Agricultural Energy Management Plan

XXXXXXXXXXXXX
XXXXXXXXXXXXX
XXXXXXXXXXXXX
XXXXXXXXXXXXX
XXXXXXXXXXXXX
XXXXXXXXXXXXX

Enterprise(s): Poultry
Acres: 17
Site Visit: Thursday, November 3, 2016
Data Collector: XXXXXXXXXX
Plan Complete: Thursday, December 22, 2016

EnSave

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TSP-14-9794

Thursday, December 22, 2016

XXXXXXXXXXXX
XXXXXXXXXXXX
XXXXXXXXXXXX
XXXXXXXXX, XX XXXXX

Dear Mr. XXXXXX:

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, 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 representative at the Princess Anne Service Center (410-651-0370) and USDA Rural Development representatives at the Delaware State Offices (302-857-3580) can assist you with the application process for both programs. In the 'Resources' section, 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 use 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 plan will serve as a guide for future decisions and improvements.

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

Sincerely,

Kyle Booth, Senior Engineer
EnSave
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Email: kyleb@ensave.com

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SUMMARY

Overview

EnSave conducted an energy data collection at XXXXXXXXXXXX on Thursday, November 3, 2016. This document 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 plan 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 plan 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 plan may contain details about systems analyzed that did not result in energy savings opportunities. Finally, this plan includes information sheets with more detail about equipment and recommended technologies, as well as links to various internet resources about funding sources. Appendix A includes a summary table of all the recommendations.

An average electricity cost of $0.16 per kWh and an average cost of $1.65 per gallon of propane were used; however, if XXXXXXXXXX actual costs are different from these documented values, the energy cost savings would vary accordingly.

The poultry facility at XXXXXXXXXX is approximately 36 years old and is equipped with some existing energy efficient equipment such as high efficiency tunnel fans and radiant tube heaters.

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
House 2	1	5.5	6.5	14,500	49
House 3	1	5.5	6.5	20,500	49
House 4	1	5.5	6.5	24,500	49

The producer expressed interest in energy efficient lighting. This measure along with others were reviewed and those found to be cost effective can be seen in Table S.1.

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 plan. For a current listing of eligible measures, 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 plan focuses on opportunities for XXXXXXXXXX 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 are for lighting and heating.

Bottom Line: Installation of all the recommended energy efficient equipment identified will result in annual energy cost savings of approximately $7,237. This represents 27.1% of the baseline annual energy costs of $26,737.

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 less energy. Detailed explanations of energy efficiency equipment are provided later. 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	28,603	0	98	$4,542	$6,282	1.4
General Lighting	713	0	2	$113	$354	3.1
Air Heating and Building Environment	0	1,565	143	$2,582	$38,772	15.0
Totals	**29,315**	**1,565**	**243**	**$7,237**	**$45,408**	**6.3**

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 and in the appendix.
3. Totals 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)	111,795	381	29,315	100	26.2 %
Propane (gal)	5,447	497	1,565	143	28.7 %
Totals	**N/A**	**879**	**N/A**	**243**	**27.6 %**

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)**
Poultry House Lighting	98	28,652.0	0.4	0.0	61.2	24.7
Air Heating and Building Environment	143	19,561.7	1.4	0.3	0.2	20.3
General Lighting	2	713.8	0.0	0.0	1.5	0.6
Totals	**243**	**48,927.5**	**1.9**	**0.3**	**62.8**	**45.7**

Note:

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

The measures recommended 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 plan, the following terms are defined as:

1. *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.
2. *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.
3. *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. These may include aspects such as operational performance, through-put, operation and maintenance costs, labor costs, productivity, etc. These considerations are beyond the scope of this energy plan. 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 on conditions at the time of the site visit. Changes to equipment or operations following the site visit are not reflected.

Current vs. Projected Electricity Use

Figures EU.1 and EU.2 reflect electricity use from April 2015 through March 2016. During the twelve-month period evaluated, XXXXXXXXX used approximately 111,795 kilowatt-hours (kWh) of electricity. The total cost of electricity was $17,749.

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. The electricity use reduction in October and November reflects downtime between flocks.

Figure EU.1. Twelve Month Electricity Use

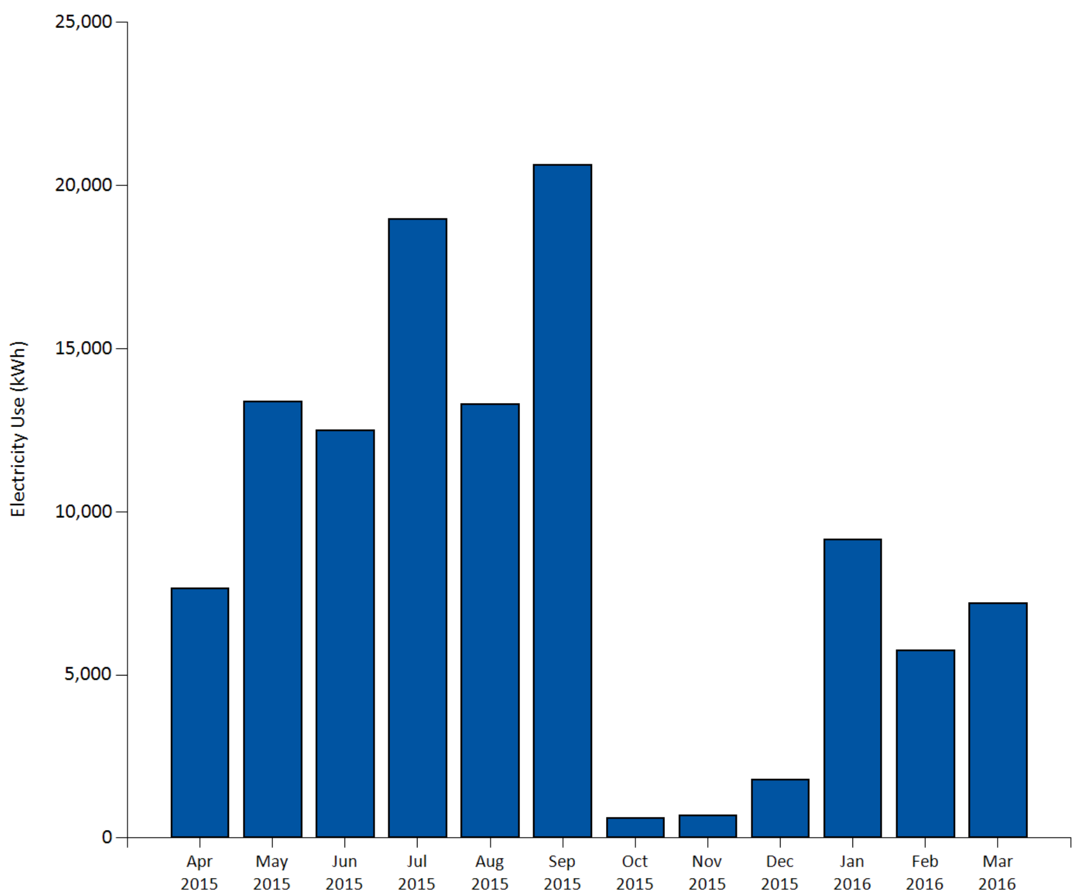


Figure EU.2 illustrates the end uses of electricity on the farm. Ventilation and poultry house lighting typically account for the largest portions of energy use. Other equipment includes feed-line motors and general lighting. Average poultry house farm miscellaneous use is 2%. Miscellaneous electrical 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.

