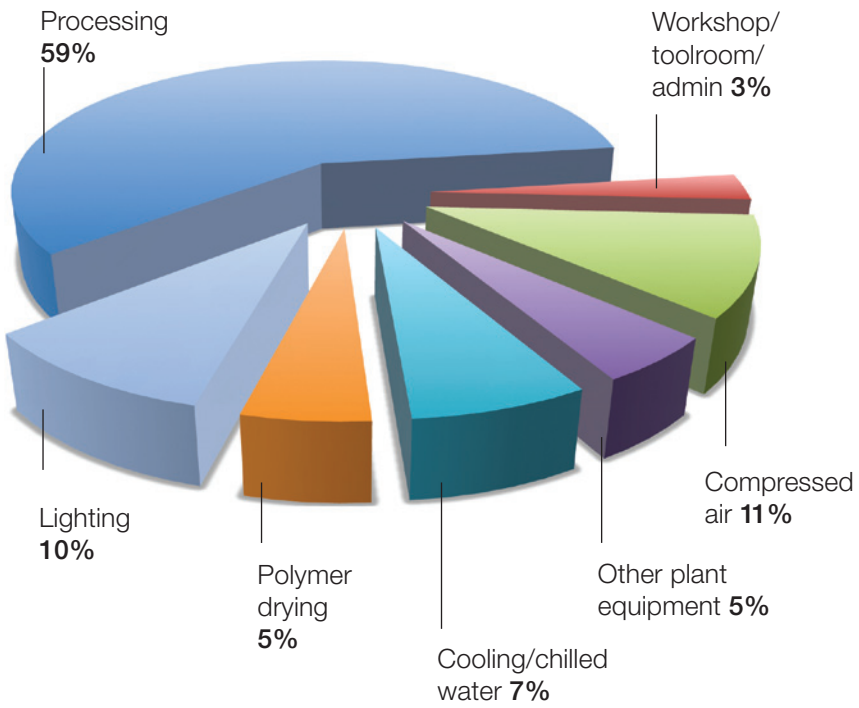
EFFICIENT LIGHTING

The amount of energy used for lighting across a plastics site can be surprising. 33 energy audits of New Zealand plastics manufacturing plants found that lighting represents 10% of total site energy use on average.

The opportunities to make lighting more efficient and more effective can be relatively straightforward, and usually have short to medium-term payback.

This Best Practice Guide provides practical advice for plastics manufacturers on reducing lighting energy use.

Average energy footprint of 33 New Zealand plastics manufacturers



PLASTICS NEW ZEALAND

Maximising the growth and success of plastics-based technology in New Zealand in an economically, socially and environmentally responsible manner.

Improving your lighting can not only reduce your energy costs but can deliver other benefits, including:

- **Improved safety**

  Having the correct light levels can help avoid accidents and prevent health and safety problems such as eye strain.

- **Improved colour rendering**

  An object can appear different colours under different lights. If the products you are making require accurate colour rendering then choosing the right light source is important.

- **Improved quality control**

  Better lighting will also result in better quality control in areas where products are being inspected.

- **Improved work environment**

  Lighting, in particular greater use of natural night, can help to make a workplace feel better for staff and has been found to lead to productivity increases.

This guide presents some typical areas of opportunity for improving lighting efficiency. There is no single ready-made solution as every plastics operation is different and lighting is about more than just energy use.

Best practice for lighting depends highly upon the application and for specific site requirements it is always recommended that you seek expert advice, preferably from an IESANZ (Illuminating Engineering Society of Australia and New Zealand) accredited lighting professional.

Check Correct Light Levels

Lighting requirements in a plastics manufacturing plant vary widely, depending on the tasks being done in different areas of the plant.

Start by measuring the lux levels throughout your site. Lux is a measure of illuminance in lumens per square metre. You can buy a simple and inexpensive (usually less than $100) lux or light meter from many electronics retailers. A lighting consultant can also undertake this service for you. It is recommended to measure lux levels at four or five different points in each space, usually one or two hours after sunrise or before sunset. If the space is mostly used at night, do the test at night. Likewise, if it is mostly used during the day, do the test in the daytime. Remember to do the test at least once a year to check light levels as lamp performance fades.

