Field Demonstration of Advanced Lighting Technologies for Poultry Houses
Phase 1 Summary Report

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The University of Arkansas's System's Division of Agriculture's Poultry Science Department and the Arkansas Resource Conservation District Council were awarded through the Arkansas Energy Office a grant funded by the American Recovery and Reinvestment Act under Department of Energy award DE-EE0000179 to implement and demonstrate innovative energy efficient lighting in tunnel ventilated broiler barns. The primary goal of this project was to demonstrate how the existing technology of incandescent bulbs, cold cathodes (CC) and dimmable compact fluorescents (CF) could be replaced by light emitting diode (LED) technology without impairing bird performance while at the same time providing growers with energy savings and a durable, long-lasting light source which could reduce the labor associated with replacing bulbs. Phase I of the grant began by identifying participant farms where one of the six energy efficient light bulb technologies would be installed as grow-out bulbs. The criteria for farm selection focused primarily on the following:

1. Targeting four house farms which are tunnel ventilated facilities with dark out walls
   (Either solid side wall or dark out curtains)
2. Currently using incandescent bulbs
3. Farm owners/managers must be willing to share the following information:
   a. Previous two-year electrical usage, kilowatt hours and kilowatt/hour costs so that a historical energy usage baseline can be established.
   b. Electrical usage information for up to two years once energy efficient lights are installed.
   c. General information on bird production history/settlement so that bird performance can be correlated to lighting source.
   d. Feedback on bulbs such any issues with bulb life span.
   e. Lighting measurements to be made periodically by Poultry Science personnel so that light intensity and lamp lumen depreciation can be monitored.

Background

The tunnel ventilated poultry house was chosen for the lighting demonstration because this type of house has either solid side walls or dark/black plastic curtains which are never lowered. Therefore, artificial lighting is required throughout the flock life. This type of poultry barn has greatly enhanced the rearing environment for modern strains of meat birds, and the higher insulation, (R-value) in walls and ceilings makes the barns more efficient to heat and cool. However, the loss of natural lighting significantly increased electrical usage associated with lighting. The tunnel ventilated poultry barn requires two types of lighting: brood and grow. Brood lights are not dimmed and are only used during the first week of broiler rearing. They are usually on for 23 hours per day the first four days and then may be on for 18 to 20 hours for the last half of the brood period. The brood lights are important because they provide optimum foot candles of light (more than two foot candles at bird height) to assure the chicks find food, water and warmth, hence beginning life well. The grow-out lighting is often used along with the brood lights during brood and then as the single light source during the grow-out period which can range from four to eight weeks, depending on the target market weight. At approximately 10 days of age, the grow lights are dimmed to provide less than one foot candle of light with 0.10 to 0.5 foot candles being the most common. This helps keep the birds calm so that growth, livability and feed efficiency are maximized. During the grow-out phase, there are varying amounts of dark periods given each 24-hour cycle depending on such factors as strain of birds and market weight. On average, lights can be on 50 to 85 percent of the time. Bottom line: lighting plays an important role in broiler production. Modern rearing conditions have resulted in lighting being a significant cost for poultry producers. However, energy efficient lighting technology needs to not only lower electrical costs, but grow-out lighting alternatives need to be dimmable and support good bird performance while withstanding the conditions encountered in poultry barns. Since lighting can have a tremendous impact on flock performance and hence a poultry producer's income, no technology was included in this demonstration which had not already been evaluated at the University of Arkansas System's Division of Agriculture Poultry Science Department Applied Broiler Research Farm (ABRF) and shown that bird performance was not impaired and that energy savings were significant.

Switching to energy-efficient bulbs has dramatically cut energy usage and costs associated with lighting at the ABRF. Immediately after farm renovation (April through November 2006) when all four houses were using 60- and 75-watt incandescent bulbs, kilowatt hour usage for lights on the farm averaged 9,432 hours at a cost of $660 per flock over a four-flock period.

From February through August 2008, with houses 1 and 2 using 23-watt dimmable fluorescent bulbs and houses 3 and 4 using a combination of 15- and 30-watt fluorescent brood lights and 8-watt cold cathode grow lights, kilowatt hour usage on the farm for lights averaged 1,996 hours at a cost of $140 for a three-flock period. Thus, savings after switching to energy-efficient lighting have averaged 7,436 kilowatt hours and $520 per flock at the ABRF.