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

Figure EU.2. Electricity Use Breakdown

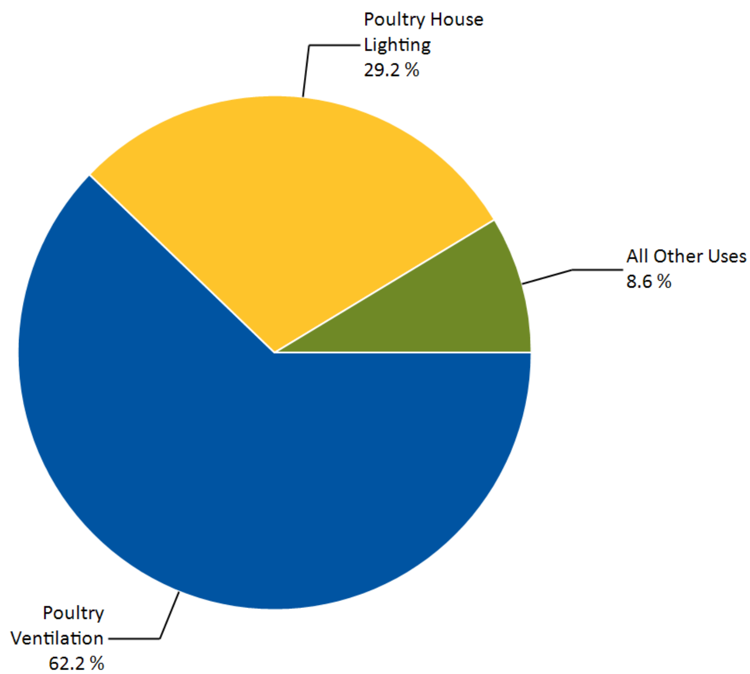
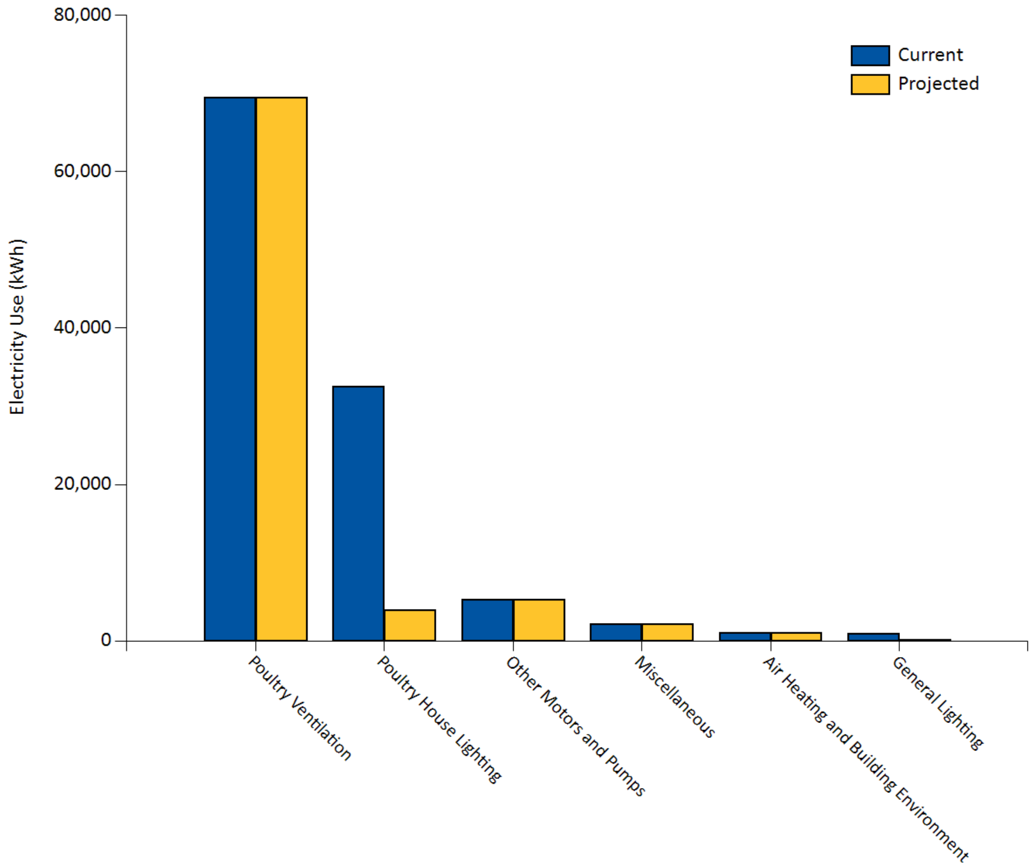


Figure EU.3 shows a comparison of the estimated current and projected energy use after the installation of all recommended measures.

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

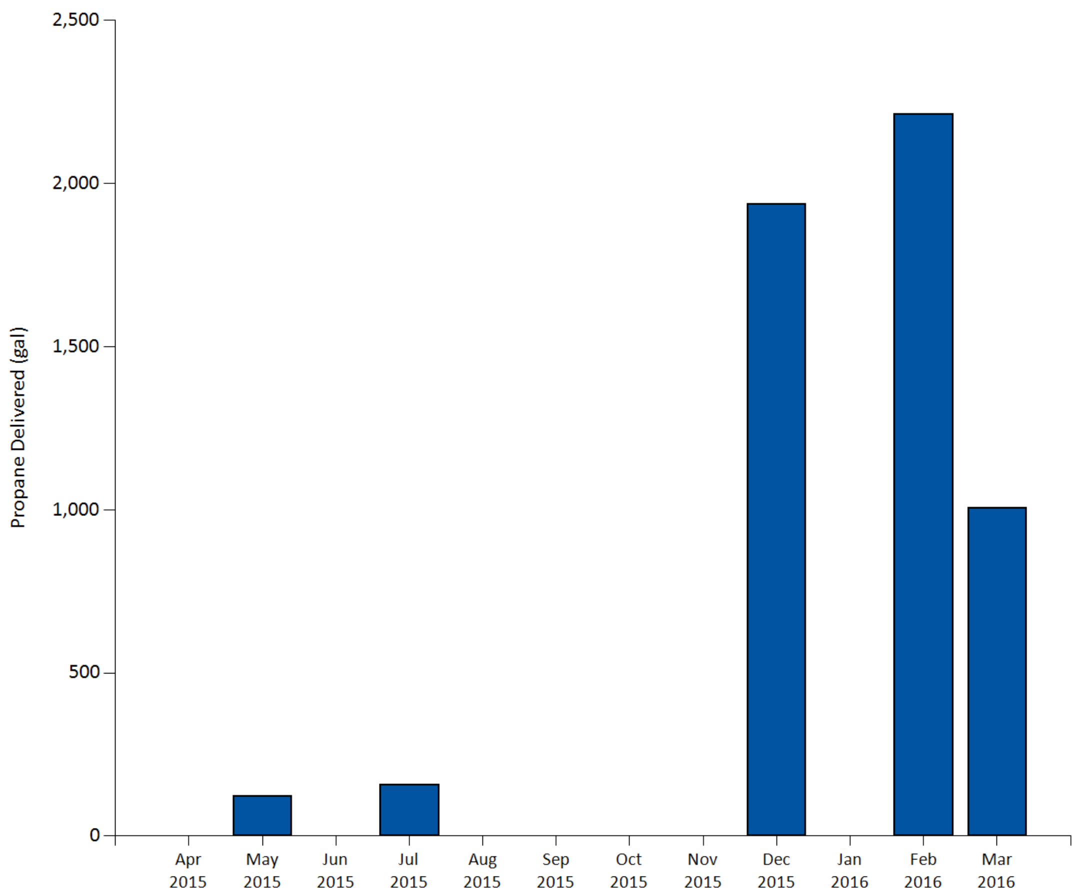


Current vs. Projected Propane Use

Figures PU.1 reflects propane use from April 2015 through March 2016. During the twelve-month period evaluated, XXXXXXXXXX used approximately 5,447 gallons (gal) of propane. The total cost of propane was $8,988.

