NATIONAL BUSINESS INITIATIVE

PSEE
PRIVATE SECTOR ENERGY EFFICIENCY

MANUFACTURING.

Introducing energy saving opportunities for business.

Preface

Reducing energy use makes perfect business sense; it saves money, enhances corporate reputation and helps everyone in the fight against climate change.

The Private Sector Energy Efficiency (PSEE) programme provides simple, effective advice to help businesses take action to reduce carbon emissions, and the simplest way to do this is to use energy more efficiently.

This overview for the manufacturing industry introduces the main energy saving opportunities for businesses in this diverse sector and demonstrates how simple actions can save energy and reduce energy bills.

Contents

Energy consumption

In 2012, South African industry consumed 290TWh of energy representing emissions of 160 million tonnes of carbon dioxide. This figure was around 35% of South Africa's total energy use. Most of these emissions came from manufacturing.

Manufacturing is any activity that transforms materials into new products. It is a diverse sector, including food production, textiles, furniture, paper, chemicals, rubber and plastic products, glass, metals and metal products, transport equipment and electrical goods.

The chart (Figure 1, right) shows a breakdown of industrial energy consumption. It is useful as an overall guide, although the pattern will vary between industry sectors.

Although the manufacturing sector is diverse, there are some common areas where energy is wasted. These are:

- Industrial buildings (including space heating, cooling and lighting).
- Compressed air.
- Motors and drives.
- Industrial process heating and cooling (including drying).

The table (page 5) shows end uses of energy that dominate in particular sub-sectors. This will help sub-sectors identify areas with the most energy saving opportunities.

Figure 1 Typical breakdown of Industrial energy consumption by end use (different processes)

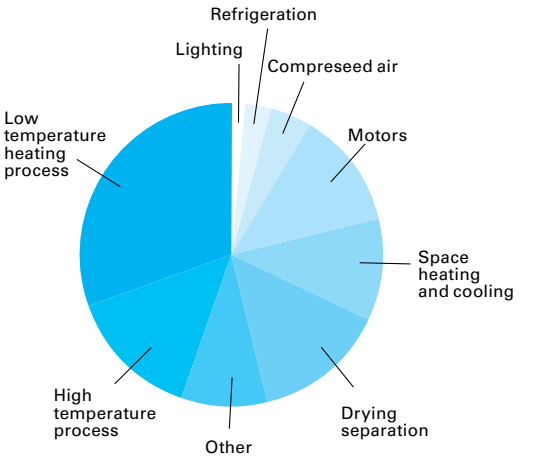


Table 1 Summary of the largest end uses of energy for the industrial sectors

Industry sector	Most energy saving potential
Cement, ceramics, foundries, glass	High temperature processes (furnaces/kilns)
Chemicals	Process heating; motor-driven processes, refrigeration
Engineering	Industrial buildings, including heating, boilers, steam systems and lighting
Food and drink manufacture	Boilers; process control; refrigeration
Paper making	Drying and separation
Printing	Compressed air

Who is this publication for?

This overview outlines energy cost saving ideas relevant to all manufacturing companies across all industry sectors. It is aimed at production and engineering managers and business leaders in manufacturing. It lists straightforward, low-cost measures as well as investment opportunities, which might require specialist advice and assistance.

The PSEE has the following specific sector overview publications which may be more relevant to certain sub-sectors:

Food and drink processing

- Food and drink processing
- Chemicals
- High temperature industry

Why save energy?

Energy bills have traditionally been considered as a fixed cost. However, with costs rising, taking a positive and proactive approach to energy efficiency can help manufacturing companies to control and reduce their energy spend. All manufacturers are under pressure to cut costs and increase profits, and saving energy is one good way to meet this goal.

Saving energy also improves environmental performance. It can help achieve the energy standard ISO 50001, the environmental standard ISO 14001 and, by cutting carbon emissions and helping to combat climate change, demonstrates a degree of corporate social responsibility to stakeholders.

Opportunities for energy saving

Industrial buildings

The energy used to heat, light and ventilate manufacturing premises may seem like a fixed overhead, but through proper control businesses can save between 15% and 20% or more of the energy used for each service.

Heating and cooling

Keeping the workplace at a comfortable temperature is essential for a happy workforce. It is not, however, usually core to production: a typical attitude is that as long as the heating and cooling systems work, they can be ignored.

Manufacturing processes often require premises to have high ceilings and good ventilation. Furthermore, delivery doors are often left open for convenience. All of these can lead to heating and cooling loss and inefficiency, wasting energy and money.

Heating and cooling alone can contribute greatly to manufacturers' energy bills. Many companies could save 20% or more of their heating and cooling costs by being more efficient in the way they manage and operate their heating systems.

Take control of your heating and cooling system

Settings on controls are often altered in response to a change in weather conditions or shift patterns. Up to 10% of heating and cooling costs can be saved through these simple measures:

- Check the thermostat regularly and set to the recommended temperature.
- If windows are regularly being opened when the heating or cooling are operating, consider altering the thermostat instead.
- Check all time switches regularly – make sure that the heating and cooling are off when the building is unoccupied.