Introduction to Demonstration Technology

Six types of bulbs were available for grow-out lights with each bulb being supplied to three farms. Three of the light bulb technologies are currently used in the poultry industry as the best energy efficient alternative for incandescent bulbs. These include two cold cathode bulbs with different Kelvin ratings (measurement of light spectrum) and a dimmable compact fluorescent bulb. The remaining three bulbs were all new LED technologies specially designed for poultry house applications. All farms were given the option of either a 23- or 26-watt non-dimmable compact fluorescent (23 W CF or 26 W CF) for brood lights which had a minimum of 1700 lumens. The grow-out bulb options demonstrated were:

A. Cold Cathode Fluorescent Light bulb (CC-2700)

- 8 Watt
- 2700 Kelvin
- Clear bulb
- Dimmable
- 325 lumens, minimum
- Base – Must meet ANSI C78.21-2003 for use in standard E26 sockets
- Precision Lighting was awarded the bid, the bulb is referred to in this document as CC-2700

B. Cold Cathode Fluorescent Light bulb (CC-4100)

- 8 Watt
- 4000 Kelvin
- Frosted bulb
- 325 lumens, minimum
- Base – Must meet ANSI C78.21-2003 for use in standard E26 sockets
- Precision Lighting was awarded the bid, the bulb is referred to in this document as CC-4100

C. LED bulb (LV LED)

- PAR- 38 (Parabolic aluminized reflector)
- 6.5 Watts, minimum

- 600 lumens, minimum
- 6,000 Kelvin
- Full range dimming capabilities and compatible with a range of dimmers currently used in the poultry industry
- 160° degree output angle distribution, minimum
- Base – Must meet ANSI C78.21-2003 for use in standard E26 sockets
- 3 year warranty
- Bid was awarded to Luma Vue, Inc., the bulb is referred to in this document as LV LED

D. LED bulb (PS LED)

- PAR-30
- 10 Watts, minimum
- 400 lumens, minimum
- 6,000 Kelvin
- Full range dimming capabilities and compatible with a range of dimmers currently used in the poultry industry
- 140° degree output angle distribution, minimum
- Base – Must meet ANSI C78.21-2003 for use in standard E26 sockets
- 3 year warranty
- Efficient Lights and Power Secure were awarded the contract, the bulb is referred to in this document as PS LED

E. LED bulb (NG LED)

- R-30
- 10 Watts
- efficiency rating of 30 delivered lumens per watt 400 lumens
- Full range dimming capabilities and compatible with a range of dimmers currently used in the poultry industry
- 120° angle output distribution, minimum
- Base – Must meet ANSI C78.21-2003 for use in standard E26 sockets
- 3 year warranty
- NextGen Illumination was awarded the contract, the bulb is referred to in this document as NG LED

F. Compact Fluorescent (DCF)

- 15 Watt
- 1,100 lumens
- Dimmable
- Base – Must meet ANSI C78.21-2003 for use in standard E26 sockets
- Precision Lighting was awarded the bid, the bulb is referred to in this document as DCF

Initiation of Program and Implementation of Technologies

Since commercial broiler companies own the birds grown on contract farms and mandate what types of equipment poultry producers will use, the first step was to educate the company personnel in the state on the demonstration project and ask for their assistance in identifying farms for participation. This helped generate both integrator and producer support. The project was well received by the industry and all but one of the 18 broiler complexes nominated farms with two complexes nominating two farms. One complex nominated two two-house farms and another provided a three-house farm. For each of the LED technologies, larger farms were chosen and these were split so that part of the houses received the new LED bulbs and the remaining houses kept their existing incandescent bulbs. For these farms, a meter was installed measuring lighting electrical usage for one LED house and one incandescent house. Delays occurred in the launch of the project due to difficulties securing the LED bulbs. However, bulb installations began in early March and all installations were completed by early July. One of the split farms decided to grow for a new integrator, and since it was his integrator which had made arrangements for the bulbs, it was decided to select a new farm that contracted with the same integrator. Bulbs were removed from the first farm and installed into the new farm by late July. One producer scheduled to receive cold cathodes asked if it were possible to receive one of the LED technologies, and since there were enough LED technologies to install in his barns, he was switched. Table 1 provides information on farm participants, including what bulbs they had prior to implementation of the new technology as well the bulbs which were installed.

