Profitable Lighting for Dairy Facilities

by Gunnar Josefsson, dairy scientist and director of research at Orion Agricultural Lighting

Introduction

There are three good reasons why a dairy farmer should consider improved lighting in the barn/s and parlor. First, Long Day Lighting (LDL) is under most conditions quite profitable and allows you to make more money. Investment budget calculations suggest a net return of about $100 per lactating cow per year and a payback time of 0.5-1.5 years. Recently developed LDL programs and new technology make it possible to practice Long Day Lighting also for larger herds milking 3X and approaching a 24/7 parlor schedule.

Second, consider the old adage "A penny saved is a penny earned." The cost of electrical energy to light the dairy facilities is substantial for farms anywhere in the US, and especially so in Western and East Coast states with higher energy rates. By switching to newer and more energy-efficient types of light fixtures, energy consumption and cost can be substantially reduced. Larger dairy facilities typically use powerful High Intensity Discharge (HID) fixtures, often with metal halide lamps. These days there is a strong trend in lighting for industrial and commercial facilites – switching from these types of fixtures to a newer type of fixtures known as High Intensity Fluorescent (HIF). This change allows saving up to 50% of the cost to operate the fixtures. Versions of these fixtures have now been developed to suit the more demanding conditions in freestall barns and parlors, allowing dairy enterprises to follow the trend in other industries.

Third, improved task lighting may promote productivity and quality of work, possibly reduce strain and fatigue and increase work satisfaction. This is especially the case with monotonous and repetitive work, such as parlor milking.

Saving money in the parlor

Existing recommendations for lighting in the parlor vary. ASABE recommends 50 foot candles. Some states have in place a minimum level required for grade A dairy permit holders. These benchmarks are given without specifying exactly how to measure the light level recommended (e.g. with platforms loaded or empty, measuring vertical vs. horizontal light etc.).

Looking at the parlor as a work place, the crucial aspect is the amount and quality of light available near the udder. The control panels sometimes are major shadowing obstacles and make it a challenge to provide adequate lighting in the critical work areas. When considering improved lighting in an existing or new parlor – ask for a plan and layout which focuses on the critical work areas, and considers the obstructions imposed by panels and trusses etc. once the parlor is fully installed. Select fixtures capable of delivering high light levels without glare and spreading the light as evenly as possible over the work area in the pit or around the rotary parlor.

	HIF fixture, six 4ft T8 lamps	MH 400W lamp	Difference
Purchase price, $	367.00	162.50	204.50
Useful life, yrs	10	10	0
Energy cost, $/kWh	0.10	0.10	0
Energy consumption, Watts	221	465	244
Operating time, hrs/day	22	22	0
Operating time, hrs/yr	8030	8030	
Energy use/day, kWh	4.9	10.2	5.4
Energy use/yr, kWh	1775	3734	1959
Energy cost/year, $	177.00	373.00	195.00
Lamp life, hours	22,000	22,000	0
Lamp replacement cost (3 times/10 yr), $	19.20	73.50	54.30

Example HIF fixture has a light output comparable to 400W MH fixture (near end of lamp life)

Table 1. Comparison data

What's the cost for energy consumed by fixtures in your parlor? Without a separate meter for the parlor lights, that's hard to know. However, the cost depends on:

- How many fixtures and how many watts per fixture (including ballast)
- How many hours per day fixtures are used in the parlor
- The energy cost per kWh

When planning lighting for a new parlor, or replacing fixtures in an existing parlor, fixtures with 400W metal halide (MH) lamps are usually considered. Newer high intensity fluorescent fixtures (HIF) are available at a higher investment cost but offering substantial energy cost savings. The question is: Do the energy cost savings off-set the higher price paid for the newer type of fixtures?

The comparison below is based on operating fixtures 22 hrs/day, an energy rate of 10 cents/kWh and does not include installation costs (assumed the same for the two options).

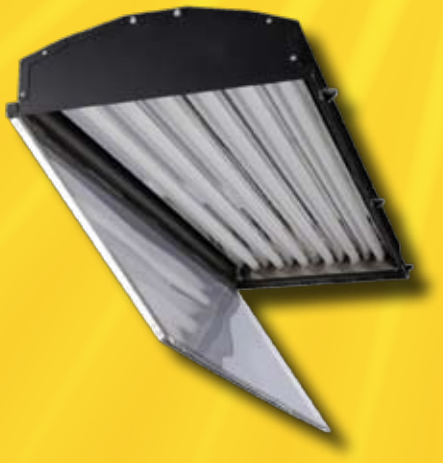
In this example, the purchase price for the HIF fixture is about twice the cost of a fixture with a 400W metal halide lamp. On the other hand, the energy consumption of the HIF fixture is about half of the energy consumed by the fixture with 400 W metal halide lamp.

When considering the energy cost savings, difference in purchase price, and difference in lamp replacement costs – choosing more energy-efficient light fixtures can generate an accumulated net cost savings of about $1,800 per fixture. For a moderate-sized parlor (six fixtures), this adds up to $10,800 net cost savings over the expected life of the investment. A larger parlor (12 fixtures) may see a total of $21,600 net cost savings over the 10 year period. If the parlor lights are used fewer hours per day, the net cost savings are reduced; e.g. if parlor lights are on 14 hrs/day, the accumulated net savings is about $1,080 per fixture over the 10 year period.

It appears that using newer lighting technology in the parlor is likely to be cost-effective under most use situations. When selecting fixtures, consider also your specific parlor layout and how a particular fixture can deliver light to the critical work areas in the pit or by the rotary.