Consider radiant heating

Because of the high ceilings and large spaces, manufacturing premises tend to lose warmed air easily and, therefore, cost more to heat.

If convective 'blown air' heaters are used, then consider changing to radiant heating. In this way, surfaces and workstations are heated directly, rather than the whole circulating air space being warmed. Therefore, radiant heating reduces losses and can improve comfort as there is more control over when the heat is on and where it is directed – the whole space need not be heated. Correct positioning of the heater is important. It should be placed directly in line with the person/object requiring the heat.

Further savings on heating can be made through boilers. See the next section on steam boilers for general hints, and also refer to other PSEE publications.

Did you know?

Space heating and cooling can account for 10-20% of all energy use in manufacturing depending on the sub sector.

Steam and hot water boilers

Many manufacturing companies use boilers to produce steam for processes; however, some of the actions suggested in this section are also applicable to low temperature hot water boilers.

Fact:

Around 10% of the heat produced in steam boilers can be lost through insufficient or ineffective insulation on the distribution system.

Keep boilers well maintained

A poorly maintained boiler can consume 10% more energy than one that has been well maintained. Most industrial sites require weekly boiler checks to troubleshoot any problems, such as warning lights, air-vent blockages and unusual noises. Boilers need servicing at least once a year or as recommended by the manufacturer, and burners and heat exchangers must be cleaned to remove the build-up of deposits. Any worn parts should also be replaced. The servicing should include a combustion and/or flue-gas test, and an adjustment to the fuel/air mix should be made to ensure that the boiler burns fuel efficiently.

Did you know?

Tuning your boiler can save money per year. Accurate control of the amount of combustion air is essential to boiler efficiency. Too much air will cool the furnace and carry away heat. Too little air will lead to incomplete combustion and possibly the formation of soot.

Case study

What other manufacturers are doing

A carpet yarn spinning and textile company employing nine people was spending up to R1 million on its annual energy bills. It was recommended that the company should replace an old boiler and steam heating system with suspended gas-fired fan heaters. Although the new system would cost almost R1 million, the payback period was under 5 years.

Check for leaks

Look for wisps of steam leaking from faulty steam traps, pipework flanges and joints. Leaks are easily detected and even a small leak can waste a lot of steam, so it is important to find and repair them promptly.

Fit insulation and inspect it regularly

Make sure that all distribution networks (such as pipes, valves and flanges) are fully insulated and that the insulation is in good condition. Reducing heat loss will cut running costs.

Isolate and control

Boilers are at their most efficient when operating at their maximum firing rate. If the business needs different rates of heat for different processes, it might be worth considering having several small boilers rather than one large one. Installing automated controls will also ensure that the boilers are used in the most efficient way.

Fact:

A single 3mm hole in your steam system could cost over R15,000/year!

Ventilation

Effective ventilation helps manufacturing companies to stay productive and safe. Because of this, many manufacturers are often concerned about changing ventilation systems that appear to be functioning adequately. However, ventilation can waste a significant amount of energy and require regular reviews.

Case study

What other manufacturers are doing

A steam trap survey at a refinery found 314 traps (8%) to be failing to open or passing steam. The steam trap replacement project provided an opportunity to standardise the assembly, installation and the approach to retrofitting. The reduction in energy losses through replacing the faulty steam traps saved over R750,000/year and made further maintenance easier and quicker.

Turn off unnecessary ventilation
If there is unnecessary ventilation, not only is energy being lost through running the ventilation system itself, but there also may be additional costs incurred in cooling or heating the replacement air.

Check that local extraction fans are not left running unnecessarily, either outside of production hours or during long breaks between shifts. When the fans cannot be seen or heard, detect air movement by holding thin strips of tissue paper in airflows or by using a child's bubble maker. Ask staff to ensure that ventilation is not running unnecessarily.

Consider automating controls
Consider automating the process of shutting down ventilation systems with controls such as timers, occupancy sensors or controls linked to machinery (interlocked controls). These will stop ventilation systems running when staff members are not working, or when related plants are off.

Localise ventilation
Locate process plant that needs local extractor ventilation in a special area and introduce fresh, untreated air close to the plant and extractor. This reduces costs by preventing heated or cooled air being drawn from the surrounding areas.

Fit and maintain shutters
Back-draught shutters or dampers prevent air blowing through fans when they are not in use. Ensure shutters or dampers are fitted and kept clean.

See the motors and drives section on page 16 for more energy saving ideas applicable to ventilation systems.

Case study

What other manufacturers are doing

By implementing improvements, one manufacturer saved nearly R2 million/year (equivalent to almost 4,000 tonnes of CO_2 per year) on ventilation costs. This was achieved by reducing fan speeds, installing non-return dampers and reducing chiller loading. The same actions could be taken by any manufacturer using large-scale ventilation and air conditioning, such as in the manufacture of semiconductors, pharmaceuticals or large computer suites.

Air conditioning

Air conditioning is sometimes essential to the manufacturing process, and it is often used to improve staff comfort (though this is more accurately referred to as 'comfort cooling', see box on the next page). Air conditioned buildings use around twice as much energy as naturally ventilated buildings. It is worth reviewing where air conditioning is used to save energy. Careful selection and control of air conditioning can reduce costs, as can a linked heating, ventilation and air conditioning system.

