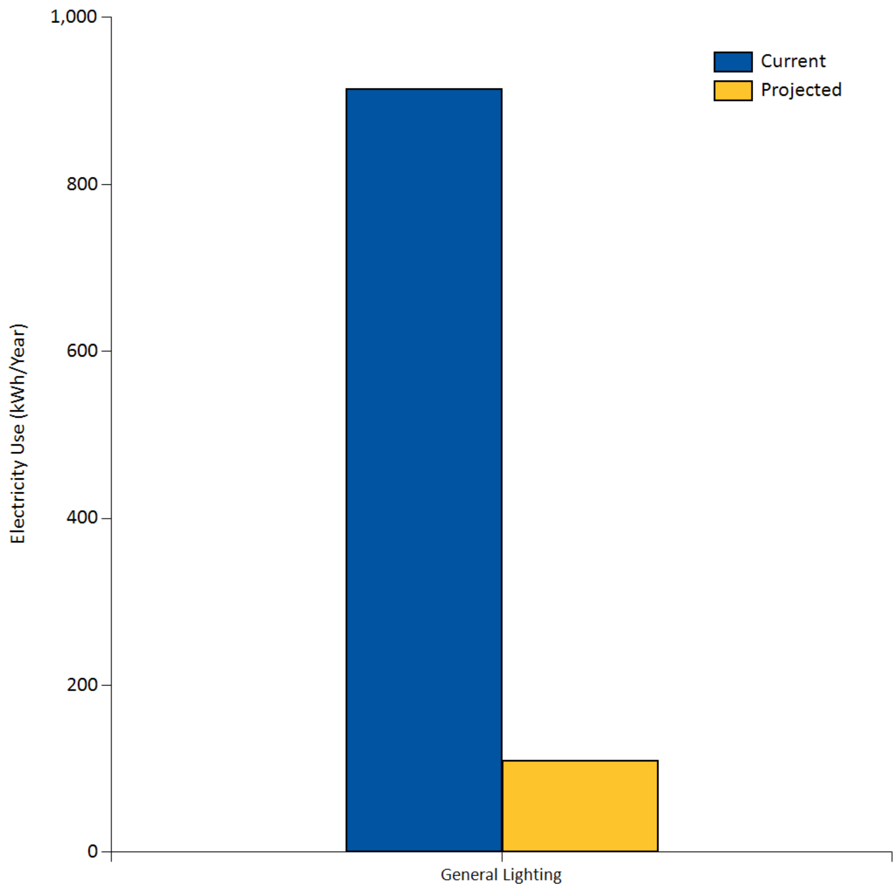


Table L.3. General Lighting: Recommended Energy Saving Equipment

Location / Equipment Description	Current Equipment	Recommended Equipment	# to Install	Est. Annual Electricity Savings (kWh)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
Security Lights	75W Mercury Vapor (93 Total Input Watts)	10W Light Emitting Diode (10 Total Input Watts)	2	725	$79	$120	1.5	10.0
Control Room Lights (Houses 1-4)	60W Standard Incandescent (60 Total Input Watts)	6W Light Emitting Diode (6 Total Input Watts)	2	39	$4	$30	7.0	10.0
Generator Room Lights (Houses 1-4)	60W Standard Incandescent (60 Total Input Watts)	6W Light Emitting Diode (6 Total Input Watts)	2	39	$4	$30	7.0	10.0
Totals				**804**	**$88**	**$180**	**2.1**	**N/A**

The lighting recommendations and considerations presented in the report represent one of several energy efficient lighting options. The recommended fixtures are commonly available and are among the most energy efficient lighting choices for the particular application. If the farm decides to pursue a different lighting type, EnSave can evaluate the energy and cost savings of the alternative.

Air Heating and Building Environment Recommendations

The farm has 6 broiler houses. The houses are described in Table H.1. The heating equipment is described in Table H.2.

Table H.1. House Group Summary

House Group	# Houses	Dimensions (ft)	Age (Years)	Sidewall Type	Ceiling Type	Tunnel Ventilated
Houses 1-4	4	500 x 43	10	Solid	Dropped	Yes
Houses 5-6	2	500 x 54	2	Solid	Dropped	Yes

Table H.2. Heater Inventory

House Group	Manufacturer / Model	Year Installed	# Heaters (All Houses)	Heater Type	Ignition Type	Input Rating (Btu/Hour)	Output Rating (Btu/Hour)
Houses 1-4	LB White	N/A	96	Radiant Brooder (Elec. Ignition)	Electronic	40,000	40,000
Houses 5-6	LB White	2013	112	Radiant Brooder (Elec. Ignition)	Electronic	30,000	30,000

Renovate from Curtain to Insulated Solid Side Walls

The farm is currently equipped with solid sidewalls.

Adding Insulation

To minimize heat loss, heated structures need an effective thermal boundary. A thermal boundary is defined as an air and insulation barrier. The insulation barrier slows the transmission of heat to unheated spaces. The air barrier restricts the flow of air from the interior heated space to unheated spaces. An effective thermal boundary is continuous and unbroken at the perimeter of the heated "conditioned" space. Insulation's resistance to heat transmission is given as an R-value. The effectiveness of insulation depends on the choice of material, its density, and installation quality. Effective installations are absent of voids, completely fill any cavities, are installed at the correct densities, and are protected from air movement.