For all participating farms, the first step was to determine the foot candles of light that were provided by the existing light bulbs. First the houses were closed to assure no outside light influenced the light reading. Then 120 readings were taken across the house in the following pattern.

- Every 10 feet for the first 150 feet down the length of the barn
- At each 10-foot location, eight readings were taken across the house and averaged
- Readings are taken:

  - At each side wall
  - Each inside water line
  - Each Feeder line
  - Two readings off center
- For this report the readings were averaged

Results

The total number of participating farms was 20 including the farm which began the project and was replaced with a second farm after one flock (Table 1). All but four producers were currently using 60-watt incandescent bulbs for their grow-out lights. Of these four, two were using 100-watt incandescent, one was using 75-watt incandescent and one was using 15-watt compact fluorescent. While the 15-watt CF grower did not fit the initial selection criteria, he and his company were very interested in trying the LED technology and he was allowed to participate. As of October 2010, almost all farms have grown at least two flocks with some farms averaging three flocks to date. Only two farms have not yet provided performance and electrical usage data but have assured us it is in the mail. The majority of farms have grow-out cycles of 49 days or longer (14 farms), with five having grow-out cycles of 42 to 46 days and only one with a grow-out cycle of 37 days. The following table summarizes the results of monitoring flock performance and light intensity. In addition, participants have shared their experience with the different technologies.

Table 1. Participant Background Information

Producer	New Grow-Out Light Source Type of Bulbs	# of Bulbs Replaced[1] Number of Bulbs (Farm Total/House Total)	New Brood Light Source Type of Bulbs	Old Grow-Out Light Source Type of Bulbs	Old Brood Light Source Type of Bulbs	Company	House Size (W x L) Feet	Total Square Footage
Belts, Scott	DCF	204/50	23 W. CF	60 W. Inc.	100 W. Inc.	Simmons Foods	43X500	86000
Bobo, Curtis	LV LED	180/45	150 W. Sodium (NR)[1]	60 W. Inc.	150 W. Sodium	Tyson Foods	40X400	64000
Byford, David	CC-2700	225/44	23 W. CF	60 W. Inc.	100 W Inc.	Tyson Foods	40X400	80,000
Carter, David	PS LED	168/42	23 W. CF	60 W. Inc.	100 W. Inc.	Pilgrim's Pride	40x400	64000
Curry, Rodney	CC-4100	177/44	23 W. CF	60 W. Inc.	100 W. Inc.	Tyson Foods	40X500	80000
Daniels, Larry	DCF	80/40	26 W. CF	60 W. Inc.	1o0 W. Inc.	Pilgrim's Pride	32X375	24000
Hill, Jason	DCF	50/25	23 W. CF	60 W. Inc.	100 W. Inc.	Pilgrim's Pride	43X500	43000
Hilton, Jeremy	LV LED	200/40	26 W. CF	60 W. Inc.	100 W. Inc.	Wayne Farms	40X400	80,000
Hogan, Robert	PS LED/LV LED	132/43	26 W. CF	100 W. Inc.	100 W. Inc.	Townsend	40X450	54,000
Hunton, Jerry	PS LED	204/50	26 W. CF	60 W. Inc.	60 W. Inc.	Simmons	42X500	105,000
Jones, Cody	NG LED	177/58	23 W. CF	15 W. CF	100 W Inc.	OK Farms	43X510	65790
Lamkin, Jeff	PS LED	164/40	23 W. CF	60 W Inc.	100 W. Inc.	Pilgrim's Pride	40X400	64000
Rankin, B.C.	LV LED	220/55	26 W CF	60 W Inc.	100 W. Inc.	Wayne Farms	43 x 500	86,000
Reed, Les	NG LED	250/50	23 W. CF	60 W. Inc.	100 W. Inc.	Tyson Foods	43X500	107500
Riley, Randy	NG LED	204/51	26 W. CF	60 W. Inc.	100 W. Inc.	George's	43X500	86000
Scheller, Gary	CC -4100	204/50	23 W. CF	60 W. Inc.	100 W Inc.	Tyson Foods	42X400	67200
Skeets, Karen	CC- 4100	214/52	23 W. CF	60 W. Inc.	300 W. Inc.	Tyson Foods	43X510	87720
Smith, Greg	LV LED	209/52	26 W. CF	60 W. Inc.	100 W. Inc.	Tyson Foods	43X500	86000
Turner, Dana	CC-2700	112/28	150 W. Sodium(NR[2])	75 W Inc.	Tube Fluorescents	Tyson Foods	40X300	48000
Zimmerman, Paul	DCF	164/40	26 W. CF	100 W. Inc.	100 W. Inc.	Tyson Foods	40X400	64000