In recent years, there has been significant progress in the application of techniques that reduce the dependency on conventional air conditioning. For example, there is now a move towards natural and passive ventilation, mixed-mode operation and low energy cooling systems.

Control it – temperatures and times
It is a common occurrence for settings to be altered on air conditioning units and not reset correctly, so check temperature and time controls regularly. Make sure, for example, that temperatures are not set at an excessively low cooling set point, for example below 24°C. Look at the operating patterns of the air conditioning chillers relative to outside conditions and check for excessive running.

Review switch on temperatures. Set higher 'switch on' temperatures and set a gap or 'dead band' between the heating and air conditioning control temperatures of at least 4°C. This prevents both systems from operating at the same time improving staff comfort, cutting operating costs and reducing wear and tear on both systems.

Comfort and process requirements can be met while keeping the operation of the air conditioning system to a minimum.

Stop relative humidity control – if possible
Controlling relative humidity is very energy intensive. Consideration should be given to whether humidity control is really needed and, if so, keep the minimum and maximum acceptable humidity levels as far apart as possible. Also some processes may need relative humidity control although full air conditioning may not be necessary.

Take advantage of free cooling
Investigate ways to reduce the internal temperature at no cost, such as by using night cooling. This can be used when external temperatures at night are colder than the required internal temperature. It is operated by simply ventilating the building with fresh air outside of working hours.

More detailed information on all of these energy saving opportunities is available in the PSEE's overview of Heating, ventilation and air conditioning.

Did you know?

The true definition of an 'air conditioning system' is one which has the ability to control temperature, humidity and air quality within precise limits, yet the term is often applied to systems which simply cool the space. These cool air systems are more correctly referred to as 'comfort cooling'.

Lighting

Most manufacturing companies spend little time considering how their premises are lit. Lighting can be a good starting point to reducing energy costs, as many of the actions cost nothing to implement, and the payback in terms of staff morale and support, not to mention cost savings, can be great. By taking the following actions, up to 20% of the energy used to light a site could be saved.

Switch off lights
Lights switched on in the morning are often left on all day – even if they are not needed. Here are some simple ideas to ensure that lights in unoccupied areas are switched off, potentially saving up to 15% of lighting costs.

- Encourage people to turn off lights – use posters and team meetings to raise energy awareness and motivate people to turn off lights.
- Make sure everyone knows where the light switches are – label light switches so that it is easy to see which switch controls which light.
- Make sure that lights are switched off when the premises are closed – carry out a survey to find out if lights are turned off out of operating hours. Ask cleaning and security staff to turn off lights in unoccupied areas.

Make good use of natural light

Most people prefer to work in natural light so make the most of daylight when it is available. Try the following:

- Check how often and how well windows are cleaned; get the cleaner in more often if necessary.
- Check that any skylights are being used effectively.
- Make sure window blinds are open in daylight hours, except when needed to reduce glare or solar gain.
- Move any objects that are obstructing windows.
- Review the location of people and if possible move them closer to a natural light source.

Fact:

1% of industrial energy consumption is used for lighting, but it can be 5-10% for some manufacturing companies.

Replace inefficient lamps

Replace lamps with more efficient equivalents. For example, replace any 38mm diameter (T12) fluorescent tubes with slimmer 26mm diameter (T8) tubes or (T5) tubes and specify all new tubes to have a 'triphosphor' coating. This will save 10% of energy consumption and improve the quality of lighting over the whole tube life. Note: slimline tubes will not work in some older fittings, so buy one new tube to check that it works before purchasing in bulk.

In some industrial settings, high pressure sodium discharge lamps (SON) can be considered. Appropriate applications include areas where free standing and wall-mounted uplighters, floodlighting or external lighting are used. They may also be useful in warehouses and other areas with high ceilings. SONs combine high efficacy with long life and are particularly suitable where lamp access is difficult.

However, SONs are not suitable for frequent switching on and off, and take time to warm up. Therefore, they should not be operated by presence detectors for security lighting applications. They do not have good colour rendering so may not be appropriate where accurate colour perception is required, for example in some food and drink or chemicals production. If good colour rendering is important, factories could use metal halide lamps. Although these lamps have a shorter lamp life than SONs, they provide excellent, crisp white light.

High frequency T5 fluorescent lighting units or LED lighting (see below) suspended above the working area can be an efficient and more user-friendly alternative to metal halide lamps.

LED lighting

Modern LED lighting can now match the quality of most conventional light sources – and is considerably more efficient, and has longer bulb life. Savings of 50-80% in energy use are possible, plus maintenance savings from fewer replacements. Where lighting is being refurbished, and luminaires replaced, LED should be the first item considered.

Building fabric

Many manufacturers do not set aside money to maintain their walls, doors, windows and roofs. But investing in the building fabric of the premises is almost always cost effective because:

- It will decrease the chances of heat loss.
- It can increase the value of the property.
- It can boost staff morale by providing a more comfortable working environment.

