

## YOUR COMPETITIVE ADVANTAGE

Energy efficiency solutions for Australian transport and logistics SMEs



### Fact sheet no.2

## Energy efficiency for warehousing, refrigerated stores & materials handling

This fact sheet provides basic information about energy efficiency in freight vehicles.

It is one of six fact sheets and other resource material developed by the Supply Chain and Logistics Association of Australia (SCLAA) and project partners to help SMEs in the supply chain and logistics sector with energy efficiency improvements and energy cost reductions.

The full suite of resources is available from <http://energy-efficiency.sclaa.com.au>

#### Obtain expert advice

To help identify the most suitable opportunities for your business, consider obtaining advice from a professional energy auditor or your supplier. Whilst an audit will come at a cost, it can save you both time and effort, and ensure you invest in the most beneficial opportunities.

#### ► Electricity is the main focus

Most energy used in the supply chain and logistics sector is in transport fuels, which is covered in Fact Sheet 1.

However, the second most significant type of energy used by the sector is electricity, used in a diverse range of plant and equipment for lighting, cooling and refrigeration, and materials handling.

#### ► Big savings in new facilities

The approach to energy efficiency will vary depending on whether you are constructing a new facility or retrofitting an existing one.

If designing a new facility for your operations, a good principle is to minimise the distance material has to travel on site.

Combined with more efficient types of equipment and practices, you could reduce energy consumption by up to 40% through clever design and construction, compared with a traditional building.

These benefits will also be achievable at significantly lower capital cost than if you were to retrofit them to an existing building.

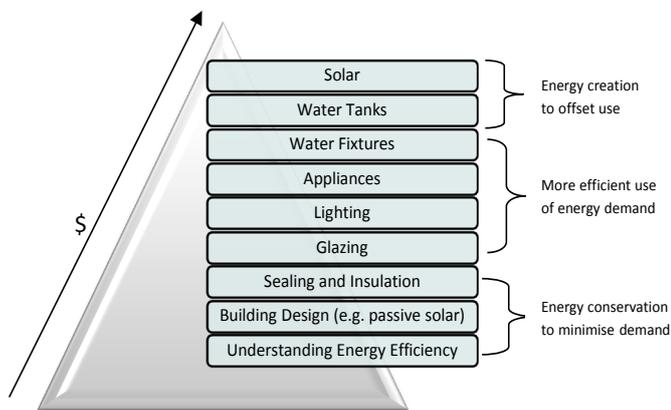
**Table 1:** Warehouse energy efficiency solutions

Typical warehouse improvements	Nominal energy saving (% of total site energy use)
Upgrade light fittings	10%
Install lighting controls	2%
Fix compressed air leaks, reduce pressure	3%
Install/improve control system on a/c	3%
Variable speed drives for fans/pumps	2%
Fit ceiling/wall insulation	5%
Improve maintenance	1%

Figure 1 summarises a range of improvement strategies applicable to all building types at the initial construction stage.

Examples of opportunities in new buildings include passive solar design (to reduce cooling and ventilation demands), skylights and windows to reduce the need for electric lighting, solar hot water for washing and amenities, heat recovery from equipment, good insulation to reduce indoor temperature fluctuations, flexible switching and control systems to ensure only occupied spaces are serviced, and failsafe/backup systems to reduce risk of energy waste (e.g. self-closing doors on air-conditioned or refrigerated spaces).

**Figure 1:** Strategies at the bottom require the least capital to implement yet deliver the biggest benefit in terms of reducing energy use.



### ► Improving existing equipment/facilities

When retrofitting an existing building, there is much that can be done to improve existing systems and equipment, from simple operational and maintenance improvements like external painting, to relocating plant and equipment to improve material flows, and replacing individual components or upgrading whole systems.

Some examples are described overleaf and presented in Table 1 above. More detail, including a tailored action plan for your business, can be accessed using the online assessment tool.

### ► Don't underestimate simple changes

Behavioural changes such as turning off lights, minimising the time a door is open to a refrigerated store, and turning forklifts off when not being used, can all improve energy efficiency at minimal cost.