Table H.3 provides the current insulation values of the houses.

Table H.3. Walls and Ceilings R-Values

House Identifier	Sidewall R-Value	Foundation Wall R-Value	End Wall R-Value	End Wall Door R-Value	Ceiling One R-Value
Houses 1-4	9.18	N/A	9.35	1	9.25
Houses 5-6	13.32	1.49	14.14	5	14.8

Ceiling Insulation

Savings calculations for adding insulation to the ceiling assume increasing the approximate R-value of the ceiling insulation by R-19. We recommend adding a minimum of R-19 insulation value to the ceiling of Houses 1-4.

We do not recommend adding insulation in the ceilings of Houses 5-6 due to the long payback period.

Dropped ceilings are easiest to insulate with blown in insulation. The most common types of blown insulation are blown cellulose and blown fiberglass. Each insulation type has a comparable insulation value and cost. Open rafter houses are more difficult and need to be either sprayed with foam insulation or have rigid insulation installed between the rafters and then have the joints sealed with foam. Air leaks in the ceiling should be sealed prior to installing additional insulation. A wind barrier should be installed at the eaves to prevent wind washing of fiberglass or cellulose insulation which will reduce its insulation value.

Wall Insulation

Savings calculations for adding insulation to the walls assume increasing the approximate R-value of the sidewall insulation and the end wall insulation by R-7 by applying one inch of polyurethane spray foam to the existing wall structure. Adding insulation to the walls of the poultry houses is not recommended due to the long payback period.

Savings calculations for adding insulation to the exposed foundation walls assume increasing the approximate R-value of the exposed area of the wall insulation by R-7. We recommend adding a minimum of R-7 insulation value to the exposed foundation walls of Houses 5-6.

Houses 1-4 do not have an exposed foundation wall.

Seal Air Leaks

All poultry houses, even brand new houses, should be checked for air leaks. A 1/8th inch crack running down each side of a 500’ long house is the equivalent of having a 2’ x 5’ hole in the house. A tighter house provides better control of the air flow, lower use of gas for heating, lower relative humidity, and better bird performance.

Sealing the air leaks in Houses 1-6 with closed-cell polyurethane foam is recommended. Estimated linear footage of air leaks to seal is calculated to be the bottom and top sill plate of the houses (twice the perimeter of the house).

Insulated Brood Curtains

There are two significant reasons for installing an insulated brood curtain. The first is that the heat produced by the heating system will be held in the area where it is needed, especially during the first few weeks of the flock. The second reason is to help reduce the moisture on the floor of the brood area. An insulated brood curtain has an approximate insulation value of R-2.5.

We recommend replacing the existing brood curtains in Houses 1-6 with insulated brood curtains. Brood curtain dimensions are based on the cross-sectional area of the house. For more information about brood curtains, see the attached resource, *Brooding Curtains*, published by EnSave.

Ceiling Stir Fans

Ceiling stir fans push hot air down from the ceiling, resulting in fewer temperature fluctuations and lower relative humidity. This leads to enhanced bird weight and productivity. Houses 1-4 do not currently have any stir fans. Houses 5-6 currently have eight 18” cage stir fans per house.

The existing amount of stir fans in Houses 5-6 is adequate, and there are no recommendations to install additional stir fans.

We do not recommend installing stir fans in Houses 1-4 due to long payback period.

Radiant Heaters

It is quite costly to heat the air with a forced hot air furnace and then remove that warm air with ventilation fans. Rather than heating the air, radiant brooders use radiant energy to efficiently heat the objects in a room (chicks and floor). Radiant brooders also do a better job of heating the chicks by providing concentric zones of temperature, with the hottest area in the center. This better enables the birds to find their own comfort zones. The farm is currently equipped with efficient radiant brood heaters in all of the poultry houses.

Insulated Tunnel Doors

Loose fitting and poorly insulated tunnel curtains are a major source of heat loss in poultry houses. Insulated and gasketed tunnel inlet doors effectively reduce conduction and infiltration losses. The doors also reduce litter caking in the tunnel area by maintaining warmer air temperatures in the winter and by directing the cool moist air from the cooling pads towards the ceiling in the summer. The doors should have a minimum insulation value of R-7. The farm is currently equipped with insulated tunnel doors on all of the poultry houses.

Insulated End Doors

Installing sealed and insulated end wall doors will provide valuable energy and cost savings.
We do not recommend replacing the roll seal doors on Houses 5-6 because they are considered energy efficient.

Houses 1-4 are currently equipped with metal and wood uninsulated end wall doors. We recommend installing insulated end wall doors on Houses 1-4. For more information about insulated end doors, see the attached resource, *End Wall Doors*, published by EnSave.

Actuated Attic Inlets

Data from the Auburn University, National Poultry Technology Center, shows that utilizing the heat trapped above a dropped ceiling can significantly reduce the heating fuel needed, especially during the first few weeks of a flock. Rather than drawing cool air in from outside, attic inlets enable attic air that has been preheated to be drawn into the house. Attic inlets are most effective in solid side wall houses that utilize tunnel ventilation and have been air-sealed. Payback periods are shortest in small bird houses with a high number of annual flocks and corresponding brood periods requiring heat. Sufficient air intake into the attic and into the house is required for this option to work.