Simple maintenance and housekeeping actions cost little and can save energy. Some examples of this include:

- When not in use, keep factory and loading bay doors closed to prevent heat loss.
- Repair broken or cracked windows as soon as possible and apply draught strips wherever draughts can be felt.

For a small investment, there are further measures which can be taken, as detailed right.

Separate warm from cool space

Separate heated offices or workspaces from unheated storage areas to reduce heat losses and improve comfort.

For doors that are used frequently consider fitting one of the following:

- Airlocks or lobby areas with doors at either end of an enclosed space.
- PVC curtains.
- Warm-air curtains.
- High-speed motorised doors.

Make sure the building fabric around doors is sealed. Avoid using doors at opposite sides of the warehouse at the same time because this will create a through draught.

Insulate roofs, skylights and cavity walls

Improving loft and wall insulation is the single most cost-effective measure that can be made to the building fabric.

- If the structure allows, make sure that there is at least 200mm of loft insulation. About 25% of a building's heat can escape through an un-insulated single skin roof (e.g. corrugated asbestos or corrugated iron). Methods for insulating these types of roof include lining, over-spraying and under-spraying.
- Consider installing polycarbonate secondary glazing under skylights – it can reduce heat losses by up to 50% and eliminates down draughts.
- Insulate cavity walls – it can reduce heat loss by up to 50%.
- As well as preventing heat loss in the cooler months, insulation can dramatically reduce cooling needs in summer by keeping internal temperatures down.

Redirect the heat

Heat rises, so if processes generate a lot of heat, the warmed air will be at the top of the building air space. Fitting de-stratification fans will re-circulate hot air back down to the shop floor, saving on heating costs.

Section 12L of the Income Tax Act

In November 2013, the Section 12L amendment to the Income Tax Act introduced a tax incentive for businesses that can show measurable energy savings. The 12L incentive allows companies to claim for tax deductions after implementing energy saving measures. The value of the incentive amounts to 45 cents deduction on taxable income per kilowatt hour of energy saved and is claimable until 2020.

Visit Sanedi.org.za for further information and tips on how to meet requirements.

Compressed air

For many manufacturers, compressed air is an essential utility. However, it is also a major source of energy wastage.

Compressed air is an expensive utility and many businesses spend money unnecessarily on it. Reducing wastage can save up to 30% of compressed air costs. Typical areas of wastage are through leaks in the distribution system and through staff using compressed air where it is not necessary.

Switch it off
Quite simply, if a compressor is not being used, then make sure that it is switched off. Pay particular attention to compressors at the end of shifts or over weekends.

Eliminate unnecessary compressed air usage
Identify where compressed air is used on a site and then check to make sure that it is required for the task. Industrial sites can often misuse compressed air just because the air supply is readily available, not because it is the most cost effective or appropriate method.

Fact:
An idling compressor can still use up to 40% of its full load.

For example, using low-pressure blowers is a more energy efficient way to dry components than using an 'air-knife' device running on compressed air. Another common misuse is cleaning machinery. If it is not necessary to use compressed air, then brushes and vacuums could be much cheaper alternatives.

Produce a compressed air usage policy for employees specifying where and when compressed air should and should not be used. Ensure that the policy is displayed at appropriate places across the site.

Case study
What other manufacturers are doing

A manufacturer reduced its energy costs by 20% after taking specialist advice on how to reduce its energy bill of more than R8 million. The firm was losing money through air leakages and poor compression during production processes. They purchased new equipment that delivered energy savings, such that the capital invested was set to be recouped within two to four years.

Ensure maintenance is carried out regularly
Follow the manufacturers' documentation for the recommended maintenance schedule. Maintenance routines should include lubrication, oil changes and filter replacement. A well-maintained compressor can be 10% more efficient than one that is poorly maintained.

Reduce air pressure
Many systems produce compressed air at a higher pressure than required. Ask equipment and tool manufacturers to specify the minimum air pressure necessary to drive the machinery and then ensure that the system meets, and does not exceed, these requirements.

If one specific application requires a higher pressure, then consider installing a smaller, local generator rather than increasing the pressure of the whole system.

Check frequently for leaks
Industrial sites often have compressed air leakage rates of up to 30%, wasting considerable amounts of energy and money. A systematic and regular leak-detection programme should be put in place to check for leaks and then make sure that they are repaired as quickly as possible. For manufacturers, it would be appropriate to schedule a leak-detection exercise every three months.

Leaks can be detected by simply listening to the system, by using a soapy solution on suspect areas to see if bubbles appear, or through ultrasonic leak detection which can be hired.

Once leaks are found, mark them on a plan of the system. Before attempting any repair work, make sure that the system is de-pressurised. Small leaks can be repaired on-site, but an equipment supplier should be contacted before tackling larger leaks. Consult a supplier if there is any doubt on how to proceed.

Did you know?

Correctly siting compressors is crucial – good placement could mean the compressors have access to cooler intake air, and a way to recover the heat that is normally expelled from the plant.

Are any parts of the system not needed?
Consider whether there are parts of the compressed air system that are not needed, such as unused pipework. Isolate areas that are not in use, this will increase the efficiency of the compressed air system.