Time to pay back purchase price difference, through energy cost savings, years	1.0	$204.50 paid back
Net energy cost savings, after purchase price difference is paid back, $/useful life	1755.00	Useful life assumed 10 yrs for both options
Cost savings due to lower cost replacement lamps for HIF fixture, $/useful life	54.00	Three lamp replacements during useful life.
NET COST SAVINGS $/useful life	**1809.00**	Useful life assumed 10 yrs for both options

Table 2. Comparison results



Hight Intensity Fluorescent (HIF) fixture, suitable for freestall barns and parlors and equipped with six 4 ft T8 fluorescent lamps.

New Long Day Lighting model for 3X herds

The principle of using programmed lighting to stimulate animal productivity is old and widely used for poultry and to some degree in swine operations. The general requirements of this herd management technique for dairy cattle are:

- Sufficient light intensity: average of
- 15 or more foot candles
- Day length of 16 – 18 hr
- An uninterrupted period of darkness: 6 or more hours/night
- An annual "break" from Long Day Lighting, e.g. during the dry period

If these requirements are met, numerous studies have demonstrated a response of about 5 lbs more milk/cow/day. Larger herds, milking 3X and/or having a parlor schedule approaching 24/7 realized they were not able to provide 6 or more hours of darkness each night. Some owners/managers experimented by using staggered schedules for different barns or different sections of barns, and others tried using red light during the "dark period." The experiences of using these approaches have been mixed, at best. Red light at low intensity is far from ideal lighting for workers in the barn. Trying to optimize the function and space utilization of dairy facilities tends to result in cows experiencing changes when moved between staggered schedules, and the production response from cows under these con-

ditions is not known.

More recently, specialized dairy cattle research and development of a new type of fixture has come to the "rescue" of dairy herds milking 3X and/or on a near 24/7 parlor schedule. Studies from University of Manitoba (professor Alma Kennedy) demonstrated that dairy cattle can be exposed to at least 1 foot candles with no tendency of interfering with their normal night time hormone balance (melatonin production dominates). At the other end of the spectrum, these studies suggest that a level of 5 foot candles is likely to interfere with the normal hormone balance during darkness (substantially reducing melatonin production). Thus, physiologically speaking, cows appear to perceive this level of light as "light" and if there is a more precise threshold, this would be somewhere in the 1 – 5 foot candle range.

Based on these new findings, a model for Long Day Lighting was developed to suit all herds milking 3X. The main principles of this approach to LDL are:

- Full light16-18 hrs/day
- Dim light 6 or more hours per night
- Identical lighting schedules in all barn/s and holding area

This system allows cows to be moved between barns or pens as needed, with no change in their LDL schedule. During the "dark" period, evenly distributed dim white light allows workers to carry out basic barn work, such as moving cows, cleaning barn etc. Lighting systems based on this model are now being designed to fit the specific layout and management routines on individual dairy farms. When planning for Long Day Lighting – keep in mind that different lactating and dry cows have very different lighting needs when practicing LDL. Be sure to request a plan that meets the lighting needs for all cattle groups (lactating, dry, heifers) and includes convenient, automatic controls (photocells and timer/s) for maximum energy efficiency.

Practicing Long Day Lighting in Western States?

Extending the day length with artificial light is easy to arrange for cows housed inside a conventional freestall barn or a fully enclosed barn. If your cows spend considerable time under open skies – this doesn't mean Long Day Lighting is impossible in your case. You should take a careful look at the practical and economical feasibility in your situation.

Some Western dairies use open-sided or curtain-sided freestall barns, confining cows inside the barn during the muddy winter season but allowing free access to outside pens during the rest of the year. Designing a system for a large CA herd demonstrated that, in spite of a high energy cost and practicing LDL less than 6 months per year, LDL was profitable. The estimated payback time for the initial investment was in this case 1.3-1.8 years, depending on installation costs, and the estimated net income was about $70/cow/year. The total net income

accumulated over the life of the investment after paying back the initial investment was for this herd estimated at about $1.4 millions.

Long Day Lighting can be practiced even if the cows spend substantial periods of time in outside dirt lots year-round. However, these lots would need to be artificially lit at night and in early mornings to provide the exact same day length as is defined by fixtures inside the barn. Another CA dairy farm is a case in point. Including powerful fixtures for the outside lots, in addition to the fixtures inside the barns - the estimated payback time for this investment was about 1.3 years and the estimated net profit per cow about $100/cow/year.

Judging from these cases, it appears that Long Day Lighting is a viable herd management option also in when cows have access to outside lots part of the year or all year round.

Recommendations

Dairy farmers in all states should take a second look at Long Day Lighting. This is a sound herd management technique based on a well researched physiological response in dairy cows. Like TMR and 3X milking, it deserves to be considered a "best management practice". For producers not interested in, or unable to use rBGH – Long Day Lighting may be a welcome option. LDL offers a net profit of about $100/cow/year and requires a moderate investment and minimal labor and other operation costs.

There are possibilities to conserve energy used for lighting on dairy farms while providing good lighting for workers and cows. Newer technology, known as HIF (High Intensity Fluorescent) fixtures can save substantial amounts of energy when used in barns and parlors.

Farmers planning to construct new facilities or remodel existing ones should request a plan for lighting as soon as possible in the planning process. The lighting system and LDL should be considered when planning electrical circuits, controls and the floor plan (placing different categories of cows). Including the capability to practice Long Day Lighting adds very little cost over and above a basic barn lighting system.

More information

Basic information on the principles of LDL can be found at University of Wisconsin: http://bse.wisc.edu/hfhp/tipsheets_html/lighting.htm and at University of Illinois: http://www.livestocktrail.uiuc.edu/photoperiod/

References for studies on dim lighting can be supplied on request.

For more specific information about LDL for 3X herds and energy-efficient fixtures with and without dim light capability, please contact the author directly.

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