While the lighting of work and office areas may only comprise a small portion of a food processor’s energy bill, savings can often be made by implementing low cost measures.

Options to reduce the amount of energy lighting consumes include:
- installing energy efficient lighting and control technology
- good housekeeping practices and making the most of natural lighting
- removing unnecessary lighting in non-critical or unoccupied areas.

Arnott’s biscuit processing plant in New South Wales saved $13,740 per year by installing occupancy detectors, delay push buttons in some areas and reducing office lamps by 30 per cent. Photoelectric sensors were installed in the manufacturing area and air conditioning schedules were adjusted to suit occupancy. The payback period was two years.

Energy efficient lighting

Light emitting diodes (LEDs)

Unlike incandescent bulbs that radiate light in 360 degrees, LED light is focused and directional. For this reason small arrays of the diodes are typically grouped together as an alternative to incandescent and florescent bulbs.

This type of lighting currently requires components such as a circuit board and driving components, all of which make LEDs relatively expensive.

However, LEDs do have a long-lifespan of around 35,000-50,000 hours, compared to about 10,000 hours for fluorescents and 1,000 hours for incandescent. For this reason best value for commercial use often occurs where maintenance and replacement costs for lighting are expensive.

Because they produce very little heat energy (3.4 BTUs/hour, compared to 85 BTUs/hour for incandescent bulbs) they can be a good option for refrigerated areas where the heat generated from light increases the heat load on the cooling system.

Unlike fluorescent lamps, LEDs also contain no toxic mercury and also have no filament, like incandescent bulbs do, that can be damaged due to shock and vibrations. As they do not emit UV rays they also tend not to attract insects.

Because of their low power requirement, LEDs are ideally suited to solar power.

Correct installation is vital as the typical incandescent fusing requirements are too robust for LEDs. Incorrect fuse sizing can cause damage to electrical systems.

Productdose.com provides an online energy saving calculator that can determine savings from replacing incandescent bulbs with compact fluorescents or LEDs. For further information visit: www.productdose.com/LightBulb_Comparison.xls

1 Sustainable Energy Authority Victoria (SEAV), 2003, Energy Best Practice Tips for Lighting www.seav.vic.gov.au
### Different types of lighting