If a system requires compressed air at different times in its operation, then consider using isolation valves to divide the system into zones.

Bring in air from outside
Colder air is denser so if the intake air is cooler, the compressor does not need to work as hard because the air requires less compression. Bringing in cooler intake air from outside can therefore produce substantial savings. Consider measuring the temperature difference to see how much could be saved.

For every 4°C drop in temperature of the intake air, efficiency improves by 1%.

Could waste heat be re-used?
Up to 90% of the heat generated by a compressor can be used to heat water or air. Therefore, consider whether the heat generated can be re-used to:

- Heat a space in the warehouse or workshop.
- Keep things dry – by simply placing the compressor in a warehouse, manufacturers could prevent perishable material such as cardboard boxes from becoming damp.

These and further measures are discussed in more detail in the PSEE technology overview of Compressed air.

Case study

What other manufacturers are doing

By implementing the action plan from an energy survey, a galvanising company is now saving over R100 000/year on its compressed air costs. The actions taken included: introducing a compressed air leakage reduction programme, installing a variable speed drive compressor and reducing the pressure of the compressed air system. The payback for the project was one to two years.

Motors and drives

Motors consume an estimated quarter of the electrical energy used by manufacturing sites. However, they are often overlooked and, as a result, many sites have relatively inefficient motor operations.

Did you know?

A fully loaded motor consumes its purchase cost in electricity in 60 to 80 days of continuous running. Always consider the whole life cycle costs before buying a new motor. Make sure calculations take into account the commissioning, installation and purchase costs as well as running costs, that is, energy and maintenance costs.

Switch it off

Identify all systems that use motors and encourage employees to turn them off when they are not required. Staff sometimes believe that leaving a motor on is necessary for a process, or even that it is more efficient to do so. Display information about when it is appropriate to turn off a motor, pump or fan.

Programmable controls, which switch machinery off automatically, could make energy saving even easier.

Maintain motor systems

Carrying out regular maintenance can reduce energy consumption by as much as 7%. Maintenance programmes should consist of lubrication schedules, cleaning, belt tensioning and alignment checks. It is also worth considering using predictive maintenance techniques that can indicate in advance when parts will need replacing. Motor suppliers will be able to provide more details.

Check that motors are the correct size

Motors are often larger than they need to be. Compare the details on the motor rating plate with the actual rating required by the equipment that the motor is driving. If a motor is oversized by 100% or more, then consider replacing it - preferably with a smaller, higher efficiency motor. If the motor is very lightly loaded (<40%) and cannot be changed, it may be possible to run the motor continually in a different connection mode (called star or delta mode), that could result in energy savings of between 5 and 10%.

Consult a motor supplier regarding connection modes. They will be able to assess the business's needs and advise about the most effective solution.

Replace failed motors with higher efficiency motors

It is usually better to purchase a new motor than to rewind an old one – new motors are between 1% and 2% more efficient than rewinds. Consider replacing failed motors with higher efficiency motors (HEMs). HEMs are more efficient than other motors due to their improved design and materials. Energy efficiency improvements of over 5% are possible if failed motors are replaced with higher efficiency models.

Reduce a motor's speed with a variable speed drive by 20% and energy consumption can drop by 50%.

Installing variable speed drives (VSDs)

A VSD (also know as a variable frequency drive or inverter) is an electronic device that can vary the speed of motor-driven equipment, such as a compressor, fan or pump. The VSD converts the incoming electrical supply of fixed frequency into a variable frequency output to control the motor – a low frequency for a slow speed and a higher frequency for a faster speed.

Fans and pumps are usually the best applications for a VSD. Usually, these are used in areas with a variable demand. Reducing the motor speed by 20% reduces the power requirement by about 50% and, therefore, greater energy savings can be made.

Refer to Motors and drives and to Variable speed drives for more detail.

Fact:

Installing a variable speed drive can typically save up to 30-40% of running costs.

Process heating

Process heating covers a wide range of systems. As this guide relates to manufacturing, this section focuses particularly on dryers, ovens and heated tanks. For information on other types of process heating, refer to the previous section on steam and hot water boilers (page 7) and read the overview on High temperature industry.

Changing or improving the manufacturing processes and recovering waste heat are the two main actions that should be considered by businesses with process heating systems. Other tips are more system-specific and these will generally require the help of an expert to implement.

Can the schedule or process be changed?

Once a process or method of working is in place it can be difficult to change. Sometimes, however, the most basic changes can give a good payback. For example:

- Has consideration been given to whether work schedules could be changed to operate equipment for shorter periods at higher capacity? Operating dryers, ovens and tanks when they are full is more efficient than running several half-loads.
- Could an alternative method be used? For example, mechanical de-watering, such as pressing or centrifuging, can reduce the need for drying heat and save energy eg. in clay brick manufacture, reducing the moisture content of the lay can significantly reduce drying energy.

Recover waste heat

The waste heat generated by most heating systems may be able to be recovered and re-used for various applications; such as preheating feedstock or a mains water feed, or as space heating in a workshop.