Houses 5-6 do not currently have any attic inlets. We recommend installing 21 attic inlets in Houses 5-6. One attic inlet is considered for approximately every 1,350 square feet of floor area in each house. It is recommended that you work with an installer who is experienced with attic inlets to properly design and install the equipment. A good installation is important to the proper operation of the attic inlets. Also make sure to learn appropriate times to use the attic inlets to maximize efficiency. For more information on attic inlets, see the attached resource, *Attic Inlets*, published by EnSave.

Houses 1-4 are currently equipped with 16 attic inlets per house. The existing amount of attic inlets in Houses 1-4 is adequate, and there are no recommendations to install additional attic inlets.

Electronic Controls

Poultry houses have multiple environmental systems – lighting, heating, and ventilation – that all interact. Electronic controls can be set so that the lights, fans, and cooling systems are turned on and off automatically. Electronic controls will help increase productivity by minimizing the chance of human error. These systems create a more stable, controlled environment for the birds to grow. The farm is currently equipped with electronic controllers in all of the houses.

Heating Summary

Figure HS.1 and Table HS.2 provide an analysis of energy savings based on the recommendations made above. Table HS.3 lists equipment options that were evaluated but not recommended.

Figure HS.1. Heating Fuel Use: Comparison of Current and Projected

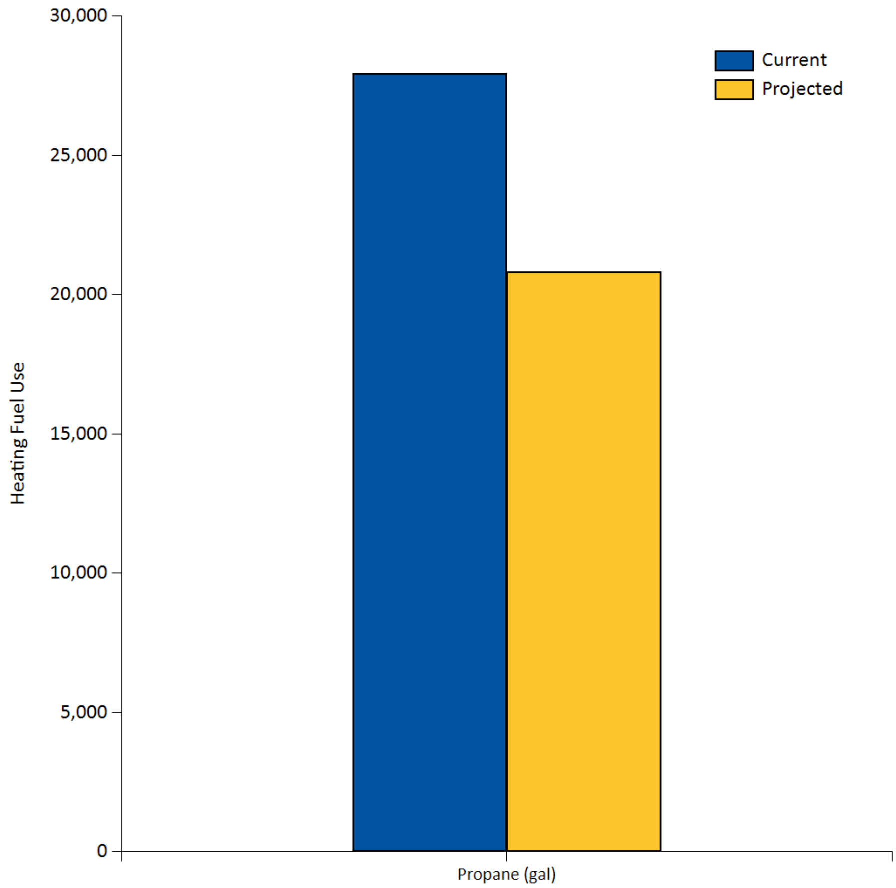


Table HS.2. Air Heating and Building Environment: Recommended Energy Saving Equipment

Location / Equipment Description	Current Equipment	Recommended Equipment	Est. Annual Propane Savings (gal)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
Houses 1-4: Seal Air Leaks	4 houses with poor air sealing.	Seal approximately 2,172 linear ft. per house in 4 houses to eliminate air leaks.	2,177	$3,545	$2,000	0.6	10.0
Houses 5-6: Seal Air Leaks	2 houses with poor air sealing.	Seal approximately 2,216 linear ft. per house in 2 houses to eliminate air leaks.	904	$1,472	$1,000	0.7	10.0
Houses 5-6: Attic Inlets	2 houses with 0 attic inlets per house.	Install 21 attic inlets per house in 2 houses.	556	$905	$6,720	7.4	10.0
Houses 1-4: Brood Curtains	4 houses with 1 uninsulated brood curtain.	Install 1 insulated brood curtain (approximately 387 ft² per house) in 4 houses.	168	$273	$2,012	7.4	10.0
Houses 5-6: Brood Curtains	2 houses with 1 uninsulated brood curtain.	Install 1 insulated brood curtain (approximately 540 ft² per house) in 2 houses.	117	$190	$1,404	7.4	10.0
Houses 5-6: Exposed Foundation Walls	2 houses with 1,662 ft² per house of poured concrete.	Install 1,662 ft² per house of 1-in. polyurethane high-density foam in 2 houses.	639	$1,040	$8,642	8.3	20.0
Houses 1-4: Ceiling One	4 houses with 21,593 ft² per house of blown cellulose.	Install 21,593 ft² per house of blown insulation in 4 houses.	2,182	$3,552	$43,186	12.2	20.0
Houses 1-4: End Wall Doors	4 houses with 2 metal and wood, uninsulated doors.	Install 2 well insulated end wall doors (approximately 240 ft² per house) in 4 houses.	366	$596	$10,560	17.7	20.0
Totals			**7,109**	**$11,573**	**$75,524**	**6.5**	**N/A**