### ► Insulation

For a warehouse with a HVAC system in place, adding insulation is the simplest way to improve the thermal performance of a building, as it significantly reduces the amount of artificial heating and cooling required. For those warehouses without a HVAC system in place, insulation can still provide benefits in the form of increased comfort levels for staff, and reduced loads on cold storage areas.

Insulation is graded by its R-value, a measure of the thermal resistance it provides - the higher the R value, the more effective the insulation. Insulation is much cheaper to include at the initial construction phase of a warehouse, but can be retrofitted later on. If you are retrofitting insulation, consider doing it in tandem with other renovations or maintenance to reduce costs.

The effectiveness of insulation is impacted by a variety of factors – insulation age, height of your roof, building shell material, orientation, spacing, gaps, air leakage etc. It can be applied to the roof, walls and floor, both internally and externally. For guidance on the suitability of insulation for your warehouse, speak further with your insulation supplier or an energy auditor.

### ► Understand your operation's energy use

Understanding which elements of your operation are the most energy intensive allows you to focus on the areas that will reap the biggest savings.

This may require extra monitoring equipment such as sub-meters and time to analyse existing energy data. Refer to the How-To Guides 'Identifying Opportunities' and 'Evaluating Opportunities' for more detail.

### ► Refrigerated stores

Poor sealing and insulation, resulting in heat gain or the loss of cold air, is a major burden on refrigeration systems.

Fixing cold air leaks in refrigerated stores can save you 10% at little cost, and it is a good place to start because it reduces avoidable energy losses at the downstream end (once the work has already been done in cooling).

Similarly, leakage of refrigerant fluid is common and good maintenance and repairs can often result in up to 10% energy savings.

Compressors use the most energy in commercial refrigeration, followed by fan motors and then other equipment (lighting, heaters, etc.).

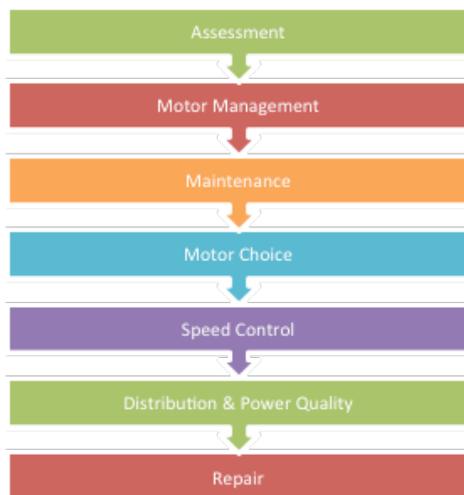
Optimising compressor operation or replacing compressors with high efficiency units can therefore save up to 10-12% of energy use compared to a conventional unit.

Simple measures like improving defrosting, regular maintenance, and keeping the door closed are all easily implemented.

### ► Motors

Electric motors are used in a range of plant and equipment throughout the supply chain and logistics sector – including fans, pumps, compressors, conveyors and cranes, as examples. The hierarchy in Figure 2 below indicates successive steps in assessing and implementing efficiency improvements in motors in commercial applications.

**Figure 2:** Hierarchy of strategies for improving motor efficiency.



Motors operate at their highest efficiency between about 60% and 100% of their full-rated load, dropping off sharply in efficiency below 50% loading.

Variable speed drives ensure that power generated matches power required. In some circumstances this power optimisation can save you more than 10% related to that component, with a payback period around 4 years.

High efficiency motors incur a 10–15% price premium on standard motors, but the payback can be as little as 6 months (typically up to 2 years depending on application).

### ► Recover energy already paid for

To keep a refrigerated area cold, heat must be removed. Rather than wasting this valuable heat, transfer it to where you can use it – for water heating, or in boilers (which can reduce boiler fuel requirements by 30%).

### ► Lighting

Lighting can account for 50-80% of energy consumed in a warehouse. Install skylights for natural light (use perspex as roofing material instead of tin) and replace all gas discharge lighting to save another 10%.

For optimum efficiency, LED lights can provide the required luminosity for a typical warehouse. While these incur higher upfront costs, they save money in the long run; firstly via reduced electricity use; secondly through replacement costs (they last ten years or more); and thirdly in lower maintenance costs (hiring scissor lifts, etc). Compact fluorescents are a cheaper alternative to LEDs, but produce fewer savings.