It may be possible to duct waste heat directly into an area for space heating – or it may be necessary to recover heat (for example hot combustion exhaust gases) using a heat exchanger.

Types of low temperature heat recovery equipment include:

- Plate heat exchangers: simple, cheap and low maintenance, but need adjacent supply and extract ducts.
- Runaround coils: supply and extract ducts don't need to be adjacent, but has moderate maintenance requirements.
- Rotary wheel: high recovery efficiency, but high maintenance and needs adjacent supply and extract ducts.

Dryers

Dryers are used in a range of manufacturing industries including food and drink, chemicals and paper. In some manufacturing sectors, dryers can contribute up to 30% of total energy use. Therefore, measures that can increase dryer efficiency or reduce the need for drying can lead to major energy savings and cost reductions.

Moisture levels

Put simply, preventing excess water getting into the feedstock during storage will reduce the amount of heat needed for drying. Conversely, increasing the allowable moisture content of the product will also reduce the need for drying. For example, an animal feed producer eliminated some dryers completely by re-branding the product and selling it undried.

Keep dryers well maintained

Make sure that dryers are regularly maintained and are operating efficiently. Check for the following and take action as needed:

- Damaged insulation. Check for signs of damage and repair insulation, either in-house or by using contractors.
- Air filters clogged or ripped. This could reduce or increase the airflow into the dryer and could, therefore, affect the drying rate. A contractor can replace the filter or unclog it using compressed air.
- Air leaks into or out of the dryer. A maintenance engineer or contractor can rectify this.
- Product quality. Ask if the product is over-dried or still wet. Monitor product quality and have controls adjusted accordingly.
- Operation of ancillary systems (such as steam, compressed air, fans and instruments). A utility manager or plant/process engineer should be able to optimise these for the required process.

Improve process scheduling

Proper scheduling should ensure that equipment is only preheated for the required period and no longer. Identify operations where dryers are heated unnecessarily and consider installing automatic controls such as a timed cut-out device.

Ovens

Ovens are used in many diverse processes ranging from baking food to curing paint. There are two main types of oven: batch and continuous. The choice of oven is largely governed by the needs of the product, but the information below is applicable to both types.

Inspect and maintain ovens

Ensure that ovens are regularly inspected. Check for worn or broken oven seals or damaged insulation, both of which lead to wasted heat energy. Repair these promptly.

Encourage employees to look for signs of inefficient ovens, such as hot air blowing out of the oven ends. Instances should be reported straightaway and maintenance checks made.

Improve process control

Bringing ovens up to temperature uses considerable heat energy. Therefore, identify the minimum time required to heat ovens and then install automatic process control to reduce the heat-up time. This will ensure that heating only takes place for as long as is necessary for the process.

Keep the heat in

In a batch oven, make sure that the doors are not left open longer than necessary. For continuous ovens, fit air curtains to tunnel openings to keep hot air in. If these are designed and balanced properly, staff should be able to stand close to the open ends without feeling any discomfort.

Tanks containing hot liquid

Tanks are widely used in manufacturing for wet processes such as glazing, degreasing and metal treatment. The following actions are low-cost measures to make tanks more efficient.

Reduce evaporation losses

Heat is lost from tank solutions through surface evaporation. Heat losses can be reduced by over 50% by fitting a lid to the tank, and by regulating the solution agitation and the level of extraction.

Cover and insulate

Tanks should be covered at night with a lid to reduce heat loss. This could halve the warm-up time the next day and save up to 30% of the heat energy. At least 50mm of insulation should be fitted to the tank sides and lid, which will result in savings of up to 90% of the heat energy.

Control solution temperatures and heating times

Tanks should not be preheated for excessive periods and should not be heated when they are not being used. Regularly maintaining and calibrating temperature sensors and controls will save energy and help to ensure product quality.

Case study

What other manufacturers are doing

An aluminium casting company has achieved impressive energy savings through implementing a number of measures at its factory including a Combined Heat and Power (CHP) unit, enabling electricity to be generated on-site and providing heat for the factory. In addition, airflow was reduced by zoning and installing automatic doors, and a Building Energy Management System (BEMS) was put in place to enable energy data to be gathered and analysed. These measures combined, resulted in annual total savings of R2,5 million equating to approximately 2,000 tonnes of CO_2.
The project achieved payback in four to six years.

Process cooling

Cooling systems are used anywhere there is a need to remove heat. The main types of cooling system are air-cooled, water-cooled and refrigerated. Process cooling is worth considering as a self-contained activity using the following steps:

Measure and monitor
Consider installing sub-meters so that it is easy to see how much electricity individual cooling processes or areas use. This will also help to identify areas where further energy savings can be made. The information gained will identify any deterioration in system performance, show the effects of operational changes and confirm the level of savings resulting from any actions taken.

Meter readings can be used to plot electricity consumption against production output. With good process control systems, there should be a direct relationship between the cooling system's electrical demand and the production output. If there is no direct relationship, then it is likely that the cooling system is not being controlled effectively.

See page 22 for more information on managing energy usage.