Table HS.3. Air Heating and Building Environment: Evaluated Equipment Not Recommended

Location / Equipment Description	Current Equipment	Considered Equipment	Est. Annual Electricity Savings (kWh) (Increase)	Est. Annual Propane Savings (gal)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
Houses 5-6: Ceiling One	2 houses with 27,295 ft² per house of blown cellulose.	Install 27,295 ft² per house of blown insulation in 2 houses.	0	720	$1,173	$27,295	23.3	20.0
Houses 1-4: Stir Fans	4 houses with 0 stir fans per house.	Install 7 stir fans per house in 4 houses.	(3,509)	327	$149	$4,200	28.1	10.0
Houses 1-4: Sidewalls	4 houses with 7,150 ft² per house of fiberglass batting.	Install 7,150 ft² per house of 1-in. polyurethane foam in 4 houses.	0	468	$763	$37,180	48.8	20.0
Houses 1-4: End Walls	4 houses with 534 ft² per house of fiberglass batting.	Install 534 ft² per house of 1-in. polyurethane foam in 4 houses.	0	34	$55	$2,777	50.2	20.0
Houses 5-6: Sidewalls	2 houses with 5,500 ft² per house of fiberglass batting.	Install 5,500 ft² per house of 1-in. polyurethane foam in 2 houses.	0	99	$161	$14,300	88.9	20.0
Houses 5-6: End Walls	2 houses with 678 ft² per house of fiberglass batting.	Install 678 ft² per house of 1-in. polyurethane foam in 2 houses.	0	11	$18	$1,763	98.1	20.0

Ventilation Efficiency Recommendations

Table V.1 provides an inventory of the existing ventilation fans for each poultry house.

Table V.1. Current Exhaust Inventory

Location / Area Description	Manufacturer	Year Installed	# Fans	Diameter (in)	Location	Run Hours	Airflow (cfm)	VER (cfm / Watt)	Est. Annual Use (kWh)
Houses 1-4	Airstream	2005	16	36in.	Sidewall	359	9,900	14.7	3,864
Houses 1-4	Airstream	2005	12	48 - 49in.	Tunnel	1,185	16,500	16.2	14,489
Houses 1-4	Airstream	2005	24	48 - 49in.	Tunnel	711	16,500	16.2	17,387
Houses 1-4	Airstream	2005	12	54 - 60in.	Tunnel	1,080	20,900	18.7	14,489
Houses 5-6	Airstream	2013	8	36in.	Sidewall	359	9,900	14.7	1,932
Houses 5-6	Airstream	2013	16	54 - 60in.	Tunnel	857	26,900	19.1	19,319
Houses 5-6	Airstream	2013	14	54 - 60in.	Tunnel	514	26,900	19.1	10,142

We do not recommend replacing any of the ventilation fans due to the long payback periods. Manufacturer's specifications and estimated staged run times were used to evaluate the replacement of existing fans at the location.

When replacing fans we recommend buying the most energy efficient fans available. The energy savings from an efficient fan will quickly offset any initial savings realized by purchasing a less expensive and less efficient fan.

When replacing older tunnel fans, consider increasing the fan size so that an air velocity of 600 ft/minute is achieved. For more information go to the internet resource *Auburn University, Poultry Ventilation and Housing Newsletters* and look for *Big Birds, Hot Weather – and Maximum Comfort, Performance and Profit* for information regarding the productivity benefit of this measure.

Additional measures to increase ventilation energy efficiency include:

- Establish a periodic fan cleaning schedule (every 3 to 4 weeks). Tests performed by the University of Georgia showed that dirty fan housings, shutters, and blades can reduce air flow and efficiency by up to 27%. Air flow also directly affects humidity levels, flock health, and performance.
- Inspect and replace worn belts and pulleys. Tests performed by the University of Georgia showed a 10-30% drop in fan output, mainly from worn belts.
- Stage the tunnel fans so that the newer, more energy efficient fans are the first to turn on if all of the fans are not needed.
- Install fan covers over unused fans during the heating season.
- Straighten bent cones and repair shutters that are not closing properly.

Table V.2 lists equipment options that were evaluated but not recommended.