Compare the measurements in the following table against the recommended minimum maintained lux levels in AS/NZS 1680:

TABLE 1 Area	AS/NZ 1680 recommended light level	Potential cost to maintain this light level *
Fine work and inspection	600 lux	up to $52/m^2/year
Laboratories Inspection and sorting	400 lux	up to $36/m^2/year
Office space Entrance foyers & reception areas	320 lux	up to $26/m^2/year
Filing and storage rooms Walkways in open plan areas	240 lux	up to $20/m^2/year
Live storage fine materials Lunchroom/canteen Locker/changing rooms	160 lux	up to $15/m^2/year
Passageways and toilets Live storage bulky items	80 lux	up to $7/m^2/year
Dead storage bulky items	40 lux	up to $4/m^2/year

** adapted from EECA Technical Guide No. 3 Improving Industrial Lighting, assuming 3,000 hours per year and 13c/kWh*

TABLE 2 Area	Measured lux range	Standard lux
Compressor area	1,160 – 1,510	160
Warehousing*	830 – 1,000	80
Production area	580 – 1,100	240
Workshop/die store	600 – 1,360	600
Cafeteria*	380 – 1,810	160
Toilets/Lockers	210 – 1,150	160
Office	330 – 740	320
Upstairs office	230 – 1,600	320

** has significant daylight contribution*

Table 1 shows that the cost of wasted electricity through excessive lighting can be significant. Opportunities to reduce light to the recommended levels are clearly worth investigating.

Where areas are overlit to this degree there is usually the potential to remove, or change, light sources to reduce electricity use. Table 2 is an example of lighting levels found during an audit of an Auckland plastics company using a lux meter. Reviewing light levels at this site found that some areas without natural light were significantly overlit, such as the compressor area and the toilets/lockers area. Reducing the light levels and installing better lighting controls has saved this site considerable electricity costs.

Remove unnecessary lamps

If you find areas lit by fluorescent tubes are overlit it can be very simple just to remove selected tubes. This is called de-lamping. Recheck light levels once you have removed lamps, to make sure the right lighting standard is being met. You should also leave some indication on the fitting that the tube has been removed deliberately, to avoid maintenance personnel accidentally re-lamping.

Note that in some cases the type of ballast used in your light fitting will mean that if you take out one tube the others sharing that ballast will not work.

Zero-cost de-lamping will save injection moulder $500 a year in electricity

An energy audit of a North Island injection moulding company found that light levels in their store room were between 1,100 and 1,200 lux. Some administrative tasks were also being undertaken in the area. The New Zealand standard recommends lighting levels of 320 lux in office areas, and even less for storage rooms.

Removing two lamps from each of the eight triple-lamp fittings in the area will reduce lighting closer to the recommended 320 lux. To do so will incur zero cost and save 3,853 kWh per annum and **$478 in electricity costs.**

Maintain lighting regularly

Even when in a clean environment and if fixtures are cleaned every 18 months, dirt build up can reduce light output by 10 percent between cleanings. For a plastics factory the impact of dirt and dust on light output is even more significant. Putting in place a regular cleaning routine is important for maintaining good light levels.

Dirt depreciation for a typical fluorescent fixture in a very clean environment

Source: ESource.com

www.plastics.org.nz

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Install Lighting Controls

Wherever possible you should control the lighting in your facility so that lights are not left on unnecessarily.

Manual Controls

Look for opportunities to simply switch off lights in areas not being used. Rewiring lighting circuits into smaller zones per light switch can increase flexibility and better options for manual control of lights. For example if you run a night shift that only operates in one area of your factory floor, separate out the lighting circuit for this area so that other areas can be turned off.

Remind staff regularly of the need to switch off lights. Use stickers on light switches to remind people of this and bring it up occasionally in staff meetings.

Occupancy Sensors

Occupancy sensors, that turn lights on when they detect motion, work well in areas of low use and are surprisingly low cost. Target areas include services rooms, tool rooms, canteens, toilets and changing rooms.

Infrared sensors have become much more affordable and start from as little as $100.

Daylight Sensors

If you have skylights or large windows providing a lot of natural light you can used daylight sensors to dim lights when natural light levels are sufficiently high. This system can cause problems when used with metal halide or mercury vapour lamps because of the long warm-up/strike times for these lamps.

However, the new fluorescent tube high bay systems are ideally suited to these kinds of controls.

Simple sensor in low use area gives quick payback

A plastics plant had their compressor area well lit when the plant was operational. But staff did not use the area very often so energy was being wasted on lighting.

Installing a 360° occupancy sensor in the compressor area, so lamps come on only when people enter the area, cost $200 and is now **saving $390 per annum** in electricity costs.

Better control of outside lighting will save $2,214 per annum

A large Auckland plastics manufacturing site has two loading bays with a canopy over each bay. The two canopies have a total of 86 fluorescent lamps to light these areas at night. Energy auditors found that the lights were being left on unnecessarily all day, wasting 23,134kWh of energy and costing **$2,214 per year.**

The company plans to install simple daylight switches in each bay so staff don't have to remember to switch lights off in the morning. Hardware and installation has been estimated to cost $4,500, giving simple payback in 2 years.