The twelve-month history of propane deliveries is depicted in Figure PU.1. Monthly propane deliveries may not reflect actual monthly propane usage.

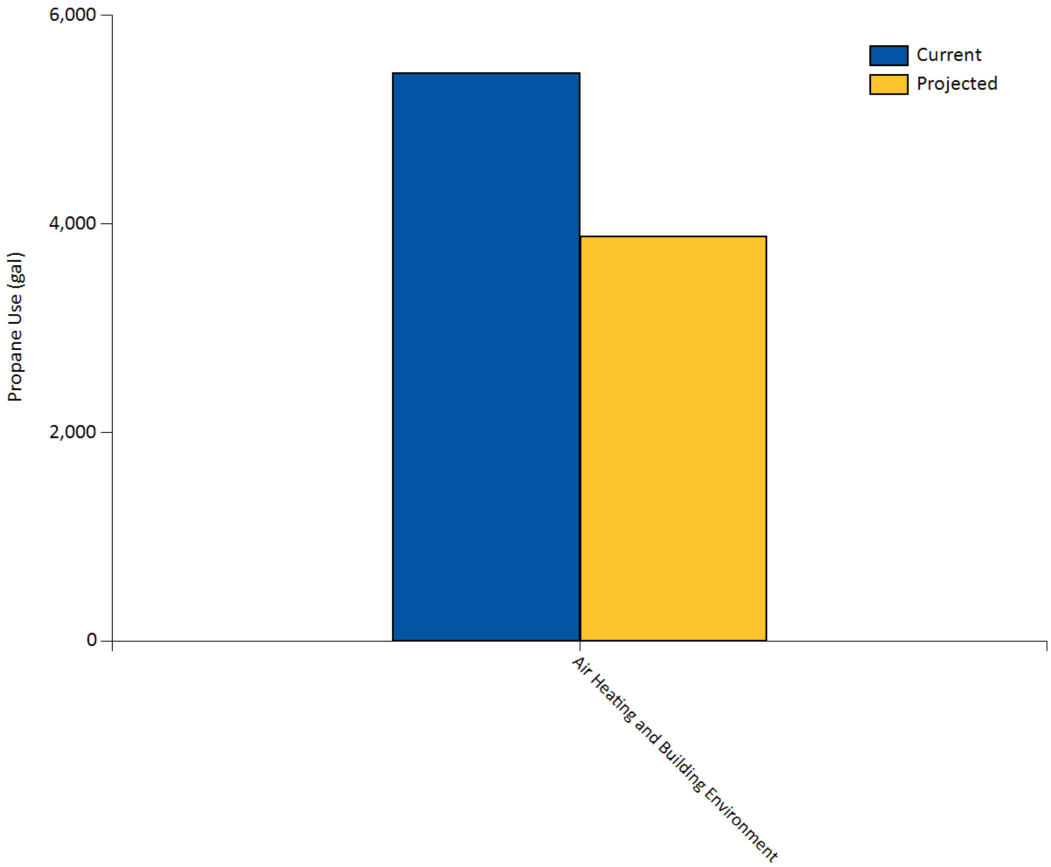
Figure PU.1. Twelve Month Propane Deliveries



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

Figure PU.2 shows a comparison of the estimated current and projected energy use after the installation of all recommended measures.

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



On-Site Energy Generation

XXXXXXXXXX currently operates one 110 kW diesel generator for back up and emergency purposes, and is only run otherwise for testing, upkeep, and maintenance. The generator serves as an emergency power supply and was not in operation for a significant period during the twelve-month period assessed. The generator was 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.

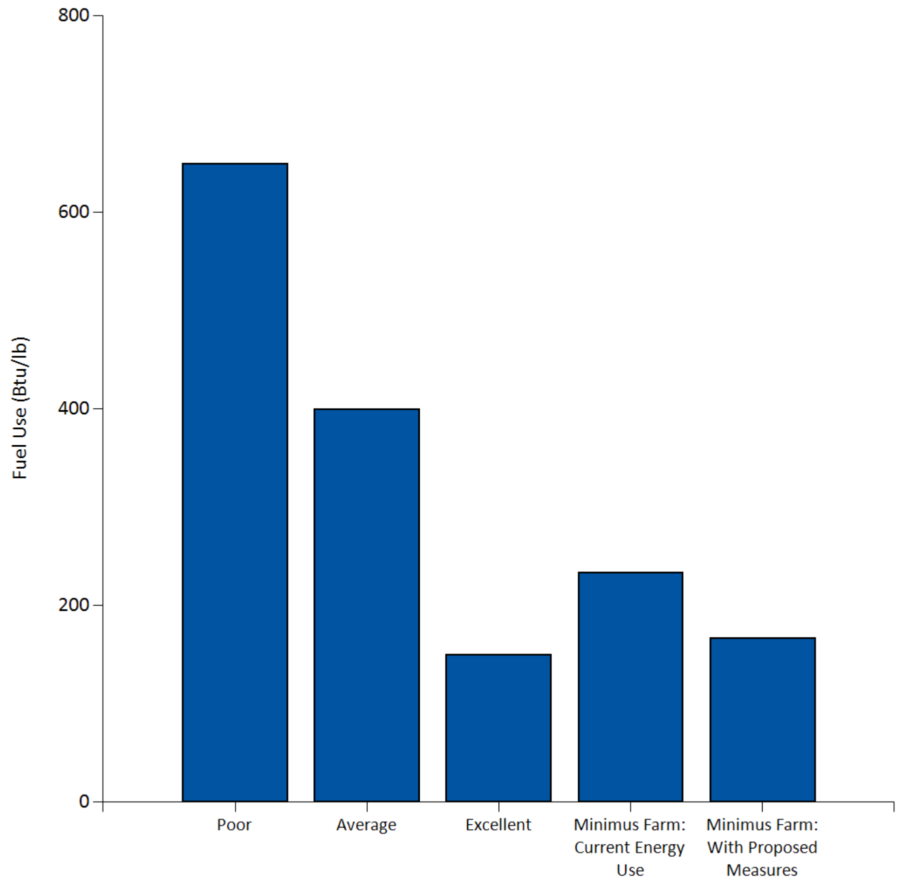
Table EGEN.1. Current Generator Inventory

Equipment Description	Manufacturer / Model	Year Installed	# Generators	Resource Type	Output (kW)
Generator	Katolight	2000	1	Diesel	110

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



XXXXXXXXXX used 5,447 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 234 Btus of energy for every pound of bird produced. This calculation does not account for bird mortality. This is a fairly low rate of propane usage.