Table V.2. Poultry Ventilation: Evaluated Equipment Not Recommended

Location / Area Description	Current Equipment	Considered Equipment	# to Install	Est. Annual Electricity Savings (kWh)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
Houses 1-4	48 - 49in. Exhaust Fan (16,500 cfm, 16.2 cfm / Watt), running 1,185 Hours / Year	48 - 49in. Exhaust Fan (16,900 cfm, 22.7 cfm / Watt)	12	3,898	$426	$13,200	31.0	15.0
Houses 1-4	54 - 60in. Exhaust Fan (20,900 cfm, 18.7 cfm / Watt), running 1,080 Hours / Year	54 - 60in. Exhaust Fan (21,000 cfm, 25.8 cfm / Watt)	12	3,937	$430	$19,200	44.7	15.0
Houses 1-4	48 - 49in. Exhaust Fan (16,500 cfm, 16.2 cfm / Watt), running 711 Hours / Year	48 - 49in. Exhaust Fan (16,900 cfm, 22.7 cfm / Watt)	24	4,678	$511	$26,400	51.7	15.0
Houses 5-6	54 - 60in. Exhaust Fan (26,900 cfm, 19.1 cfm / Watt), running 857 Hours / Year	54 - 60in. Exhaust Fan (27,100 cfm, 23.0 cfm / Watt)	16	3,156	$345	$25,600	74.3	15.0
Houses 5-6	54 - 60in. Exhaust Fan (26,900 cfm, 19.1 cfm / Watt), running 514 Hours / Year	54 - 60in. Exhaust Fan (27,100 cfm, 23.0 cfm / Watt)	14	1,657	$181	$22,400	124	15.0
Houses 5-6	36in. Exhaust Fan (9,900 cfm, 14.7 cfm / Watt), running 359 Hours / Year	36in. Exhaust Fan (10,200 cfm, 20.8 cfm / Watt)	8	525	$57	$7,200	126	15.0
Houses 1-4	36in. Exhaust Fan (9,900 cfm, 14.7 cfm / Watt), running 359 Hours / Year	36in. Exhaust Fan (10,200 cfm, 20.8 cfm / Watt)	16	1,050	$115	$14,400	126	15.0

Ventilation Fan Selection

Exhaust fan efficiency is rated in two ways: 1) efficacy in cfm/watt, (cubic feet of air moved per watt of power rating) and 2) by airflow ratio - this ratio gives an indication of the fan's ability to continue to push air when there is wind blowing against the fan or there is an increase in the static pressure inside the structure. Fans with higher efficacies are better performing fans, and fans with higher airflow ratios are better suited for houses with higher static pressures.

It is often more cost effective in the long run to buy a more expensive, more efficient fan because lower operating costs over the fan's lifetime will exceed the initial higher cost.

Refrigeration

There are no activities or equipment at this site applicable to this section.

Other Motors and Pumps

Table M.1 provides a list of the motors analyzed in this report.

Table M.1. Current Motor Inventory

Equipment Description	Manufacturer / Model	# Motors	Motor HP	RPM Rating	Casing Type	Annual Run Hours	Motor Estimated Annual Electricity Use
Feed Line Motors	GE / 5KC46GN0075AU	28	0.33	1500 - 2700	TEFC	560	4,530
Cross Auger Motors	Baldor Reliance / 34K687W204G1	6	0.5	1500 - 2700	TEFC	560	1,397
Vent Box Motors	N/A	8	0.33	1500 - 2700	TEFC	280	647
Tunnel Inlet Motors	N/A	8	0.5	1500 - 2700	TEFC	280	932
Recirculating Cool Cell Motors	N/A	16	0.5	1500 - 2700	TEFC	420	2,795

Feed line motors, cross auger motors, vent box motors, tunnel inlet motors, and recirculating cool cell motors were not evaluated for replacement because NEMA currently does not evaluate motors less than 1 Horsepower (hp), so no recommendations can be made for these motors.

If it was not possible to read motor nameplate information, a Totally Enclosed Fan Cooled (TEFC) motor type and/or 1,800 revolutions per minute (RPM) were assumed. When actual motor efficiencies were not available, the estimated energy and related cost savings assume a baseline using the Energy Policy Act of 1992 minimum requirements, which all motors manufactured after 1997 meet.

Improving the efficiency of a pump motor will likely increase the life of the pump and reduce operating costs significantly. To minimize energy consumption of motors, always replace a burned out motor with the most energy efficient motor available. EnSave recommends using NEMA Premium® standard motors where possible. For more information on NEMA Premium®, see http://www.nema.org/Policy/Energy/Efficiency/Pages/NEMA-Premium-Motors.aspx.

Water Heating

There are no activities or equipment at this site applicable to this section.

Waste Handling

The location decakes after every flock using non-stationary equipment. This equipment does not use a significant amount of energy and was not evaluated in this report.

Water Management

The water source used for agricultural purposes on this farm is municipal water.

Material Handling

The location uses bins for storage and augers to distribute the feed to the birds. The associated motors were addressed in the *Other Motors and Pumps* section of the report.

Miscellaneous Electrical Equipment and Efficiency Recommendations

Poultry houses use a variety of motors. These motors are used for augers moving feed from silos to the houses and the feed lines, to pump drinking water to the chickens, and to pump water to the evaporative cooling system (e.g. foggers or cooling pads).

These motors operate every day that a flock is in a poultry house. However, there are two reasons it is not justifiable to replace these motors, based on energy savings:

- They do not operate a sufficient number of hours annually to justify replacement. Typically a motor needs to run a minimum of 2,000 hours annually to justify replacement.
- Most of these motors are small, 3/4 hp or 1 hp, and do not draw enough energy to justify replacement.