*Don't forget to turn lights off when they are not needed!*

### ► Heating, ventilation and cooling (HVAC)

The biggest opportunities for energy reductions in warehouse HVAC depend on whether an air conditioner is fitted, and whether it is a stand-alone unit or a central unit.

Air conditioners use a lot of energy when operating, so the control system is crucial to ensure they only work when they have to: a flexible control system and responsive air conditioning system can save more than 3% of total warehouse energy use.

The biggest savings can be locked in at the design stage:

- The use of natural cooling through vents and doors to control air movement can reduce the need for cooling systems on hot days. Where this can't be achieved, fans systems can be used to circulate air to prevent the use of air conditioning
- Good insulation can reduce heat loss in colder areas on hot days
- For central plant air conditioning systems, economy cycles that exchange ambient air to help control indoor temperature not only reduce energy use but can also improve indoor air quality

Routine maintenance on HVAC systems is a low-cost action that can save another 1% or more of total warehouse energy. Similarly, high efficiency motors on the air conditioner compressor or variable speed drives and controls for fans can save 1-2% by matching ventilation and temperature to only what is required.

## ► **Conveyors**

If you have an old conveyor system on the site, consider upgrading individual components or sub-systems to newer designs. Examples of modern conveyor types include

- › narrow belt
- › electro-adhesion
- › vertical carousels or lift modules

If conducting a major upgrade, automated storage and retrieval systems (AS/RS) reduce labour costs by using unmanned guided forklifts to store or retrieve products. The cost of such systems can be high, but they also produce compounding savings by reducing the need for lighting, ventilation, and safety incidents.

## ► **Forklifts**

Switching fuels may not save much energy (or it could be hard to quantify), but it sure can save costs. Some operators are swapping their LPG forklifts for natural gas, while others are switching to hybrid or battery-electric models.

Some models of excavator, front-end loader and other construction-based equipment are now available with energy-recovery (or hybrid) systems that can reduce diesel use by more than 20%.

Again, simple things can also provide meaningful savings: turning the engine off on forklifts, tractors, loaders, and cranes (rather than idling) is an example. Large pieces of equipment can use over 4 litres of diesel simply idling for an hour.

## ► **Warehouse management systems (WMS)**

A good WMS can save energy by streamlining, integrating and optimising operations within the warehouse. Efficiency can be achieved with a WMS via:

- › inter-leaving tasks (multi-tasking) for mobile equipment like forklifts, so they can do other tasks in between loading/unloading
- › enabling cross-docking, whereby freight is unloaded from one truck and loaded directly into another at the dock without being stored in the warehouse
- › optimising storage locations to reduce handling time and distance within the warehouse – for example, by co-locating fast-moving stock near receive/despatch areas
- › allow integration of energy management systems, such as switching lights on/off only in areas being used at the time
- › enabling flexible fulfilment so items can be picked by zone, order or item
- › and integrating with other management systems for labour, freight carriers, stock control, etc.
- › vertical carousels or lift modules

Even though these examples show that a WMS can have impacts on many areas of the business, a good system and supplier should be able to commission a new system within 6 weeks in most SME applications.

## ► **More information**

### ***Cut Costs: energy efficient warehouse operation***

A UK based guide to enable organisations to identify prioritised opportunities, develop a business case and implement an energy reduction programme

[http://www.ukwa.org.uk/\\_files/23-carbon-trust-23.pdf](http://www.ukwa.org.uk/_files/23-carbon-trust-23.pdf)

### ***Case Study No.1 - Keysborough Spec 1***

New warehouse purchase case study

<http://energy-efficiency.sclaa.com.au>

### ***Energy Efficiency Assist***

A series of videos covering energy efficiency opportunities for the manufacturing sector: Motors & Drives, Lighting, Process Cooling & Refrigeration, Boiler, Compressed air, Heating Ventilation Air Conditioning (HVAC), Easy wins, Demand Management, Energy Data Management, Understanding your bill

<http://energyefficiencyassist.com.au/onlineinteractivetools>

### ***Lighting trials means lights on at Australia Post***

Lighting case study of warehouse-style building (Dandenong Letter Centre, Vic)