Consider Different Lighting Technology

The most significant opportunity to save energy on lighting comes when you can change to a more efficient type of lighting technology. You need to be careful though, as it is important that the type of lighting you install is suitable for the way an area is used. If you have specific requirements for light levels in an area, we recommend contacting a specialised lighting consultant.

The performance of different lighting types and their typical use is shown in the table below. Use this table to work out what lighting is going to be best for the needs of the different areas of a site.

	Incandescent bulb	Halogen	Fluorescent tube	Compact fluorescent	Mercury vapour	Metal halide	High pressure sodium
Installation cost	Low	Low	Low	Low	Moderate	Moderate to high	Moderate to high
Efficacy (lumens/watt)	Low (8-17)	Low (20-30)	Moderate to high (60-100)	Moderate to high (40-65)	Low to high (15-70)	High (60-100)	High (60-120)
Typical wattage range*	40 - 200 W	10 - 50 W	8 - 120 W	7 - 20 W	40 - 500 W	70 - 400 W	35-1,000 W
Running cost	Highest	Highest	Moderate to low	Moderate to low	High to moderate	Moderate to low	Low
Typical lamp life	<1,000 hrs	2,000-3,000 hrs	7,500-20,000 hrs	6,000-10,000 hrs	20,000-24,000 hrs	10,000-20,000 hrs	14,000-24,000 hrs
Replacement costs	Low	Medium	Low	Medium	Low	High	High
Colour rendering	Excellent (100)	Excellent (100)	Medium to good (50-98)	Medium to good (50-80)	Poor (15-50)	Medium to good (60-90)	Poor (17-25)
Best applications	Short hours of operation. Task lighting, or areas where colour rendering is important	Short hours of operation. Spot lighting displays.	Long hours of operation. Multiple applications. Use with high quality fittings to replace HID highbay.	Long hours of operation Replace incandescent lamps and sometimes replace HID	Short hours of operation. Areas where colour rendering isn't important – high pressure sodium usually better choice	Long hours of operation. Areas where ceiling height is greater than 4 metres.	Long hours of operation. Areas where colour rendering isn't important. Exterior lighting.

** wattage can potentially be much higher for specialised lighting such as stage lights or floodlights.*

(Adapted from multiple sources, including: Sustainability Victoria (2009) Energy Efficiency Best Practice Guide: Lighting and EECA Technical Guide No. 3 Improving Industrial Lighting)

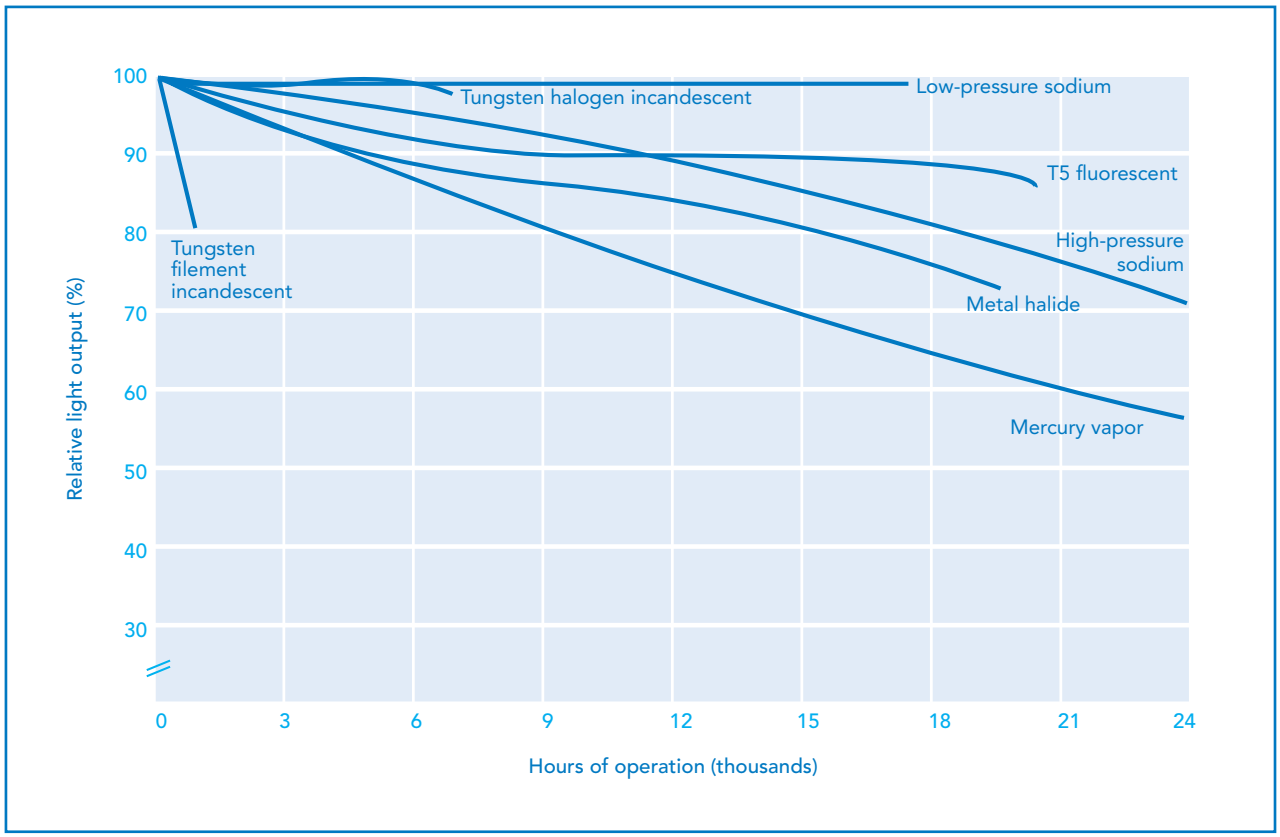
You should also keep in mind that the efficacy of lamps does decrease over time and the rate of this decline depends on the type of lamp. The graph below shows typical life expectancy for different lamps. Metal halide lamps in particular have a large decrease in their light output over their lifetime.