Implement effective control
Set target temperatures for processes. Monitor the actual temperatures achieved under normal working conditions and identify if there is any overcooling, which is a major cause of energy wastage in cooling systems. Overcooling could be reduced by changing operating procedures or by installing automatic controls. Control needs to be effective both at the point of use, (for example, the local control of temperature on a food processing line) and at the system level (for example, the control of cooling water temperature at a central cooling tower).

Plan a programme of maintenance
Ensure that the cooling system operates efficiently by carrying out planned, preventive maintenance.

Focus on the four key areas below:

- Pipework and controls – check for leaks, poor insulation, scale formation, sensors drifting and control valves sticking.
- Water treatment – necessary to meet health and safety requirements, and to prevent corrosion and fouling.
- Pumps – inspect regularly, replace worn parts and clean filters. When motors fail, consider replacing them with higher efficiency motors and make sure that the motor is not oversized. See page 16 for more information about motors.
- Cooling towers – check the thermostat controls on sump heaters, check for wear and damage to fans and water dispersion equipment.

Energy management

Good energy management costs almost nothing – but can lead to huge savings.

Develop a policy and raise awareness

Commitment to energy efficiency needs to come from senior managers, who should agree and implement an energy policy. The policy should clearly identify the formal roles and responsibilities of the management team. Make one person responsible for implementing energy, and allocate enough time and budget, to the role.

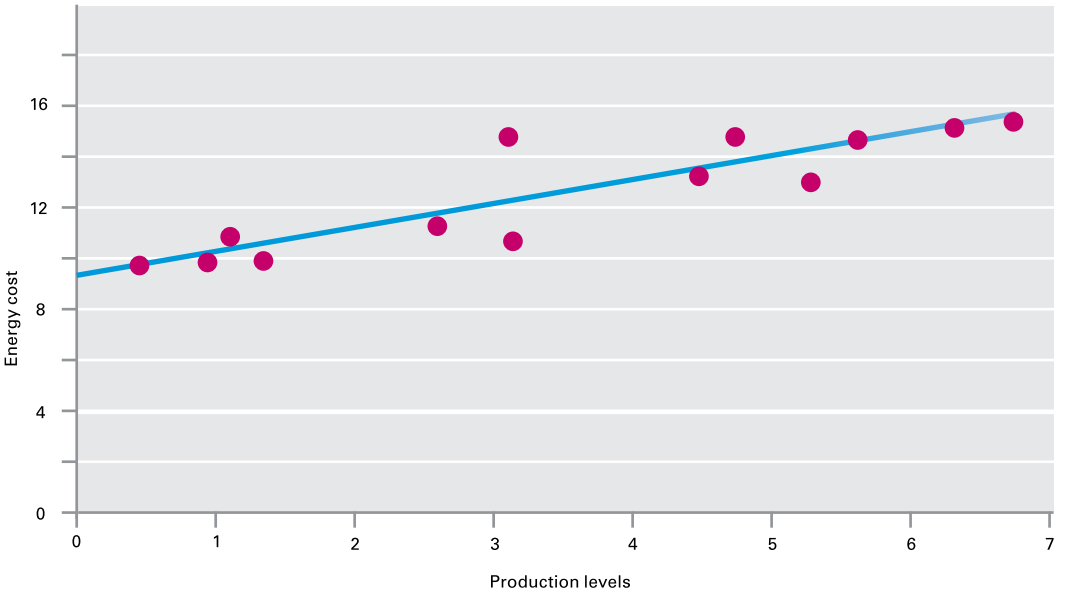
Conduct a walk round

Review energy use and procedures regularly by carrying out a walk round. Use a checklist, which could be based on the action checklist on page 24, to identify new sources of waste energy or new ways of saving energy. Further information is available in Assessing the energy use at your industrial site from the PSEE.

Monitor energy consumption

Measure energy consumption by reviewing invoices and meters to build a picture of monthly energy performance. Larger sites should have meters recording half-hourly electricity consumption which are a rich source of data.

Figure 2 Example graph of energy costs plotted against production



Check and record consumption of all energy sources for the site.

Understand energy consumption

Monitoring consumption helps to identify periods of high-energy use, such as periods of extra production. It can also demonstrate whether energy saving measures are having an impact.

As well as being a basic check on how the business is performing, energy use data can be useful when compared with production levels.

The simplest way to do this is to plot a graph comparing energy use against production levels like the one shown in Figure 3 above. The high intercept on this example shows that a high baseload of energy is being used, even when there is no production.

The slope of the graph shows production-related energy use. As energy saving measures in this overview are implemented, there should be a reduction in both the gradient and the intercept on the energy usage axis. Comparing energy use and performance data month on month, year on year can also show where energy savings measures have had an impact.

Set realistic targets and deadlines for improvement

Most businesses could reduce their energy consumption by between 10 and 40%. However, it is important to be realistic: many companies start by aiming for savings of 5% per year.

Have an action plan and implement it

An action plan should be developed listing improvements to be made, when they will be made and who will be responsible. The list should be prioritised in order of energy saving potential and payback period.

For further advice please download our Energy management guide.