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. Measures commonly recommended for similar producers with higher fuel use may not be cost effective for your location.

RECOMMENDATIONS

Poultry House Lighting Efficiency Recommendations

The farm is currently using:

- Twenty-two 23 watt compact fluorescent (CFL) lights and forty 75 watt incandescent lights in House 2
- Thirty-eight 23 watt CFL lights and fifty 75 watt incandescent lights in House 3
- Forty-four 23 watt CFL lights and fifty-two 75 watt incandescent lights in House 4

We recommend replacing the existing CFL and incandescent fixtures with 8 watt LED fixtures.

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:

1. Have been specifically designed for poultry houses.
2. Have a color temperature in the range of 3,500-6,400 Kelvin.
3. Have been tested by an independent third party to perform well in poultry houses.
4. Are fully dimmable.
5. Protect against the intrusion of dust and moisture.
6. Come with a warrantee (a three year warrantee is typical).
7. 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 and PL.3 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	# Bulbs / Fixture	Bulb Wattage	Light Intensity % (Dimming)	Total Fixture Wattage	Est. Annual Use (kWh)
House 2	Brood	1	1	7	24	Incandescent	14	1	75	100	75	970
House 2: Brood Only	Brood	1	1	7	24	Compact Fluorescent	22	1	23	100	23	468
House 2	Grow Out	1	8	14	20	Incandescent	24	1	75	75	75	1,040
House 2	Whole House	1	15	21	20	Incandescent	40	1	75	75	75	1,733
House 2	Whole House	1	22	46	20	Incandescent	40	1	75	50	75	4,125
House 2	Whole House	1	47	49	24	Incandescent	40	1	75	50	75	594
House 3	Brood	1	1	7	24	Incandescent	16	1	75	100	75	1,109
House 3: Brood Only	Brood	1	1	7	24	Compact Fluorescent	38	1	23	100	23	808
House 3	Grow Out	1	8	14	20	Incandescent	32	1	75	75	75	1,386
House 3	Whole House	1	15	21	20	Incandescent	50	1	75	75	75	2,166
House 3	Whole House	1	22	46	20	Incandescent	50	1	75	50	75	5,156
House 3	Whole House	1	47	49	24	Incandescent	50	1	75	50	75	743
House 4	Brood	1	1	7	24	Incandescent	22	1	75	100	75	1,525
House 4: Brood Only	Brood	1	1	7	24	Compact Fluorescent	44	1	23	100	23	935
House 4	Grow Out	1	8	14	20	Incandescent	34	1	75	75	75	1,473
House 4	Whole House	1	15	21	20	Incandescent	52	1	75	75	75	2,252
House 4	Whole House	1	22	46	20	Incandescent	52	1	75	50	75	5,363
House 4	Whole House	1	47	49	24	Incandescent	52	1	75	50	75	772

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

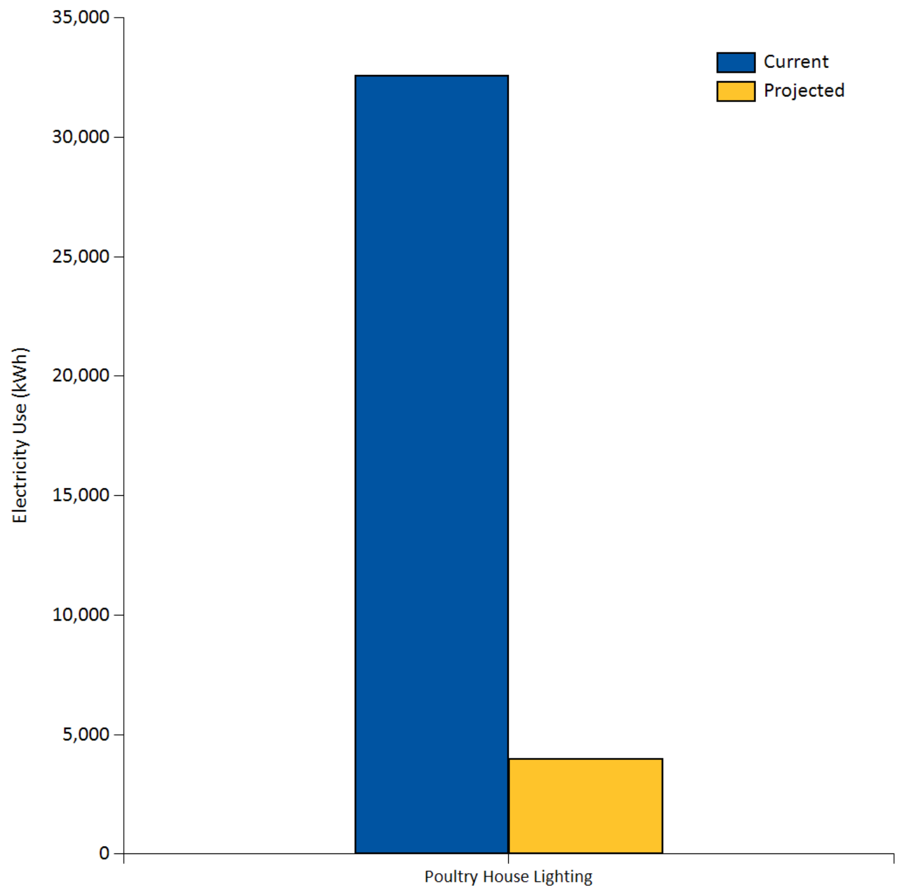


Table PL.3. Poultry House Lighting: Recommended Energy Saving Equipment

Location	Current Equipment	Recommended Equipment	# to Install	Est. Annual Electricity Savings (kWh)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
House 3	75W Incandescent (75 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts) with Dimmer Controls	50	9,433	$1,498	$1,390	0.9	10.0
House 4	75W Incandescent (75 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts) with Dimmer Controls	52	10,170	$1,615	$1,434	0.9	10.0
House 2	75W Incandescent (75 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts) with Dimmer Controls	40	7,559	$1,200	$1,170	1.0	10.0
House 3: Brood Only	23W Compact Fluorescent (23 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts)	38	527	$84	$836	10.0	10.0
House 2: Brood Only	23W Compact Fluorescent (23 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts)	22	305	$48	$484	10.0	10.0
House 4: Brood Only	23W Compact Fluorescent (23 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts)	44	610	$97	$968	10.0	10.0
Totals				**28,603**	**$4,542**	**$6,282**	**1.4**	

General Lighting Efficiency Recommendations

Table L.1 contains the current lighting inventory.

Table L.1. Current Lighting Inventory

Location / Equipment Description	# Fixtures	Fixture Type	# Bulbs / Fixture	Bulb Wattage	Annual Run Hours	Total Fixture Wattage	Est. Annual Use (kWh)
House 2 Security Light	1	High Pressure Sodium	1	150	4,368	188	821
Control Room Lights	6	Incandescent	1	75	273	75	123

XXXXXXXXX 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 high pressure sodium and incandescent fixtures with LEDs. 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.