General Suggestions: Mississippi State University Extension Service has compiled a list of helpful, inexpensive ways poultry growers can reduce their energy costs. Their publication, *Reduce Energy Costs in Poultry Houses* (attached) is a worthwhile list of techniques every grower can implement fairly quickly.

Low Cost Energy Saving Tips

Some energy savings potential requires minimal investment other than labor. Examples include combining trips and eliminating unnecessary energy expenditures by turning off lights and shutting down engines during periods of inactivity. Another example of a low cost energy saving measure is periodic cleaning of fan blades in dusty environments (e.g., every 3 to 4 weeks) and maintaining belt tension on belt driven fans. This may increase existing fan efficiency by 10% or more without replacement. These actions can increase the useful life of fans.

PRODUCTIVITY BENEFITS

The following measures are ways to increase productivity on a poultry farm.

Additional Ventilation

There is evidence indicating that by providing 600 ft/min of air velocity during the last two weeks of grow-out, birds can gain upwards of 1/2 pound over what they would have gained at a lower, more typical velocity of 400 ft/min. This weight gain can add significant income at relatively little cost.

A study conducted at the Agricultural Resource Service (ARS) poultry research unit at Mississippi State University, found a 0.20 pound gain for 20,000 birds will produce a 4,000 total pound weight gain. If $0.05 is paid per pound to achieve higher air velocity then the grower will have a gross gain of $200 per house, per flock. While it was not reported, there will also be a financial gain from a higher feed conversion. The cost for running the additional fans to maintain the 600 ft/min velocity, rather than the more common 400 ft/min, was determined to be about $71, leaving the grower with a conservative estimated gain of about $129 per house, per flock.

Air Cooling and Evaporative Cooling

Significant temperature control within a poultry house can be achieved with the installation of evaporative cooling. There are three types of evaporative cooling (EC) systems:

1) Misting
2) A wall mounted evaporator pad with outside misting spray onto the pads
3) A wall mounted recirculating water evaporator pad

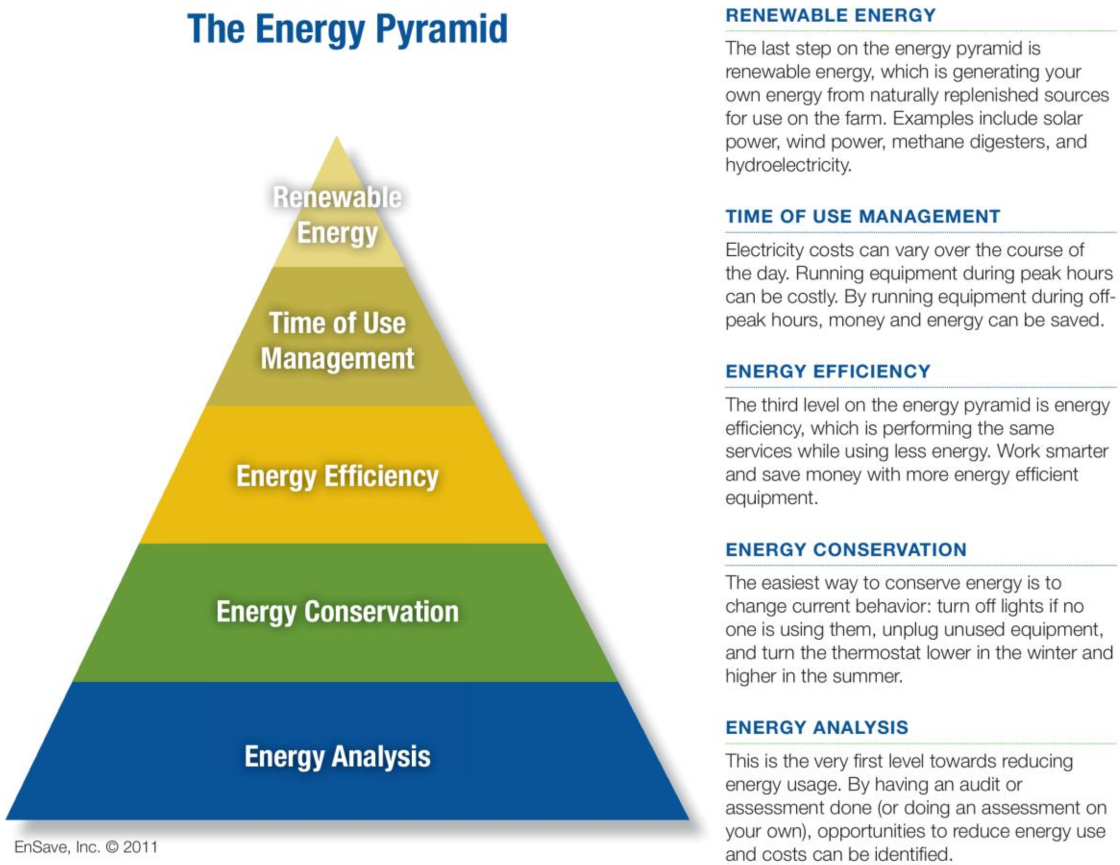
The misting system requires the most attention to operate by the grower and is subject to the most maintenance. The second system uses a similar type of small spray nozzle as the misting system and is therefore also subject to a high level of maintenance. However, it operates for less time than the first. The third system has the fewest maintenance issues and requires the least amount of operational attention. All of these systems require regular attention. The cooling capacity of evaporated water can be of tremendous value during hot weather. The farm is currently equipped with wall mounted recirculating water evaporator pads.