Action checklist

Cost	Action	Progress
	Heating	
None	Check thermostat settings	
None	Check timer switches	
Medium	Consider radiant heating	
	Steam boilers and systems	
Low	Prepare a maintenance schedule	
Medium	Investigate installing automatic controls	
Low	Check for leaks	
Low	Fit insulation and inspect regularly	
	Ventilation	
None	Turn off ventilation when not needed	
Low	Consider automating controls	
Low	Put process plant that need local ventilation in a special area	
Low	Fit and maintain shutters	

Cost	Action	Progress
	Air conditioning	
None	Consider whether it is really necessary	
None	Check temperatures and times	
None	Stop relative humidity control – if possible	
None	Take advantage of free cooling	
	Lighting	
None	Switch off unnecessary lighting	
None	Make better use of natural light	
Low	Replace inefficient lamps	
	Building fabric	
None	Keep factory and loading bay doors closed when not in use	
Medium	Consider fitting airlocks/PVC curtains/warm-air curtains/motorised doors	
Medium	Fit destratification fans to recirculate heat	
Low	Repair broken windows and apply draft strips	
Medium	Insulate roofs, skylights and cavity walls	
	Compressed air	
None	Cut down on unnecessary compressed air usage	
None	Turn off compressors when not needed	
None	Reduce air pressure	

Cost	Action	Progress
None	Check frequently for leaks	
None	Isolate parts of the system that are not needed	
Low	Investigate supplying compressor air from outside	
	Motors and drives	
None	Switch off motors when they are not required	
Medium	Check that motors are the correct size	
Medium	Replace failed motors with higher efficiency ones	
Medium	Install variable speed drives where possible	
	Industrial process heating and cooling	
Low	Maintain all process equipment to optimum standard	
Variable	Automate controls where possible	
Medium–High	Check for any opportunities for waste heat recovery and use	
	Process heating	
Variable	Optimise the schedule or process	
Medium	Investigate waste heat recovery	
	Dryers	
None	Optimise the moisture level in the raw material or product	
None–Low	Switch off process heating when not required, consider automatic controls	

Cost	Action	Progress
	Ovens	
None–Medium	Close doors or fit air curtains	
	Tanks	
Low	Fit lids, control agitation and extraction	
Low	Insulate tanks	
	Process cooling	
Low	Identify areas of overcooling and rectify	
	Energy management	
None–Low	Develop a policy and raise awareness	
None–Low	Conduct a walk round	
None–Low	Monitor energy consumption	
None–Low	Analyse energy use	
None–Low	Set targets	
None–Low	Design an action plan	

Next Steps

Start with the following easy low and no-cost options to help save money and improve the energy performance of the site:

Step 1 Understand your energy use

Look at the site and identify the major areas of energy consumption. Check the condition and operation of equipment and monitor power consumption over one week to obtain a base figure against which energy improvements can be measured.

Step 2 Identify your opportunities

Compile an energy checklist. Walk round the site and complete the checklist at different times of day (including after hours) to identify where energy savings can be made. An example checklist can be found in the PSEE's fact sheet Assessing the energy use at your industrial site, and some ideas of actions you can take are given on pages 18-20 of this overview.

Step 3 Prioritise your actions

Draw up an action plan detailing a schedule of improvements that need to be made and when, along with who will be responsible for them.

Step 4 Seek specialist help

It may be possible to implement some energy saving measures in-house, but others may require specialist help. Discuss the more complex or expensive options with a qualified technician.

Step 5 Make the changes and measure the savings

Implement your energy saving actions and measure against original consumption figures. This will assist future management decisions regarding your energy priorities.

Step 6 Continue to manage your site's energy use

Enforce policies, systems and procedures to ensure the site operates efficiently and that savings are maintained in the future.

Plug into energy efficiency with PSEE

The Private Sector Energy Efficiency (PSEE) project aims to improve energy efficiency in industrial and commercial sectors across South Africa. PSEE offers a variety of services to help companies plug in to energy efficiency:

Website – Visit us at www.psee.org.za for our full range of advice and services.
➘ **www.psee.org.za**

Remote advice – Call us on 0801 113 943 or visit **www.psee.org.za** to access independent, authoritative advice and our publications and tools.

Publications – We have a library of publications detailing energy saving techniques for a range of sectors and technologies.
➘ **www.psee.org.za/Resouces**

Survey-based support – Review of energy use for medium-sized companies to identify energy savings opportunities and develop a suggested implementation plan.
➘ **www.psee.org.za/Services/Medium-Companies**

Case Studies – Our case studies show that it's often easier and less expensive than you might think to bring about real change.
➘ **www.psee.org.za/Resouces**

Strategic energy management – Holistic engagements for large companies to help improve operational energy efficiency and support the development of a comprehensive energy and carbon strategy.
➘ **www.psee.org.za/Services/Large-Companies**

The Private Sector Energy Efficiency (PSEE) programme aims to improve energy efficiency in commercial and industrial companies in South Africa through the provision of various services to assist companies in identifying and implementing energy saving measures. The PSEE programme is implemented by the National Business Initiative (NBI), supported by the Department of Energy, and funded by the UK Department for International Development (DFID).

e-mail: info@psee.co.za
tel: 0801 113 943
web: www.psee.org.za

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