1 Does not include bulbs replaced due to failures

2. NR-Not replaced

Brood Bulbs

With the exception of three farms, all growers were using 100-watt incandescent bulbs for brooding (Table 2). The other three were using 150-watt sodium, tube fluorescents and 300-watt incandescent. No initial measurements were taken on one farm because they had pulled their bulbs before we could grid the light pattern. One interesting observation was 16 of the barns did not have an average of two foot candles of light in the brood chamber. Only three averaged slightly more than two foot candles (FC) of light across the brood chambers. A delay in receiving the 26-watt CFL resulted in not all farms getting their new brood lights when they received their new grow lights. This meant post light measurements for brood and grow occurred for some farms prior to the second or third flocks. Installation of the 23- and 26-watt non-dimmable compact fluorescent lights (CFL) along with the new grow lights dramatically improved average foot candles in the brood chambers ranging from 108 to 350 percent with only three growers still averaging less than two foot candles. Only one grower actually experienced a drop in foot candles measured with brood and grow lights. This was the farm which kept their existing fluorescent tubes and the new grow bulbs installed were the CC2700. All farms measured post one flock experienced a drop in light intensity as measured in foot candles with the loss ranging from -9 to -52 percent of the light intensity of that measured when the new bulbs were installed. Measurements of brood and grow lights will continue and if the trend of light loss continues, it may be necessary in the future to install a brighter CFL to compensate for the light loss so that the average brood light does not fall below two foot candles. Besides the loss in light intensity, the 23- and 26-watt CFL are proving to be durable with no lamp failures to date.

Table 2. Brood Lighting and Light Intensity Changes in Foot Candles Before and After New bulbs

	Bulbs			Average Brood Lighting Measured in Foot Candles[1]				Light Intensity Changes (%)		
Farm	Old Brood Bulbs	Grow Bulb	New Brood Bulb	Before Retrofit	After Retrofit	After 1st Flock (FC)	After 2nd Flock	New Bulbs as Compared to Old Bulbs	Change to New Brood Bulbs After One Flock	Change to New Bulbs After Two Flocks
1 Belts	100 W. Inc.	15 w DCFL	23 w CFL	1.32	4.41	2.13	2.41	334%	-52%	-45%
2 Daniels	100 W. Inc.	15 w DCFL	26 W CFL	0.85	2.26	ND	1.86	266%	ND	-18%
3 Hill	100 W. Inc.	15 w DCFL	23 w CFL	1.06	3.72	2.27	P	351%	-39%	P
4 Zimmerman	100 W. Inc.	15 w DCFL	26 w CFL	1.44	NR	2.17	1.94	151%	-11%	P
5 Byford	100 W. Inc.	2700 K CC	23 w CFL	1.92	4.18	ND	1.68	218%	ND	-60%
6 Scheller	100 W. Inc	2700 K CC	23 w CFL	1.12	1.21	1.10	1.24	108%	-9%	8%
7 Turner	Fluorescent Tubes	2700 K CC	NC[2]	2.15	1.64	ND	1.66	76%	ND	1%
8 Curry	100 W. Inc.	4100 K CC	23 w CF	0.95	2.25	ND	1.17	237%	ND	-48%
9 Skeets	300 W. Inc.	4100 K CC	23 w CFL	1.24	1.69	ND	1.23	136%	ND	-27%
10 Bobo	150 W. Sodium	LV LED	NC	ND[1]	ND	ND	1.71	ND	ND	ND
11 Hilton	100 W Inc.	LV LED	26 w CFL	0.83	1.34	1.10	P	161%	-18%	P
12 Rankin	100 W. Inc.	LV LED	26 w CFL	1.53	3.35	P	P	219%	ND	P
13 Smith	100 W. Inc.	LV LED	26 w CFL	1.22	2.47	1.68	1.80	202%	-32%	-27%
14 Carter	100 W. Inc.	PS LED	23 w CFL	1.40	2.42	ND	1.94	173%	-20%	-24%
15 Hogan	100 W. Inc.	PS LED	26 w CFL	2.48	NR	4.42	P	178%	P	P
16 Hunton	100 W. Inc.	PS LED	26 w CFL	1.13	2.51	ND	2.27	222%	ND	-9%
17 Lamkin	100 W. Inc.	PS LED	23 w CFL	1.45	2.72	2.08	1.97	188%	-24%	-28%
18 Jones	100 W. Inc.	NG LED	23 w CFL	0.86	2.89	1.68	1.75	336%	-42%	-39%
19 Reed	100 W. inc.	NG LED	26 w CFL	2.52	3.59	2.52	2.84	143%	-30%	-21%
20 Riley	100 W inc.	NG LED	26 w CFL	0.64	NR	NR	2.05	320%	P	P