An average light efficacy of 100 lumens/watt is used 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 to meet the estimated energy savings within this evaluation.

Most LED fixtures are dust and moisture resistant, and there is generally no need to enclose them in vapor proof enclosures. The dust and moisture resistance of the 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 energy use. Table L.3 provides economic details.

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

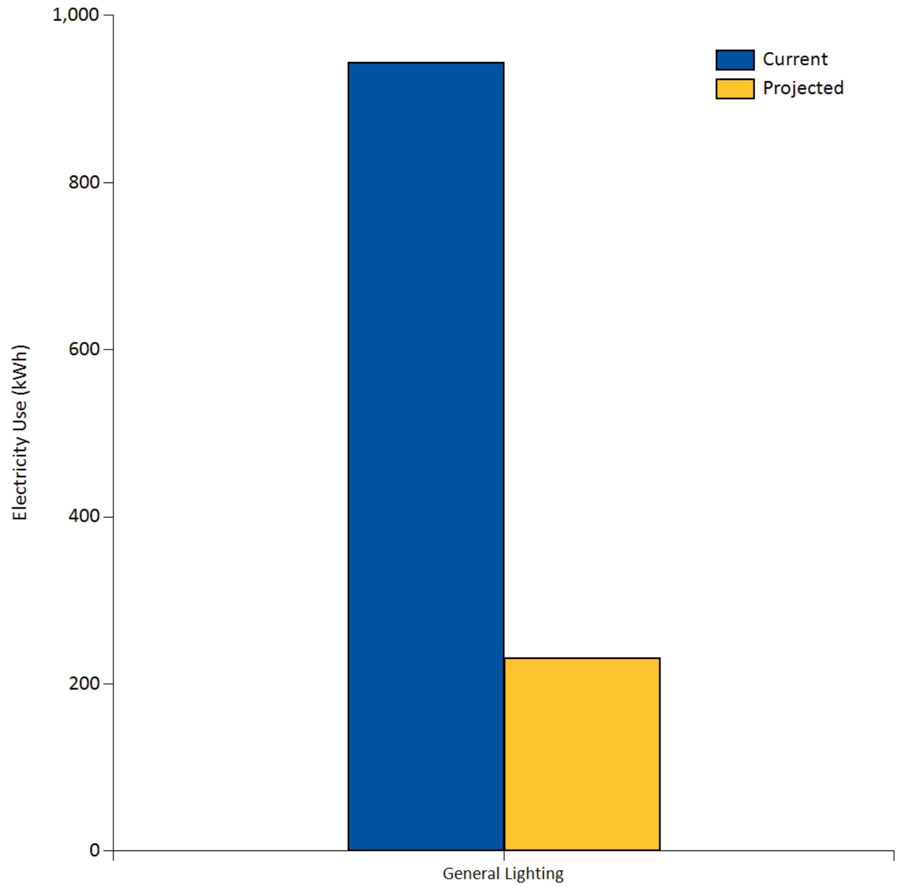


Table L.3. General Lighting: Recommended Energy Saving Equipment

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)
House 2 Security Light	150W High Pressure Sodium (188 Total Input Watts)	50W Light Emitting Diode (50 Total Input Watts)	1	603	$96	$240	2.5	10.0
Control Room Lights	75W Incandescent (75 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts)	6	110	$17	$114	6.5	10.0
Totals				**713**	**$113**	**$354**	**3.1**	

The lighting recommendations and considerations 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 application. If you decide to pursue a different lighting type, we can evaluate the energy and cost savings of the alternative.

Fluorescent lights are regulated under the Resource Conservation and Recovery Act. It is illegal to dispose of these lights in the trash. Please contact your local waste district regarding the proper disposal of fluorescent lamps. Additional information is provided in the Resources section.

Air Heating and Building Environment Recommendations

The farm has 3 broiler houses. The houses are described in Table H.1. The heating equipment is described in Table H.2. Table H.3 lists the wall and ceiling R-values. Table HS.2 provides a summary of the recommended air heating and building environment recommendations.

Table H.1. House Group Summary

House Group	# Houses	Dimensions (ft)	Age (Years)	Sidewall Type	Ceiling Type	Tunnel Ventilated
House 2	1	360 x 35	36	Solid	Dropped	Yes
House 3	1	450 x 36	31	Solid	Dropped	Yes
House 4	1	500 x 40	26	Solid	Dropped	Yes

Table H.2. Heater Inventory

House Group	Description	Manufacturer / Model	Year Installed	# Heaters (All Houses)	Heater Type	Ignition Type	Input Rating (Btu/Hour)	Output Rating (Btu/Hour)
House 2	Brood Chamber Heaters	Radiant/EZ-100-40	2010	3	Radiant Tube	Electronic	100,000	100,000
House 2	Grow Out Chambers	LB White/AW250	2010	4	Forced Hot Air	Electronic	250,000	250,000
House 3	Brood Chamber Heaters	Radiant/EZ-100-40	2010	3	Radiant Tube	Electronic	100,000	100,000
House 3	Grow Out Chambers	LB White/AW250	2010	4	Forced Hot Air	Electronic	250,000	250,000
House 4	Brood Chamber Heaters	Radiant/EZ-100-40	2010	3	Radiant Tube	Electronic	100,000	100,000
House 4	Grow Out Chambers	LB White/AW250	2010	4	Forced Hot Air	Electronic	250,000	250,000

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
House 2	11.99	1.8	11.99	1	6.4
House 3	11.99	1.8	11.99	1	6.4
House 4	11.99	1.8	11.99	1	12.8

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. An 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.

Renovate Houses from Curtain to Insulated Solid Side Walls

The farm is currently equipped with solid sidewalls.

House 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 2-3.

Adding insulation to the ceiling of House 4 is not recommended 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.

House 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 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 2-4. The exposed, above ground, uninsulated foundation walls can be a major source of heat loss for these houses. Installing one inch of spray polyurethane insulation over the exposed wall would increase the insulation value to approximately R-7. A layer of high density (6 lb. or greater) foam is typically applied to protect the insulation from pecking.

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.

The poultry houses on the farm are well-sealed, therefore there are no recommendations to seal air leaks in the houses.

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 do not recommend replacing the existing brood curtains in the poultry houses with insulated brood curtains due to long payback period.

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.

The farm currently has four 18” cage stir fans in each house. The existing amount of stir fans is adequate, and there are no recommendations to install additional stir fans.

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 a combination of radiant tube heaters and forced hot air heaters.

We recommend replacing the forced hot air heaters in Houses 2-4 with radiant tube heaters. The total rated output capacity in BTU/Hour is listed in the table of recommendations. This represents the current capacity of existing heaters that are proposed for replacement with radiant heaters. The total rated output capacity for the replacement heaters should approximately match that of the existing heaters being replaced. Different heater types have different ratings which will determine approximate quantity of replacement heaters needed. Consult your equipment supplier, installer and/or integrator to assure all other considerations for heating are met. These may include proper coverage for all areas of house, control systems, etc.

For more information on radiant heaters, see the attached resource, *Radiant Heaters*, published by EnSave.

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.

Installing insulated tunnel doors is not recommended due to the long payback period.

Insulated End Doors

Installing sealed and insulated end wall doors will provide valuable energy and cost savings. However, in this case installing insulated end doors is not recommended due to the long payback period.