<http://www.eec.org.au/UserFiles/File/M&V/M&V%20CaseStudy%20Aust%20Post.pdf>

### ***Metcash Distribution Centre (NSW)***

Case study on the Metcash distribution centre

<http://www.gbca.org.au/gbca.asp?docID=34523&show-hidden=1>

### ***Cool energy savings for cold storage warehouse***

Two page case study of Swire Cold Storage (Lurnea, Sydney) proving the business case and initiatives undertaken

<http://www.environment.nsw.gov.au/resources/sustainbus/12154ESSwireCs.pdf>

### ***Reducing energy use in the cold storage industry - a case study***

Case study: Oxford Cold Storage Company (Laverton, Vic)

[http://www.airah.org.au/imis15\\_prod/Content\\_Files/EcoLibrium/2013/Apr13/EcoApril13\\_Forum.pdf](http://www.airah.org.au/imis15_prod/Content_Files/EcoLibrium/2013/Apr13/EcoApril13_Forum.pdf)

## Energy Smart Tips for Warehouses

Short factsheet covering: Energy Star's 7 Steps of Energy Management, Lighting, Building envelope, HVAC, Refrigeration

<http://smartenergy.arch.uiuc.edu/pdf/Warehouses%20Niche%20Market%20Report%20FINAL%20-%2005.02.2011.pdf>

## Retrofit suggestions for energy efficient warehouse facilities

Short guide to warehouse retrofit opportunities

[http://www.envido.co.uk/wp-content/uploads/Envido\\_warehouse\\_opportunities.pdf](http://www.envido.co.uk/wp-content/uploads/Envido_warehouse_opportunities.pdf)

## Save Energy in Your Warehouse to Meet Green Initiatives

Article that highlights a number of easily achieved adaptations which will make warehouses and distributions more eco-friendly

[http://www.supplychaindigital.com/warehousing\\_storage/save-energy-in-your-warehouse-to-meet-green-initiatives](http://www.supplychaindigital.com/warehousing_storage/save-energy-in-your-warehouse-to-meet-green-initiatives)

## Distribution centre energy efficiency

Online case study

<http://www.energymanagertoday.com/distribution-center-energy-efficiency-084396/>

## Refrigeration systems: guide to key energy saving opportunities

Introduces the main energy saving opportunities for (UK) businesses with cold storage facilities and demonstrates how simple actions can save energy, cut costs and increase profit margins

[http://www.carbontrust.com/media/13055/ctg046\\_refrigeration\\_systems.pdf](http://www.carbontrust.com/media/13055/ctg046_refrigeration_systems.pdf)

## Efficiency and sustainability in materials handling

Coverage of energy efficient technologies for sustainability in warehousing

<http://www.mmh.com/criticaltopic/energy>

## Material handling meets energy efficiency

Case study on design of material handling system

<http://www.plantservices.com/articles/2012/03-What-Works-material-handling-energy-efficiency/?page=full>

The following are private sites. SLCAA does not endorse these sites but is supplying the links for user reference only.

## Forklift driver tips for cost efficient driving

20 simple tips for keeping drivers and load safe and moving up to speed and reduce needless energy wastage and wear and tear

<http://www.toyota-forklifts.eu/en/Support/Pages/CB-driving-tips.aspx>

## Toyota industrial equipment - forklift calculator

Forklift fuel efficiency comparison calculator

<http://www.toyotaforklift.com/calculator/>

## Electric or IC engine - which is right for your site?

Outlines the pros and cons of electric and internal combustion engine forklifts

<http://forkliftbriefing.com/?A=ST&E=1003&H=Electric-or-IC-engine&Z=1202>

## Lighting solutions for warehouses

Short one page guide to lighting solutions for warehouses

<http://www.greenearthenergyefficiency.com.au/solutions/warehouses/>

## Thermal insulation painting

Protective paint & coatings designed for a wide range of applications (commercial buildings, trucks) to lower internal temperatures

<http://www.thermoshield.com.au/>



Learn more on how to make your business more energy efficient at [sclaa.com.au](http://sclaa.com.au)

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Suite 154  
4/16 Beenleigh Redland Bay Road  
Loganholme QLD 4129  
Australia

P 1300 364 160  
F 1300 364 145  
[www.sclaa.com.au](http://www.sclaa.com.au)

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