#### Table 1: Comparison of different types of lighting

<table>
<thead>
<tr>
<th>Type of light</th>
<th>Wattage (W)</th>
<th>Capital cost</th>
<th>Relative operating costs</th>
<th>Efficacy (lumens/watt)</th>
<th>Average life (hours)</th>
<th>Deterioration of light quality over time</th>
<th>General information</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent</td>
<td>15-1,500</td>
<td>Low</td>
<td>High</td>
<td>10-17</td>
<td>750-2,500</td>
<td>Light output falls 15 per cent through life</td>
<td>Electricity heats a tungsten filament to produce bright light. 90 per cent electricity lost to heat.</td>
<td>Bulbs to be phased out by 2010.</td>
</tr>
<tr>
<td>Tungsten halogen (240 V)</td>
<td>50-2,000</td>
<td>Low</td>
<td>High</td>
<td>22</td>
<td>2,000</td>
<td>Very little</td>
<td>Electricity to heat a tungsten filament enclosed in pockets of halogen gas. Emits bright white light using less than 10-20 per cent of the energy of an incandescent bulb, also lasts around twice as long.</td>
<td>Dimmable so often used for &quot;mood&quot; or display lighting. Typically used for uplighting.</td>
</tr>
<tr>
<td>Tungsten halogen (6-21 V)</td>
<td>10-75</td>
<td>Low/medium</td>
<td>Medium</td>
<td>30-50</td>
<td>2,000-4,500</td>
<td>Very little</td>
<td>Fluorescent lamps pass an electrical current through a tube filled with argon and mercury producing UV radiation that bombards the phosphorous coating to emit light. They produce little heat, are efficient (use 20 per cent of the power of incandescent bulbs) and long lasting.</td>
<td>Low voltage used for downlighting.</td>
</tr>
<tr>
<td>Fluorescent</td>
<td>8-36</td>
<td>Low/medium</td>
<td>Low</td>
<td>Tube 30-110 Compact 50-70</td>
<td>Tube 7,000-24,000 Compact 10,000</td>
<td>&lt;20 per cent</td>
<td>Good for small areas with low ceilings or task-level lights, or large areas requiring no detail work.</td>
<td></td>
</tr>
<tr>
<td>Metal halide</td>
<td>35-3,500</td>
<td>High</td>
<td>Very low</td>
<td>60-115</td>
<td>5,000-20,000</td>
<td>45 per cent</td>
<td>Metal halides provide bright white point light. They are more efficient than mercury vapour and brighter than sodium lights.</td>
<td>Lighting in areas where ceiling is greater than 4m</td>
</tr>
<tr>
<td>Mercury vapour</td>
<td>40-1,000</td>
<td>Low</td>
<td>High</td>
<td>25-60</td>
<td>16,000-24,000</td>
<td>High</td>
<td>Producing a cool blue/green light, mercury vapour lamps have a longer lifespan to metal halides.</td>
<td>Exterior lighting and lighting were colour rendering is not important.</td>
</tr>
<tr>
<td>Sodium high pressure</td>
<td>35-3,500</td>
<td>High</td>
<td>Medium</td>
<td>50-140</td>
<td>16,000-24,000</td>
<td>15 per cent</td>
<td>Sodium high-pressure lights provide a warm white light. The colour rendering is not as good as metal halide but the lifespan is longer.</td>
<td>Exterior, security lighting. Internal use in factories with ceiling height over 4m and where colour rendering is not important.</td>
</tr>
<tr>
<td>Light emitting diodes (LED)</td>
<td>3-4.2</td>
<td>High</td>
<td>Very low</td>
<td>11-15</td>
<td>50,000</td>
<td>Very little</td>
<td>Light Emitting Diodes (LEDs) are tiny semiconductors encapsulated in plastic. LEDs produce very little heat and are extremely efficient in both consumption and light output, surpassing both incandescent and halogen lamps. Lighting is available in a large range of colours.</td>
<td>In the past this type of lighting has been used predominantly for back lighting, such as signs. With the development of white LEDs, they can now be used to replace fluorescent and incandescent bulbs.</td>
</tr>
<tr>
<td>Intelligent fluoro high-bay</td>
<td>200</td>
<td>Low</td>
<td>87</td>
<td>20,000+ hours</td>
<td>Very little</td>
<td>Light fitting set with sensors to adjust the level of lighting in response to natural lighting and occupancy.</td>
<td>High bay installations between 6-16m.</td>
<td></td>
</tr>
</tbody>
</table>

---

High intensity discharge (HID) lighting

- Mercury vapour lamps are the oldest type of HID and are used primarily for street lighting. Most indoor mercury vapour lamps have been replaced by metal halide lamps.
- Metal halide lamps produce a bright, white light with the best colour rendition of all HIDs. Metal halide lamps do, however, have shorter life spans than both mercury vapour and high-pressure sodium lamps. They come in standard or pulse start with pulse start more efficient and quicker starters.
- High-pressure sodium lights produce a warm white light and are commonly used for outdoor lighting. They have poorer colour rendition than metal halide lamps but a longer lifespan.

Fluorescents

There are two main types of fluorescent lamps, the tube and compact lamps, both of which are designed to fit into conventional fittings.

Fluorescent lamps need magnetic or electronic ballasts. Electronic ballasts can solve flickering and humming and are more efficient, but are more costly than magnetic ballasts.

Fluorescent tubes

The standard tube, fluorescent halophosphor T8, has a standard magnetic ballast and a lifespan of around 6,000 hours.

The fluorescent triphosphor T8 is no more efficient than the standard T8 but they do have 20 per cent greater light output. This can mean fewer lamps are needed. They also have a longer lifespan, lasting around 13,000 hours (magnetic ballast) and 16,000 hours (electronic ballast).

The fluorescent triphosphor T5 is the most energy-efficient tube, being 23 per cent more efficient than triphosphor T8 and 38 per cent more efficient than standard T8s.

T5s are most economical when they are installed as new fixtures as they require different fittings to T8s. They only operate with electronic ballasts and have a lifespan of around 16,000 hours.

Compact fluorescents

Compact fluorescent lamps last up to 10 times longer than incandescent bulbs and consume 75 per cent less energy.

Intelligent lighting

Intelligent lighting uses fluorescent tubes in a specific reflective design to maximise the utilisation of light, particularly in high bay installations. These are installed in conjunction with sensors which can adjust the amount of light in response to natural light when installed in rooms with skylights or window. In addition the lights can be installed with sensors to detect occupancy. The lights will turn off when rooms are not occupied, saving energy.