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.

We do not recommend installing attic inlets due to the long payback period.

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 show a comparison of the estimated current and projected energy use after the installation of the recommended measures. Table HS.3 lists equipment options that were evaluated but not recommended.

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

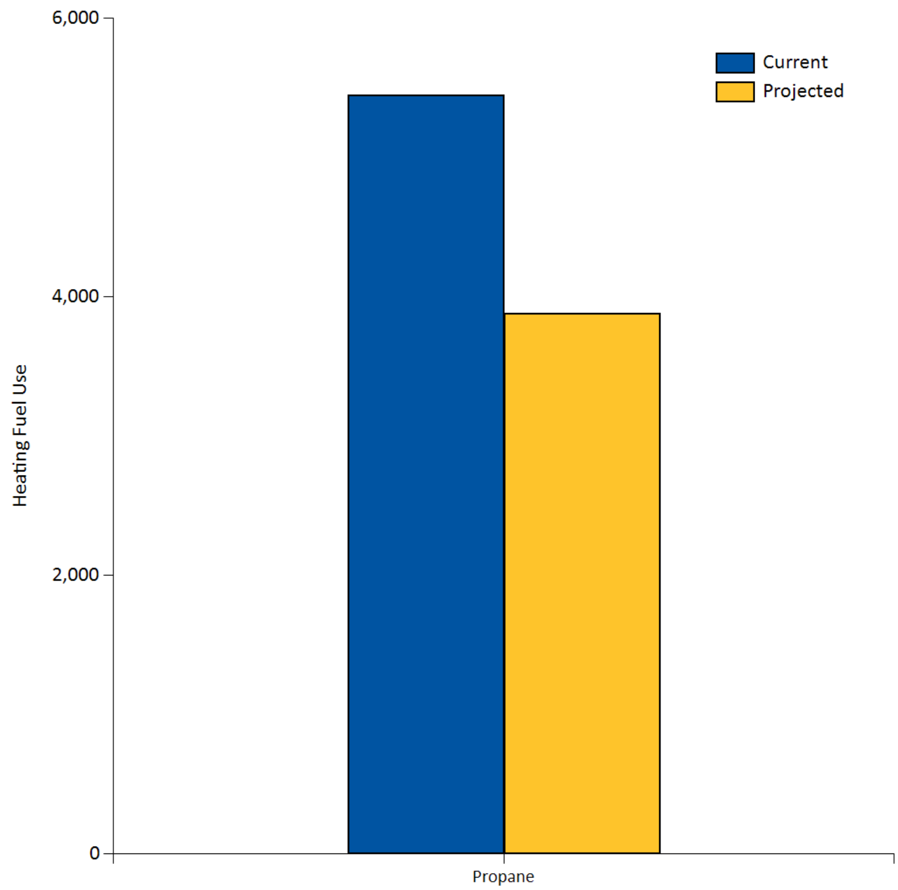


Table HS.2. Air Heating and Building Environment: Recommended Energy Saving Equipment

Location / Equipment Description	Current Equipment	Recommended Equipment	Est. Annual Propane Savings (gal)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
House 3: Ceiling One	1 house with 16,300 ft² per house of blown fiberglass.	Install 16,300 ft² per house of blown insulation in 1 house.	384	$634	$8,150	12.9	20.0
House 2: Ceiling One	1 house with 12,682 ft² per house of blown fiberglass.	Install 12,682 ft² per house of blown insulation in 1 house.	299	$493	$6,341	12.9	20.0
House 2: Heaters	1 house not fully heated with radiant heaters.	Replace 1,000,000 output Btu / hour per house in 1 house of non-radiant heaters with radiant tube heaters with electronic ignition.	175	$288	$4,362	15.1	20.0
House 3: Heaters	1 house not fully heated with radiant heaters.	Replace 1,000,000 output Btu / hour per house in 1 house of non-radiant heaters with radiant tube heaters with electronic ignition.	225	$371	$5,608	15.1	20.0
House 2: Exposed Foundation Walls	1 house with 790 ft² per house of concrete block 6".	Install 790 ft² per house of 1-in. polyurethane high-density foam in 1 house.	70	$116	$2,054	17.7	20.0
House 3: Exposed Foundation Walls	1 house with 972 ft² per house of concrete block 6".	Install 972 ft² per house of 1-in. polyurethane high-density foam in 1 house.	87	$143	$2,527	17.7	20.0
House 4: Exposed Foundation Walls	1 house with 1,080 ft² per house of concrete block 6".	Install 1,080 ft² per house of 1-in. polyurethane high-density foam in 1 house.	96	$159	$2,808	17.7	20.0
House 4: Heaters	1 house not fully heated with radiant heaters.	Replace 1,000,000 output Btu / hour per house in 1 house of non-radiant heaters with radiant tube heaters with electronic ignition.	229	$378	$6,923	18.3	20.0
Totals			**1,565**	**$2,582**	**$38,772**	**15.0**	

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

Location / Equipment Description	Current Equipment	Considered Equipment	Est. Annual Propane Savings (gal)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
House 3: Brood Curtains	1 house with 2 uninsulated brood curtains.	Install 2 insulated brood curtains (approximately 648 ft² per house) in 1 house.	41	$67	$842	12.5	10.0
House 2: Brood Curtains	1 house with 2 uninsulated brood curtains.	Install 2 insulated brood curtains (approximately 700 ft² per house) in 1 house.	44	$73	$910	12.5	10.0
House 4: Brood Curtains	1 house with 2 uninsulated brood curtains.	Install 2 insulated brood curtains (approximately 720 ft² per house) in 1 house.	45	$75	$936	12.5	10.0
House 4: Attic Inlets	1 house with 0 attic inlets per house.	Install 15 attic inlets per house in 1 house.	99	$163	$2,400	14.7	10.0
House 3: Attic Inlets	1 house with 0 attic inlets per house.	Install 13 attic inlets per house in 1 house.	83	$136	$2,080	15.2	10.0