1. Brood lighting average foot candle measurements were based on both the brood and grow bulbs both turned on full light intensity
2. NC-Light were not changed
Not R-Bulbs not replaced because 26 watt CFL had not arrived yet

Grow Out Bulbs

The results of monitoring the average foot candles for the old and new grow bulbs are shown in Table 3. With the exception of the 2700 CC and 4100 CC, light measurements improved with the installation of the technologies with the greatest average foot candles shown with the DCFL followed by the LV and PS LED then the NG LED. After two flocks, both CC were averaging well below the foot candles measured prior to bulb replacement with an average reading of .41 FC. The low level of light may be impacting bird performance particularly during the transition from brood to grow when the brood lights have been turned off but the grow lights have been left on full intensity. The low light level may be causing birds to be less active and not seeking food and water at an optimum level during this transition period and it has been indicated by some of the participants that bird weights at settlement are below their usual performance levels. While the DCFL give the best light output, they have proven to be the least durable of the lighting technologies evaluated with 84 bulbs having failed so far (Table 4). There have been 25 bulb failures with the CC2700 with 15 occurring on one farm during an electrical storm. All of the LED technologies have held fairly steady on the foot candles measured and there have been no bulb failures. The NG LED does have the lowest foot candles measured but bird performance as measured by average weight and feed conversion indicates the flocks are settling very competitively in the tournament settlements. Two of the producers indicated their first flocks were slightly heavier than other growers in the tournament settlement, thus netting them additional pay. The brighter of the LED bulbs, the PS and LV LED have caused some issues with bird performance particularly feed conversion. A couple of the growers experienced flightier birds and more bird activity during the grow period which possibly negatively affected feed conversion. However, increasing the amount the lights were dimmed in additional flocks seems to have resolved the issue.

On two of the split farms, electrical usage has been compared between two of the LED technologies and 60-watt incandescent bulb houses (Tables 5 and 6). The two houses in each comparison were identical in structure and management. The third split farm comparison experienced a meter failure in the incandescent house and this was not reported to the project coordinator until flock settlement, therefore no usable data was collected. This was also the farm which was pulled from the demonstration by the integrator so the meters were removed from the farm. The energy comparison data collected to date indicates that the LED technologies are saving producers roughly 81 to 84 percent for the lighting costs as compared to incandescent technology. The two-year energy usage data has been collected from producers as well as energy usage since installation of the demonstration technologies. Because this was the hottest summer in the last two years, the savings is not readily apparent from the few months of data collected during the

demonstration due to high energy usage by fans during high temperature months. It will take additional time and cooler weather before energy comparisons will shed light on how much producers are benefiting from the more efficient lights.

Additional Information and Comments on the Lighting Technologies

I. 15 watt DCFL

Average light loss or lamp lumen depreciation across the barn for this bulb is about 42 percent for a 43-foot-wide barn while it is only 28 percent for a 32-foot-wide barn. There does not appear to be any difference due to length of barn nor whether the barn has a dropped or conventional ceiling. Average available light after two to three flocks ranges from .88 foot candles to 1.25 foot candles for grow out lights and 1.94 foot candles to 2.41 foot candles for brood and grow lights. Flock performance has not been affected. Growers like the light yet complain about too many bulb failures.

II. 2700 Kelvin 8 watt Cold Cathode

There are concerns that the 2700K cold cathode may also have durability issues but it is difficult to be conclusive since 15 lamp failures on one farm occurred after lightening struck close to the barn which could have caused a significant power fluctuation that would have been difficult for any bulb to withstand. A second farm experienced failure of nine bulbs with no known cause. However, there have been few other bulb failures.