Heat loss through the cooling pads during cold weather months is significant. Heated air will pass through the cells near the top of the wall and cool outside air will flow in through the bottom portion of the cells. Installing tunnel doors, which can be locked down, will help reduce the heating costs and improve the health of the birds.

ENERGY PYRAMID

EnSave uses an energy pyramid as a model to outline the steps necessary for reducing energy usage. Figure EP.1 shows the energy pyramid.

Figure EP.1. Energy Pyramid



The energy pyramid is a concept used to help guide farmers toward energy independence. The energy pyramid has been proven to be very effective, and it serves as a road map to show where a farm is on their way to energy independence.

Drumstick Acres has done a great job with energy analysis and conservation. The next step for the farm would be to implement the energy efficiency measures recommended in this report.

STATEMENTS AND DISCLAIMERS

Disclaimer

The intent of this energy evaluation is to estimate energy savings associated with recommended energy conservation measures at Drumstick Acres. This report is not intended to serve as a detailed engineering design document. Detailed design efforts may be required in order to implement several of the improvements evaluated as part of this Plan. As appropriate, costs for those design efforts are included as part of the cost estimate for each measure.

Energy savings and equipment costs presented in this document are estimates and are based upon information gathered during the process of conducting this energy audit. Actual savings and costs may vary from estimates due to a variety of factors including changes in energy usage and energy costs, equipment costs, product availability, and geographic location.

As a result, EnSave, Inc. is not liable if projected energy or cost savings are not actually achieved. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees. Drumstick Acres shall independently evaluate any advice or direction provided in this report. In no event will EnSave, Inc. be liable for the failure of the customer to achieve a specified amount of energy savings, the operation of the customer's facilities, or any incidental or consequential damages of any kind in connection with this report or the installation of recommended measures.

Statement of Vendor Neutrality

EnSave's goal is to help our clients save energy and conserve natural resources. EnSave does not represent any equipment manufacturer or dealer. Any quotes or manufacturer literature included in this report are intended as illustrations only.

The presence or absence of any trade or company names in this report should not be interpreted as any reflection on the quality of the company or its products.

RESOURCES

The following resources describe the equipment and productivity benefits. They include explanations of how each piece of equipment saves energy and how each process improvement helps increase production.

1. *Reduce Energy Costs In Poultry Houses*, published by Mississippi State University
2. *Best Practices Guide – Energy Savings for Poultry*, published by EnSave, Inc.
3. *Attic Inlets*, published by EnSave, Inc.
4. *Brooding Curtains*, published by EnSave, Inc.
5. *End Wall Doors*, published by EnSave, Inc.
6. *Efficient LED Lighting*, published by EnSave, Inc.
7. *Exterior LED lighting,* published by EnSave, Inc.
8. *Ventilation Fan Simple Payback Calculator work sheet,* published by EnSave, Inc.
9. *Managing Mercury on the Farm*, published by EnSave, Inc.

INTERNET RESOURCES

The following resources provide additional information about funding sources and energy information.

Funding Sources

1. AR NRCS Environmental Quality Incentives Program, http://www.nrcs.usda.gov/wps/portal/nrcs/main/ar/programs/financial/eqip/

2. USDA RD Rural Energy for America Program (REAP) Information, http://www.rurdev.usda.gov/Energy.htmlli>

3. Database of State Incentives for Renewables & Efficiency (DSIRE), http://www.dsireusa.org/

Energy Information

1. Auburn University, Poultry Ventilation and Housing Newsletters, http://www.aces.edu/dept/poultryventilation/Newsletters.php

2. University of Georgia Poultry Housing Tips, http://www.poultryventilation.com/poultry-tips

3. National Renewable Energy Laboratory, http://www.nrel.gov/

4. University of Illinois at Urbana-Champaign's Bioenvironmental and Structural Systems Laboratory, www.bess.uiuc.edu.

5. Lamp Recycling, http://www.epa.gov/osw///hazard/wastetypes/universal/lamps/index.htm

6. Improving Gas Heat System Efficiency, http://www.aces.edu/dept/poultryventilation/documents/Nwsltr-69ImprovingGasHeatSystemEfficiency.pdf

7. Poultry House Light Dimming Issues, http://www.aces.edu/dept/poultryventilation/documents/Nwsltr-68LightDimmingIssues.pdf

8. Six Tops Tips for Best Tunnel Cooling, http://www.aces.edu/dept/poultryventilation/documents/Nwsltr-72TipsonTunnel.pdf

9. Keys to Top Evaporative Cooling Performance, http://www.aces.edu/dept/poultryventilation/documents/Nwsltr-41EvapCooling.pdf

10. Steel Truss R-Value, http://www.khhpc.com/portals/0/pdfs/news%20publications/envelop%20the%20steel.pdf

Appendix A: Detail Listing of Estimated Annual Energy Efficiency Improvements

Tables A.1 and A.2 provide a detailed listing of all recommended measures. This is provided for NRCS purposes as needed. Note that for some measures the quantity is in the "# to Install" column and for others it is included in the description of the "Recommended Equipment".

