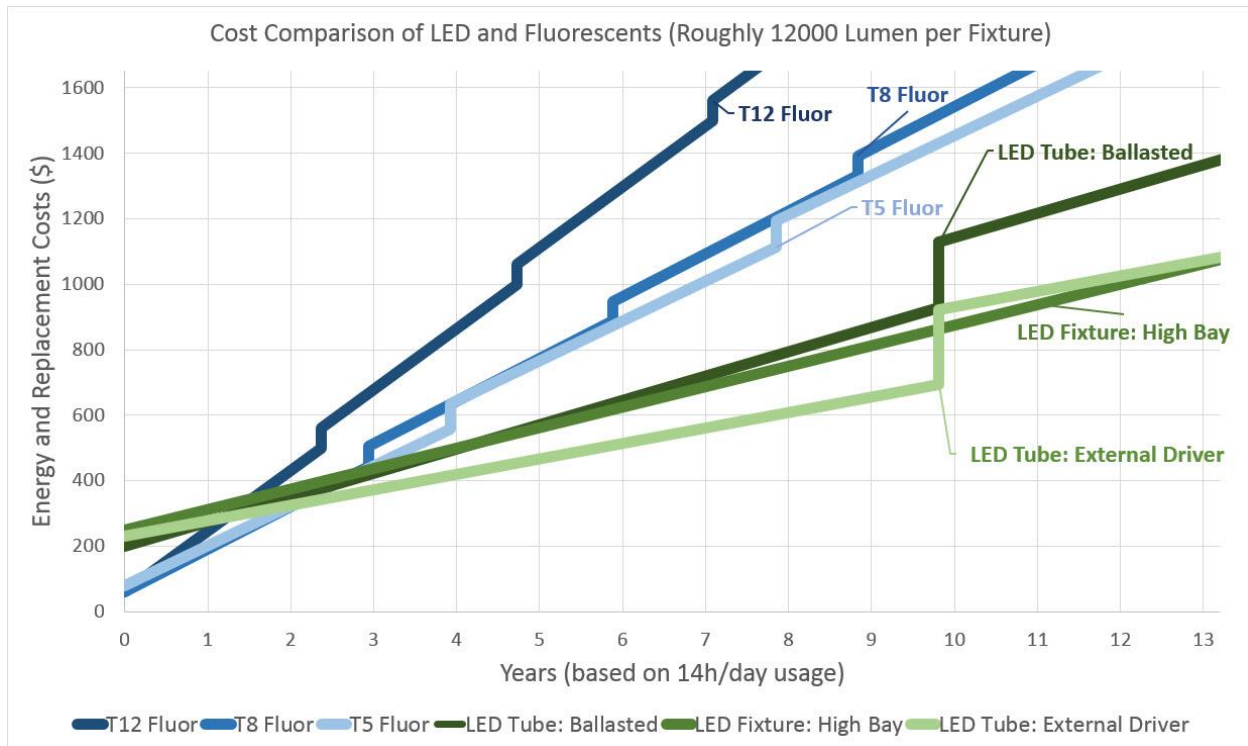


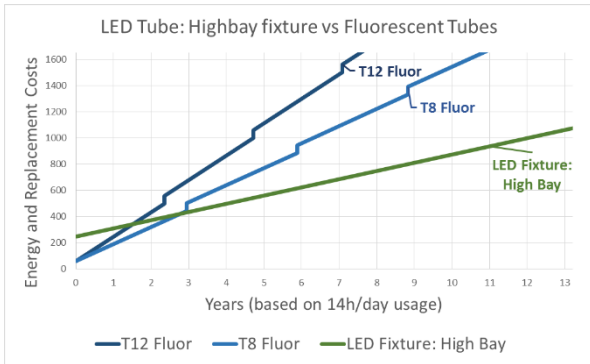
FARM ENERGY AND AGRI-PROCESSING (FEAP) PROGRAM

Upgrading to LEDs: What Are the Options?

In the past the majority of farm buildings have been lit by fluorescent tubes, incandescent bulbs, or metal halide lamps. In recent years, Light Emitting Diode (LED) technology has progressed rapidly becoming both more available and affordable than ever before. Many producers want to know what the options are for LED upgrades in order to choose which type would be best for their farms. The lighting industry is moving away from using LED tubes in existing fluorescent fixtures in favor of upgrading the fixtures themselves to UL approved self-contained fixtures with integrated drivers, therefore no rewiring of existing fluorescent fixtures is required (*this is explained in greater detail on page 2*). This factsheet outlines what is available in the industry currently without promoting a certain brand or company. More information may be required to adequately select a lighting system for your needs. Contact a lighting professional to discuss which options are right for your system.