By the time you come to replace these lamps you may be replacing a lamp that is at half of its original light output. Remember this when someone is selling you an alternative lamp that they claim can match the light output of your current lighting.

Performance varies even within types of lamp. Data for a particular lamp can be found in technical information available from the manufacturer, but the chart below gives an indication of typical lumen maintenance.

Typical light output over time for different lamp types

Source: adapted from National Lighting Bureau



Several plastics factories in New Zealand have replaced their high-bay metal halide or mercury vapour lighting with banks of high-output T5 fluorescent lamps contained in good quality, reflective fittings. The companies have all reported positively on the new technology.

In most cases the replacement of traditional high bay fittings with fluorescent banks was found to have payback of two to three years.

This fluorescent lighting has a number of advantages over traditional high-bay metal halide lamps, including:

- Similar efficacy (lumen/watt)
- More diffuse light
- Ability to dim and switch
- Rapid start
- More sustained light output over lamp lifetime
- High colour rendering
- Lower cost lamp replacement
- Single lamp failure does not cause total loss of light in an area

These fluorescent high-bay alternatives are also readily available as off-the-shelf solutions from electrical wholesalers.

Changing to fluorescent high bay lights pays dividends for Linkplas

A site energy audit recommended that Auckland blowmoulders Linkplas change from metal halide highbay lighting to new highbay fluorescent tube alternatives. The plant had fifteen 400W metal halide fittings in place. Taking into account energy and lamp replacement costs, each fitting was costing $435.25 per annum. Replacing these metal halides with thirteen High Five fluorescent highbay fittings, each containing 4 x 54W tubes, has reduced these annual costs to just **$225.68.**

Did you know...

A drinks vending machine usually has two 36W fluorescent lamps, equating to around 86W once ballast losses are accounted for. These lamps use your electricity 24 hours a day 365 days a year.

Ask the vending machine service agent to disconnect this lighting at no cost during the next refill. Disconnecting the lamps will save you around 750 kWh equating to almost **$100 a year.**

Lamp Disposal

When replacing lighting, always dispose of lamps safely. Metal halide, mercury vapour and fluorescent lamps all have mercury in them that needs to be recycled appropriately. A nationwide collection service is available for the recycling of mercury-containing lamps from www.interwaste.co.nz.

Next steps

If you are considering upgrading or changing your lighting it pays to talk to an expert. Lighting is a specialised area and we recommend you talk to an IESANZ (Illuminating Engineering Society of Australia and New Zealand) accredited lighting professional. You can find a professional at www.iesanz.org

For more information on lighting efficiency you could also try **www.rightlight.govt.nz**

Best Practice Energy Programme

Plastics New Zealand is a national trade organisation representing over 200 member companies.

It is estimated that the New Zealand plastics industry consumes more than 1.7 petajoules of energy per annum.

The Plastics NZ Best Practice energy Programme helps plastic companies to minimise their energy footprint through energy audits and practical actions.

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