This page left blank, see Table A.1 beginning next page.

Table A.1. Detail Listing of Estimated Annual Energy Efficiency Improvements

				Estimated Reduction in Energy Use			Estimated Costs, Savings, Payback, and Prioritization for Implementation				Environmental Benefits: Greenhouse Gas (Estimated Values)			Environmental Benefits: Air Pollutant Co-Benefits (Estimated Values)	
Location / Equipment Description	Current Item	Recommended Item	# to Install	Est. Annual Electricity Savings (kWh)	Est. Annual Propane Savings (gal)	Energy Savings (MMBtu)	Implementation Cost [a]	Energy Cost Savings [b]	Est. Payback in Years [a]/[b]	Expected Useful Life (Years)	CO_2 (lbs)	N_2O (lbs)	CH_4 (lbs)	SO_2 (lbs)	NO_x (lbs)
Houses 1-4: Seal Air Leaks	4 houses with poor air sealing.	Seal approximately 2,172 linear ft. per house in 4 houses to eliminate air leaks.	N/A	0	2,177	199	$2,000	$3,545	0.6	10.0	27,554.5	0.9	4.4	0.2	21.8
Houses 5-6: Seal Air Leaks	2 houses with poor air sealing.	Seal approximately 2,216 linear ft. per house in 2 houses to eliminate air leaks.	N/A	0	904	83	$1,000	$1,472	0.7	10.0	11,445.2	0.4	1.8	0.1	9.0
Houses 1-4	100W Standard Incandescent (100 Total Input Watts)	10W Light Emitting Diode (10W Total Input Watts) with Dimmer Controls	200	55,188	0	188	$6,360	$6,027	1.1	10.0	76,667.2	1.2	1.0	181.3	62.9
Security Lights	75W Mercury Vapor (93 Total Input Watts)	10W Light Emitting Diode (10 Total Input Watts)	2	725	0	2	$120	$79	1.5	10.0	1,007.3	0.0	0.0	2.4	0.8
Control Room Lights (Houses 1-4)	60W Standard Incandescent (60 Total Input Watts)	6W Light Emitting Diode (6 Total Input Watts)	2	39	0	0	$30	$4	7.0	10.0	54.6	0.0	0.0	0.1	0.0
Generator Room Lights (Houses 1-4)	60W Standard Incandescent (60 Total Input Watts)	6W Light Emitting Diode (6 Total Input Watts)	2	39	0	0	$30	$4	7.0	10.0	54.6	0.0	0.0	0.1	0.0
Houses 1-4: Brood Curtains	4 houses with 1 uninsulated brood curtain.	Install 1 insulated brood curtain (approximately 387 ft² per house) in 4 houses.	4	0	168	15	$2,012	$273	7.4	10.0	2,120.6	0.1	0.3	0.0	1.7
Houses 5-6: Attic Inlets	2 houses with 0 attic inlets per house.	Install 21 attic inlets per house in 2 houses.	42	0	556	51	$6,720	$905	7.4	10.0	7,034.5	0.2	1.1	0.1	5.6
Houses 5-6: Brood Curtains	2 houses with 1 uninsulated brood curtain.	Install 1 insulated brood curtain (approximately 540 ft² per house) in 2 houses.	2	0	117	11	$1,404	$190	7.4	10.0	1,479.5	0.0	0.2	0.0	1.2

Table A.2. Detail Listing of Estimated Annual Energy Efficiency Improvements Continued

												Environmental Benefits				
				Estimated Reduction in Energy Use			Estimated Costs, Savings, Payback, and Prioritization for Implementation					Greenhouse Gas (Estimated Values)			Air Pollutant Co-Benefits (Estimated Values)	
Location / Equipment Description	Current Item	Recommended Item	# to Install	Est. Annual Electricity Savings (kWh)	Est. Annual Propane Savings (gal)	Energy Savings (MMBtu)	Implementation Cost [a]	Energy Cost Savings [b]	Est. Payback in Years [a]/[b]	Expected Useful Life (Years)	CO_2 (lbs)	N_2O (lbs)	CH_4 (lbs)	SO_2 (lbs)	NO_x (lbs)
Houses 5-6: Exposed Foundation Walls	2 houses with 1,662 ft² per house of poured concrete.	Install 1,662 ft² per house of 1-in. polyurethane high-density foam in 2 houses.	N/A	0	639	59	$8,642	$1,040	8.3	20.0	8,086.8	0.3	1.3	0.1	6.4
Houses 1-4: Ceiling One	4 houses with 21,593 ft² per house of blown cellulose.	Install 21,593 ft² per house of blown insulation in 4 houses.	N/A	0	2,182	200	$43,186	$3,552	12.2	20.0	27,610.5	0.9	4.4	0.2	21.8
Houses 1-4: End Wall Doors	4 houses with 2 metal, uninsulated doors.	Install 2 well insulated end wall doors (approximately 240 ft² per house) in 4 houses.	8	0	366	34	$10,560	$596	17.7	20.0	4,633.6	0.1	0.7	0.0	3.7
Totals				**55,991**	**7,109**	**842**	**$82,064**	**$17,687**	**4.6**	**N/A**	**167,748.9**	**4.1**	**15.2**	**184.6**	**134.9**