Light loss ranges from 0 to10 to 45 percent for grow out and 0 to 60 percent for brooding. The bulbs with the greatest amount of light loss were very dirty. Average available light for grow out after the first few flocks ranges from .38 foot candles to .45 foot candles. The farm with the greatest amount of light loss still had an average .39 foot candles. Average available light for brooding ranges from 1.24 to 1.66 foot candles.

Barns appear dark and all company field representatives complain there is not enough light. There has not been a change in production. Only one farm is happy with the bulbs.

III. 4100 Kelvin 8 watt Cold Cathode

The 4100 Kelvin cold cathode is durable enough for poultry barns.

Light loss is very similar between farms and ranges from 22 to 30 percent for grow out and 40 to 50 percent for brooding. The average light available also is very similar between farms. For grow out, the range is between .35 and .43 foot candles and 1.01 and 1.11 foot candles for brooding. The wider house has the least amount of light.

Production has been affected negatively. Both farms are showing lighter average bird weights increased feed conversion ratios as well as one of the farms showing an increase in mortality. The 40-foot-wide barns appear to have plenty of light, they clean bulbs between flocks, and both the grower and company service technician like the lights. The 43-foot-wide houses appear dark, and neither the grower nor the company service technician likes the light.

IV. Luma Vue 6 watt LED

The Luma Vue LED seems to be a very durable bulb. However, the bulbs tend to become loose and one farm experienced two bulbs that actually fell out of the sockets. There have been no bulb failures.

Light loss ranges from 8 to 21 percent for grow out and 7 to 27 percent for brooding, (the 7 percent barn has sodium brood lights). Available light is very consistent and averages 1.05 foot candles for grow out. There is also very slight differences in average light available for brooding ranging from 1.44 to 1.80 foot candles.

There is not enough production data in to be confident there is no effect on flock performance, but we do not anticipate any performance changes. However, one farm reported birds between four and six weeks had dug under the lights at the water lines, causing excessive water on the ground. The behavior had stopped by seven weeks and he admitted he may need to adjust his lighting protocol. There are also complaints from some growers that the bulbs won’t dim enough before going completely out. One grower is not having any trouble. All growers like the lights as long their production is not altered.

V. Power Secure 10 watt LED

The Power Secure LED is holding up well under poultry barn conditions. There have been no bulb failures.

There is great variation of light loss ranging from 3 to 30 percent for grow out. However, for brooding, the range of light loss was 16 to 28 percent. Interestingly, there is little variation of average foot candles between farms after the first two flocks. Average

light available for grow out ranged from .95 foot candles to 1.04 foot candles and for brooding the range was 1.83 to 2.10 foot candles. Except for the farm that had installed ‘Y’s, this farm has 4.42 foot candles (the ‘Y’s provide twice the number of brood bulbs).

There is only slight production change for most farms and growers as well as company service technicians like the light. However, there is concern that the lights won’t dim enough before flickering and going completely out. One farm reported birds taking too long to move to the non-brood end of barn as well as birds eating all the feed under the lights before moving to feeders in dark areas. Production data for this farm indicates a lighter bird at market. Also, all farms reported that the catch crews would unscrew some, if not all, the bulbs during the catching process trying to get the barns darker.

VI. NextGen 10 watt LED

The NextGen LED is proving to be durable enough for poultry barns. There have been no bulb failures.

Light loss for grow out ranges from 15 percent (white drop ceiling) to 21 percent (black drop ceiling) to 35 percent (conventional ceiling). For brooding, the light loss is 39 percent, 21 percent and 41 percent respectively. All barns are 43 feet wide. Average light available is very similar between all farms and averages .55 foot candles for grow out and ranges from 1.21 to 2.84 for brooding.

Production has been positively affected with a reduction in mortality, improved feed conversion ratio, and one farm has shown a nearly half-pound average gain improvement when he did not dim his lights until birds were six weeks old. Interestingly, this half pound of gain did not negatively affect mortality or feed conversion ratio which improved settlement pay. All growers and company service technicians like the lights and there are no dimming issues.