These lights can generally be installed to replace metal halide light and use 50-80 per cent less operating energy due to the lower wattage requirements for the same light output.

---


Replacement of incandescent lights with CFLs can save significant amounts of money.
Halogen lights

While halogen lights are more energy efficient and longer lasting than incandescent bulbs, it is important to remember that these types of lamps only provide a small, direct beam of light. Often this means that several lamps will be required to meet lighting requirements, negating any energy benefits.

Halogen bulbs also get hotter than other bulbs and should not be used in areas where they are likely to come in contact with flammable material.

Phase out of inefficient light bulbs

The Australian Government is working towards a full phase out of inefficient light bulbs by 2009-2010. Bulbs targeted are those with an efficiency less than 15 lumens per watt. For the food industry, the impact will be most commonly seen in office/administration areas and hallway lighting. Currently, alternative options for equipment such as ovens are still being explored.


Table 2 demonstrates the potential savings achievable by retrofitting efficient lighting.

<table>
<thead>
<tr>
<th>Existing lamp</th>
<th>Energy efficient lamp</th>
<th>No. of lights</th>
<th>Light wattage (kW)</th>
<th>Cost to run per year</th>
<th>Annual savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent 15</td>
<td>Compact fluorescent 15</td>
<td>0.075</td>
<td>$347</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichroic down lights 10</td>
<td>Compact fluorescent 10</td>
<td>0.035</td>
<td>$108</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury 20</td>
<td>Compact fluorescent 10</td>
<td>0.007</td>
<td>$22</td>
<td>$86</td>
<td>Bulbs last up to twice as long</td>
</tr>
<tr>
<td>Metal halide 20</td>
<td>Intelligeht floreal high-bay 20</td>
<td>0.220</td>
<td>$1,355</td>
<td>$2,967</td>
<td></td>
</tr>
<tr>
<td>Halophosphate fluorescent 16</td>
<td>Triphosphate fluorescent 8</td>
<td>0.040</td>
<td>$99</td>
<td>$98</td>
<td>Bulbs last 60 per cent longer</td>
</tr>
<tr>
<td></td>
<td>Total saving</td>
<td></td>
<td></td>
<td>$3,429</td>
<td></td>
</tr>
</tbody>
</table>

Good housekeeping

Lighting use, design and maintenance

Consideration of lighting needs, design and maintenance can provide significant savings. The following methods can help reduce energy for lighting.

- Task-level lighting can direct light to where it is needed rather than lighting large areas.
- Occupancy and movement sensors can automatically turn off lighting in inactive areas such as freezers and storage rooms.
- Light switch segregation can allow lights in areas not in use to be switched off.

- Retrofitting fluorescent light fittings with high frequency eco-controllers, which increase efficiency and reduce energy use.
- Natural light utilisation, e.g. skylights, can reduce light requirement. The downside is they must be cleaned and can create glare and reflection. The additional heat load from sunlight must be considered for air conditioned areas. Proper design and installation of skylights can minimise these downsides.
- Regular cleaning of light fittings, reflectors and diffusers will reduce energy losses.
- Photoelectric sensors can measure natural light and adjust lights accordingly, including security lights.
- Auto or step dimmers can reduce total energy demand by up to 20-30 per cent.
- Walls and ceilings painted in light colours reduce light requirements.

Remove unnecessary lighting
Replacing lights with lower energy units will reduce energy use. De-lamping is another simple method to reduce lighting costs. Investigate if it is possible to remove lights in areas where lighting levels are currently higher than the Australian Standards require. A lux meter can be used to measure lighting levels. When removing fluorescent tubes consider replacing remaining tubes with efficient tri-phosphor tubes that produce 15 per cent more light and last longer than standard tubes.

To calculate annual savings from ‘de-lamping’ use the following equation:

\[ S = \frac{((N \times P \times H \times T)}{1000} + \text{cost of replacing lighting} \]

- **S** = annual savings
- **N** = number of lamps removed
- **P** = Power rating of lamps (W)
- **H** = usage per year (h/year)
- **T** = cost of electricity ($/kWh)

This series of eco-efficiency fact sheets will demonstrate the importance of water in a modern food factory and suggest areas where savings can be made. The project website www.eco-efficiency.com.au has more ideas and case studies.