Location / Equipment Description	Current Equipment	Considered Equipment	Est. Annual Propane Savings (gal)	Est. Annual Cost Savings ($)	Est. Implementation Cost ($)	Est. Payback (Years)	EUL (Years)
House 2: Attic Inlets	1 house with 0 attic inlets per house.	Install 10 attic inlets per house in 1 house.	58	$97	$1,600	16.6	10.0
House 2: Tunnel Intake Doors	1 house with 2 uninsulated tunnel intake curtains.	Install 2 new insulated tunnel intake doors (approximately 600 ft² per house) in 1 house.	106	$175	$4,200	24.0	20.0
House 4: Tunnel Intake Doors	1 house with 2 uninsulated tunnel intake curtains.	Install 2 new insulated tunnel intake doors (approximately 750 ft² per house) in 1 house.	132	$218	$5,250	24.0	20.0
House 3: Tunnel Intake Doors	1 house with 2 uninsulated tunnel intake curtains.	Install 2 new insulated tunnel intake doors (approximately 650 ft² per house) in 1 house.	115	$189	$4,550	24.0	20.0
House 4: Ceiling One	1 house with 20,100 ft² per house of blown fiberglass.	Install 20,100 ft² per house of blown insulation in 1 house.	189	$312	$10,050	32.2	20.0
House 3: End Wall Doors	1 house with 2 metal, uninsulated doors.	Install 2 well insulated end wall doors (approximately 86 ft² per house) in 1 house.	14	$24	$948	39.7	20.0
House 2: End Wall Doors	1 house with 2 metal, uninsulated doors.	Install 2 well insulated end wall doors (approximately 88 ft² per house) in 1 house.	15	$24	$963	39.7	20.0
House 4: End Wall Doors	1 house with 2 metal, uninsulated doors.	Install 2 well insulated end wall doors (approximately 96 ft² per house) in 1 house.	16	$27	$1,056	39.7	20.0
House 4: Sidewalls	1 house with 6,250 ft² per house of fiberglass batting.	Install 6,250 ft² per house of 1-in. polyurethane foam in 1 house.	39	$64	$8,125	127	20.0
House 4: End Walls	1 house with 544 ft² per house of fiberglass batting.	Install 544 ft² per house of 1-in. polyurethane foam in 1 house.	3	$6	$707	127	20.0
House 3: End Walls	1 house with 490 ft² per house of fiberglass batting.	Install 490 ft² per house of 1-in. polyurethane foam in 1 house.	3	$5	$637	127	20.0
House 2: Sidewalls	1 house with 5,160 ft² per house of fiberglass batting.	Install 5,160 ft² per house of 1-in. polyurethane foam in 1 house.	32	$53	$6,708	127	20.0
House 2: End Walls	1 house with 543 ft² per house of fiberglass batting.	Install 543 ft² per house of 1-in. polyurethane foam in 1 house.	3	$6	$705	127	20.0
House 3: Sidewalls	1 house with 5,650 ft² per house of fiberglass batting.	Install 5,650 ft² per house of 1-in. polyurethane foam in 1 house.	35	$58	$7,345	127	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	Fan Manufacturer	Fan Model	Year Installed	Total # Fans	Diameter (in)	Location	Staging	Run Hours	Airflow (cfm)	VER (cfm / Watt)	Est. Annual Use (kWh)
House 2-4	Hired-Hand	6603-7060	2010	9	50 - 53in.	Tunnel	Stage I	3,314	25,900	20.0	38,620
House 2-4	Hired-Hand	6603-7060	2010	6	50 - 53in.	Tunnel	Stage II	1,988	25,900	20.0	15,448
House 2-4	Hired-Hand	6603-7060	2010	6	50 - 53in.	Tunnel	Stage III	663	25,900	20.0	5,149
House 2-4	Airstream	CGBD3614	1980	12	36in.	Sidewall	Stage III	1,322	8,050	12.4	10,299

We do not recommend replacing the 36" ventilation fans due to the long payback period. The 50" tunnel fans are the most efficient fans available in their airflow range, and there are no recommendations to replace these fans.

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:

1. 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.
2. 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.
3. 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.
4. Install fan covers over unused fans during the heating season.
5. 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)
House 2-4	36in. Exhaust Fan (8,050 cfm, 12.4 cfm / Watt), running 1,322 Hours / Year	36in. Exhaust Fan (9,470 cfm, 19.3 cfm / Watt)	12	2,515	$399	$10,800	27.0	15.0
House 2-4	50 - 53in. Exhaust Fan (25,900 cfm, 20.0 cfm / Watt), running 1,988 Hours / Year	No Recommendation	6	0	$0	$0	N/A	15.0
House 2-4	50 - 53in. Exhaust Fan (25,900 cfm, 20.0 cfm / Watt), running 663 Hours / Year	No Recommendation	6	0	$0	$0	N/A	15.0
House 2-4	50 - 53in. Exhaust Fan (25,900 cfm, 20.0 cfm / Watt), running 3,314 Hours / Year	No Recommendation	9	0	$0	$0	N/A	15.0

Note: The tunnel fans are considered efficient, and there are no recommendations to replace these fans.

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 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.

Table M.1. Current Motor Inventory

Equipment Description	Manufacturer / Model	Year Installed	# Motors	Motor HP	RPM Rating	Casing Type	VFD?	Annual Run Hours	Motor Estimated Annual Electricity Use (kWh)
House 2 & 3: Cross Auger Motor	Dayton/6K719Q	N/A	2	0.75	1500 - 2700	N/A	No	560	651
House 2, 3 & 4: Feed Line Motors	GE/C63BXGJH-4538	N/A	8	0.75	1500 - 2700	N/A	No	560	2,604
House 4: Cross Auger Motor	Dayton/6K714J	N/A	1	0.5	1500 - 2700	N/A	No	560	233
Well Pump Motor	Not accessible	N/A	1	1	N/A	N/A	No	1,680	1,291
Cool Pad Recirculating Pump Motor	Little Giant/9EH-CIM	N/A	6	0.33	N/A	N/A	No	336	582

Feed line, cross auger, and cool pad recirculating pump motors were not evaluated for replacement because NEMA currently does not evaluate motors less than 1 horsepower (hp), so no motor recommendations can be made for these motors.

The submersible well pump motor was also not evaluated for replacement because there are currently no standards for energy efficiency.

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.

Always replace a burned-out motor with the most energy efficient motor available. We recommend 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.

Water Management
The water source used for agricultural purposes is a well. Electric motors used for water management are listed in the *Other Motors and Pumps* section. NEMA Premium efficiency standards do not apply to submersible electric motors and thus there are no efficiency recommendations for these pumps.

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.

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:

1. 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.
2. Most of these motors are small, 3/4 hp or 1 hp, and do not use 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 use 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 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 pad systems.