In summery

The LED technologies demonstrated on poultry farms in this project are proving energy efficient as well as conducive to bird performance, and they are durable under poultry house conditions. This technology is better than existing energy efficient technology, and, at this point, it is anticipated that poultry producers and companies will readily adopt the technology. The next segment of the grant, Phase II, will involve educating the industry on findings from this project and securing feedback to determine which LED technology or technologies the industry would like their producers to install on their farms. The first industry forum is scheduled for November 4th at The Poultry Federation Live Production Committee meeting. Once the poultry industry has given its consent to

technology installation, RC&D will begin the bulb purchase process and poultry grower meetings will be scheduled to educate growers on their options for securing the technology through the grant program.

Table 3. Average Barn Light Levels (Foot Candles, FC) Measured Before and After New Bulb Installations

Farm	New Grow Bulbs Installed	Average Grow Out Light Levels Prior to Retrofit[1] (FC)	Average Grow Out Light Level After Replacement (FC)	Average Grow Out Light Level After 1st Flock (FC)	Average Grow out light level after 2nd flock (FC)	Average Grow Out Light Level After 3rd Flock (FC)	% light Level of New Bulbs Compared to Old Bulbs	% Light Level after First Flock as Compared to Initial Replacement Light level	% Light Level After Second Flock as Compared to Initial Replacement Light Level	% Light Level After Third Flock as Compared to Initial Replacement Light Level
1 Belts	15 w DCFl	0.56	1.68	0.93	0.88	P	300%	55%	52%	P
2 Daniels	15 w DCFl	0.18	1.72	ND[1]	1.23	P	956%	ND	71%	P
3 Hill	15 w DCFl	0.54	2.02	1.25	P[1]	P	374%	62%	NC	P
4 Zimmerman	15 w DCFl	0.90	1.51	1.24	1.22	P	168%	82%	81%	P
5 Byford	2700K CC	0.67	0.71	ND	0.45	0.39	106%	ND	63%	55%
6 Scheller	2700 K CC	0.67	0.44	0.43	0.45	P	66%	98%	102%	P
7 Turner	2700 K CC	0.90	0.42	ND	0.38	P	47%	ND	90%	P
8 Curry	4100 K CC	0.58	0.55	ND	0.40	0.43	95%	ND	73%	78%
9 Skeets	4100 K CC	0.48	0.50	ND	0.37	0.35	104%	ND	74%	70%
10 Bobo	LV LED	ND	1.17	ND	1.13	1.08	ND	ND	96%	92%
11 Hilton	LV LED	0.83	1.34	1.10	Terminated	-	161%	82%	ND	ND
12 Rankin	LV LED	0.70	1.24	P	P	P	177%	P	P	P
13 Smith	LV LED	0.86	1.25	1.12	0.99	P	145%	90%	79.2%	P
14 Carter	PS LED	0.90	1.35	ND	1.08	0.95	150%	ND	80%	70%
15 Hogan	PS LED	1.26	1.07	1.04	P	P	85%	97%	P	P
16 Hunton	PS LED	0.77	1.34	ND	1.05	0.97	174%	ND	78%	72%
17 Lamkin	PS LED	0.83	1.18	1.07	0.98	0.96	142%	91%	83%	81%
18 Jones	NG LED	0.54	0.67	0.54	0.57	P	124%	81%	85%	P
19 Reed	NG LED	0.86	0.79	0.54	0.63	P	92%	68%	79%	P
20 Riley	NG LED	0.41	0.71	0.55	0.60	0.46	173%	77%	84%	65%

1 ND-No data was collected; P-pending flock completion data will be collected

Table 4. Bulb Failures to date

Producer	Bulb	Flock #	Bulb Failures	Comment
Belts	DCFl	1	22	
Belts	DCFl	2	31	
Hill	DCFl	1	14	
Zimmerman	DCFl	2	8	
Scheller	CC2700	2	15	(Lightening)
Turner	CC2700	3	1	
Skeets	CC4100	3	9	

Table 5. Lighting Electrical Usage Comparisons Between Poultry Barns With Incandescent and NG LED Lighting

Farm-Reed	Incandescent House Meter Reading in Kilowatts	NG LED House Meter Reading kilowatts	Difference (%)
Flock 1	1557	292	81%
Flock 2	3343	631	81%

Table 6. Lighting Electrical Usage Comparison Between Poultry Barns with Incandescent and PS LED

Farm-Carter	Incandescent House Meter Reading in Kilowatts	PS LED House Meter Reading kilowatts	Difference (%)
Flock 1	2118	335	84%
Flock 2	4103	725	84%