High Bay LEDs and LED Fixtures



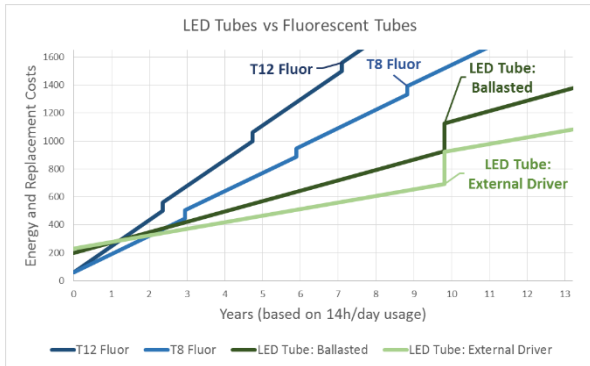
The lighting industry is moving towards self-contained LED fixtures that replace an entire fixture. For example, instead of just replacing the tubes in a fluorescent fixture with LED tubes, the entire fluorescent fixture is replaced by a self-contained LED fixture.

High bay LEDs are available in many different sizes, wattages and lumen outputs making it easier to adapt to your current situation. In general these high bay lights are more effective at ceiling heights

of 30+ feet. They can replace fluorescent tube fixtures, overhead High Intensity Discharge lights (HIDs) and others, depending on the building. In order to disperse the light in a desired manner there are many different light shades and reflectors of different angles. These can replace multiple fluorescent fixtures depending on the size and application.



There are a variety of different LED fixtures available for any situation. They are generally sealed units with all of the lighting components built in. With a high lumen per watt rating and a long life expectancy these fixtures are ideal in most lighting situations both from a cost effective and an energy efficiency perspective. They come in many different sizes and wattages that can be fit to a variety of lighting systems.



LED Tubes

There are three different types of LED tubes available: 1) Tubes with matching external drivers. These drivers replace the ballasts in fluorescent fixtures, converting the power to an LED compatible voltage. 2) Tubes that are designed to be used with fluorescent ballasts. 3) Tubes that have internal drivers that are meant to be wired directly to the main power source (*not recommended*).

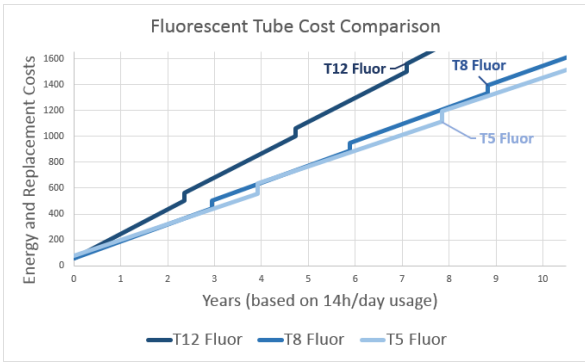
The first two options are recommended and UL approved as a retrofit kit, while the third option has complications making it not recommended for safety reasons.

External Driver: (Best Performance) The LED tubes used with external drivers are arguably the best option when retrofitting a fixture. The ballasts in the fluorescent fixture are removed and replaced with an LED driver. The driver acts similar to a ballast; it steps the power down to be compatible to the LED tube. The LED driver and tube combination is considered by UL to be a retro-fit kit so once installed it is UL approved and more efficient than the other types of LED tubes.

Ballasted: (Easiest Installation) The LED tubes designed to be used with fluorescent ballasts are the simplest to install. Fluorescent tubes are simply removed and replaced with the LEDs. The downside to this type is that the inefficient ballasts are needed to step the power down for the LEDs, reducing the energy saving potential of replacing the inefficient ballasts with the highly efficient LED external drivers (fluorescent ballasts and LED external driver can be compared at roughly 40W and 12W respectively).