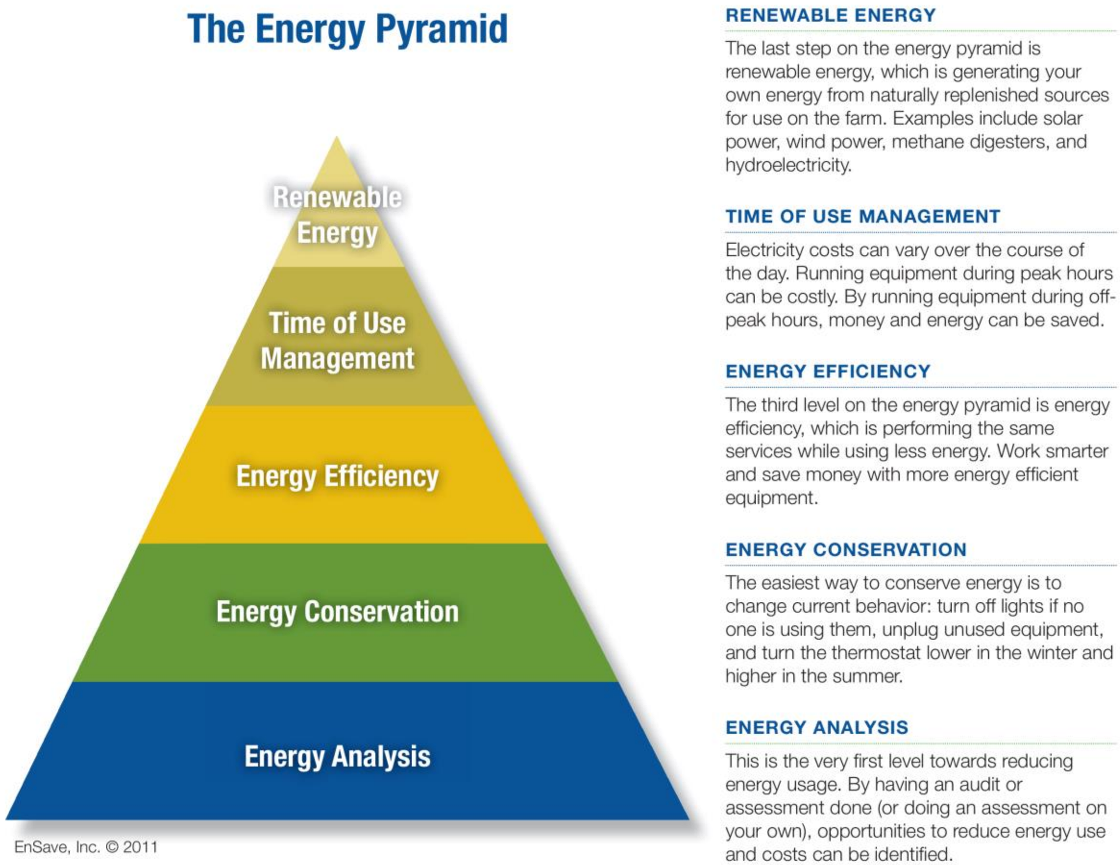
Vent Box Doors

Although installation or replacement of vent doors or insulation may benefit productivity by helping to maintain the proper static pressure and airflow in the houses, it will not benefit energy consumption. For this reason, replacing or installing vent doors or insulation on the vent doors is not analyzed in the energy audit.

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 guide that serves as a road map to help farms improve their efficiency and reduce their dependence on purchased energy.

The next step for the farm would be to implement the energy efficiency measures recommended.

STATEMENTS AND DISCLAIMERS

Liability

The intent of this energy evaluation is to estimate energy savings associated with recommended energy conservation measures at Minimus Farm. This plan is not intended to serve as a detailed engineering design document. Detailed design efforts may be required to implement several of the improvements evaluated. 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 on information gathered during the process of developing this energy plan. 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.

EnSave, Inc. is not liable if projected energy or cost savings are not actually achieved. All savings and cost estimates are for informational purposes and are not to be construed as a design document or as guarantees. XXXXXXXXXXX shall independently evaluate any advice or direction provided. EnSave, Inc. will not 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 plan or the installation of recommended measures.

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 are intended as illustrations only.

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

This report was developed by EnSave using FEAT™ software, a product of EnSave.

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. *Efficient LED Lighting*, published by EnSave, Inc.

4. *Exterior LED lighting,* published by EnSave, Inc.

5. *Radiant Heaters*, published by EnSave, Inc.

6. *Tunnel Ventilation Fans*, published by EnSave, Inc.

7. *Ventilation Fan Simple Payback Calculator work sheet,* published by EnSave, Inc.

8. *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. MD NRCS Environmental Quality Incentives Program, https://www.nrcs.usda.gov/wps/portal/nrcs/main/md/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. AgroClimate Tool, http://agroclimate.org/tools.php

Appendix A: Detail Listing of Estimated Annual Energy Efficiency Improvements

Table A.1 provides 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".

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

											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)
House 4	75W Incandescent (75 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts) with Dimmer Controls	52	10,170	0	35	$1,434	$1,615	0.9	10.0	10,187.4	0.2	0.0	21.7	8.8
House 3	75W Incandescent (75 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts) with Dimmer Controls	50	9,433	0	32	$1,390	$1,498	0.9	10.0	9,449.1	0.1	0.0	20.2	8.1
House 2	75W Incandescent (75 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts) with Dimmer Controls	40	7,559	0	26	$1,170	$1,200	1.0	10.0	7,571.7	0.1	0.0	16.2	6.5
House 2 Security Light	150W High Pressure Sodium (188 Total Input Watts)	50W Light Emitting Diode (50 Total Input Watts)	1	603	0	2	$240	$96	2.5	10.0	603.8	0.0	0.0	1.3	0.5
Control Room Lights	75W Incandescent (75 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts)	6	110	0	0	$114	$17	6.5	10.0	109.9	0.0	0.0	0.2	0.1
House 2: Brood Only	23W Compact Fluorescent (23 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts)	22	305	0	1	$484	$48	10.0	10.0	305.4	0.0	0.0	0.7	0.3

											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)
House 4: Brood Only	23W Compact Fluorescent (23 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts)	44	610	0	2	$968	$97	10.0	10.0	610.9	0.0	0.0	1.3	0.5
House 3: Brood Only	23W Compact Fluorescent (23 Total Input Watts)	8W Light Emitting Diode (8 Total Input Watts)	38	527	0	2	$836	$84	10.0	10.0	527.6	0.0	0.0	1.1	0.5
House 2: Ceiling One	1 house with 12,682 ft² per house of blown fiberglass.	Install 12,682 ft² per house of blown insulation in 1 house.	N/A	0	299	27	$6,341	$493	12.9	20.0	3,736.7	0.3	0.1	0.0	3.9
House 3: Ceiling One	1 house with 16,300 ft² per house of blown fiberglass.	Install 16,300 ft² per house of blown insulation in 1 house.	N/A	0	384	35	$8,150	$634	12.9	20.0	4,802.6	0.3	0.1	0.0	5.0
House 3: Heaters	1 house not fully heated with radiant heaters.	Replace 1,000,000 output Btu / hour per house in 1 house of non-radiant heaters with radiant tube heaters with electronic ignition.	N/A	0	225	21	$5,608	$371	15.1	20.0	2,811.7	0.2	0.0	0.0	2.9
House 2: Heaters	1 house not fully heated with radiant heaters.	Replace 1,000,000 output Btu / hour per house in 1 house of non-	N/A	0	175	16	$4,362	$288	15.1	20.0	2,183.0	0.2	0.0	0.0	2.3

											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)**
		radiant heaters with radiant tube heaters with electronic ignition.													
House 4: Exposed Foundation Walls	1 house with 1,080 ft² per house of concrete block 6".	Install 1,080 ft² per house of 1-in. polyurethane high-density foam in 1 house.	N/A	0	96	9	$2,808	$159	17.7	20.0	1,203.2	0.1	0.0	0.0	1.3
House 3: Exposed Foundation Walls	1 house with 972 ft² per house of concrete block 6".	Install 972 ft² per house of 1-in. polyurethane high-density foam in 1 house.	N/A	0	87	8	$2,527	$143	17.7	20.0	1,082.9	0.1	0.0	0.0	1.1
House 2: Exposed Foundation Walls	1 house with 790 ft² per house of concrete block 6".	Install 790 ft² per house of 1-in. polyurethane high-density foam in 1 house.	N/A	0	70	6	$2,054	$116	17.7	20.0	880.1	0.1	0.0	0.0	0.9
House 4: Heaters	1 house not fully heated with radiant heaters.	Replace 1,000,000 output Btu / hour per house in 1 house of non-radiant heaters with radiant tube heaters with electronic ignition.	N/A	0	229	21	$6,923	$378	18.3	20.0	2,861.5	0.2	0.0	0.0	3.0
Totals				**29,317**	**1,565**	**243**	**$45,409**	**$7,237**	**6.3**	**N/A**	**48,927.5**	**1.9**	**0.2**	**62.7**	**45.7**