Integrated Driver: (Not Recommended) The LED tubes with internal drivers are designed to be wired directly to the mains. This option is not recommended because it requires altering the fluorescent fixtures by removing the ballasts and connecting the high voltage main line to the fixture heads directly. This rewiring is often done incorrectly or without using the correct gauge of wire, instead using the existing wire left over from the ballast removal (this is a fire hazard due to the high voltages running through the low voltage wire). Once the old fixture has been altered to fit these LEDs a field inspection is required to recertify them as UL approved. Even after all of these steps have been completed there is still the danger of someone putting a fluorescent tube back in the fixture that has had the ballast removed, a major fire hazard, as the voltage would be many times higher than that rated for the fluorescent tube.





T5 Fluorents: Some high efficiency fluorescent are still competitive in today's market with energy efficiency and therefore remain a viable option for lighting upgrades. For instance a 325W six tube T5 fluorescent fixture (shown on right) has similar lumen outputs to the 245W self-contained LED fixture. Although it is slightly less efficient (90 lumens/watt without the ballast, compared to the LEDs 100 lumens/watt) and has a shorter life expectancy (20,000 hours compared to the LEDs 100,000 hours) it has a cheaper upfront and replacement cost (approx. \$200 compared to LEDs approx. \$700 upfront cost).



Incandescent, Compact Fluorescent Lighting (CFL), and LED Bulbs



Figure 1: 100 Watt Incandescent

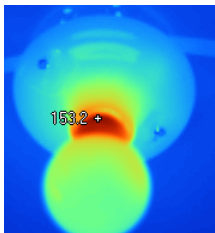


Figure 2: 15 Watt CFL

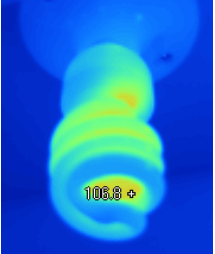
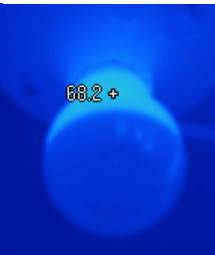


Figure 3: 9 Watt Dimmable LED



Cost, longevity, and efficiency are factors to consider when choosing a lighting system.

With those three factors in mind, CFL and LEDs are shown to be superior by the data in Table 1.

Both of these bulbs are directly compatible with incandescent fixtures. They simply screw in with no alterations needed.

With CFLs having a relatively cheaper initial cost and above average energy efficiency and LEDs

having best in the market energy efficiency with a more expensive upfront cost, other factors should be taken into account in order to decide which type is best for your system.

The CFL has a few draw backs that LEDs do not have. CFL bulbs do not operate well in cold temperatures and have trace chemicals integrated into the bulb (roughly 5mg of mercury per bulb). Most CFLs are not compatible with household dimmer switches, while most LEDs are (check the manufacturer's specifications to be sure it is dimmable). While LEDs operate well in most common temperatures, they have cooling requirements that necessitate the need for open fixtures. Airtight fixtures limit the air movement to the cooling components and could decrease the performance and the longevity of the LEDs.

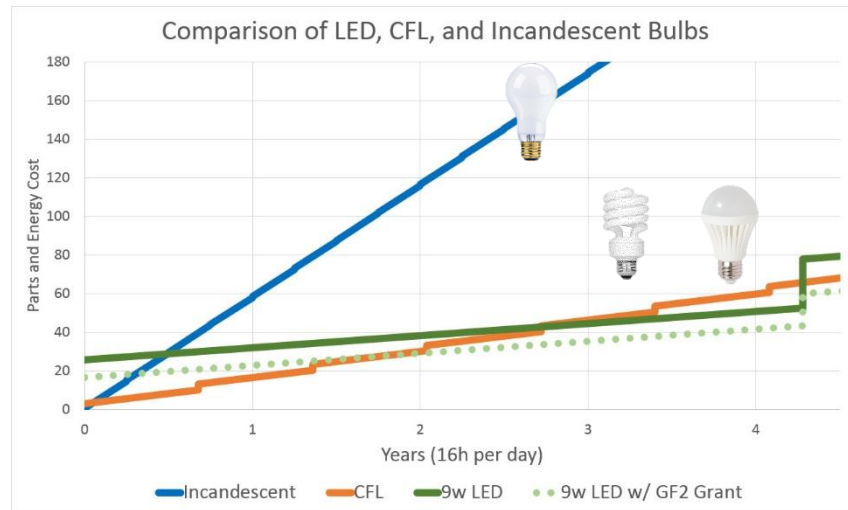


Table 1: Cost Comparison of Light Bulbs

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