Implementing Energy Efficiency for New Zealand Textiles Care Businesses
Introduction

This Quick Start Guide has been developed to help New Zealand textiles care operators to review the way they use energy in their operations and implement real energy savings. Real examples of improvements made within the New Zealand industry have been used to illustrate points wherever possible.

This Guide should act as a starting point to engage in energy management. Users can research individual areas in more depth as they find areas of relevance to their operations.

Acknowledgements

The Textiles Care Federation and Textiles NZ would like to acknowledge the following people who have contributed to this guide:

Simon Wilkinson, Stewardship Solutions Ltd. Co-author and coordinator.

Sam Fairley and Ross Grant, Energy NZ Ltd. Co-authors.

Brad Craig, La Nuova Apparelmaster. Peer reviewer.

Fred Gardyne, ALSCO. Peer reviewer.


Warren Frogley, Brandmad. Design.
How to Use This Guide

Chapter One of this Guide introduces the reader to energy management and advises on how to implement simple steps towards an energy management system. Taking this systematic approach has been consistently shown to deliver the best energy saving results for companies.

Chapter Two examines the different energy sources available and how these are charged to companies in New Zealand. Understanding fuels and their costs is an essential part of their management and can lead to significant cost savings.

Chapter Three contains the details of the technical energy saving initiatives for Textile Care sites. These can be used to help a company identify specific savings opportunities by making changes in processes or machinery.

Each energy efficiency opportunity is given a rating out of 5 in three situations, to allow the user to assess the value of the opportunity against the particular circumstances of the facility:

- **Retrofit** – retrofitting an existing plant.
- **New Facility** – building a new plant.
- **Operation/Maintenance** – ongoing facility operation and maintenance.

Each opportunity is also assessed in terms of the Financial Performance of the initiative.

### ADDITIONAL BENEFITS:

**Retrofit**
- Very difficult to implement and potentially risky
- Difficult to implement and requires high expertise
- Relatively easy to accomplish with some pitfalls
- Easy implementation with minimal expertise to accomplish
- Very easy to implement with minimum expertise

**New Facility**
- Very difficult to implement and potentially risky
- Difficult to implement and requires high expertise
- Relatively easy to accomplish with some pitfalls
- Easy implementation with minimal expertise to accomplish
- Very easy to implement with minimum expertise

**Maintenance**
- Potential increase in maintenance costs and difficult to avoid serious adverse effects
- Requires advanced training to maintain at a well-managed site
- Requires some degree of training to maintain at a well-managed site
- Easy to maintain at a well-managed site with minimal training
- Foolproof to operate and maintain

**Savings Potential**
- Very minimal potential savings relative to system energy use
- Low potential savings relative to system energy use
- Moderate potential savings relative to system energy use
- Good potential savings relative to system energy use
- Excellent potential savings relative to system energy use

**Payback**
- Very long payback
- Low payback
- Medium payback
- Quick payback
- Very quick payback

Note that cost savings and payback on initiatives will vary from site to site and depends on the price of energy, plant operating hours and other variables.
Energy Management

Why look at energy?

Improving the way your business manages energy use has financial, environmental and reputational benefits. Systematically identifying energy performance improvements can drive significant cost savings, competitive advantages and mitigate against energy price volatility.

Financial

Energy is a variable and controllable cost for manufacturing businesses. Improving energy efficiency is one of the simplest ways to reduce costs and improve competitiveness. Every dollar saved in energy translates directly into a dollar increase in profit. This can be simply translated into the equivalent in new sales. If the profit margin of your business is 10%, then every $1,000 saved through energy management is the equivalent of $10,000 in additional product sales.

Environmental

Using energy more efficiently means less energy generation and consequently less impact on the environment. A reduction in energy use is often the primary means by which a business can reduce its greenhouse gas emissions. For example, in New Zealand, a reduction of 1 kWh of mains electricity saves the equivalent of 0.15 kg of CO₂.

Reputational

Customers are increasingly looking at the environmental performance of companies they buy products from. Implementing energy efficiency is an important way of demonstrating a company’s environmental performance.

Energy Management Systems

Maximum results can be achieved by approaching energy efficiency in a systematic way. An energy management system (EnMS) establishes an ongoing process of identifying, planning and implementing improvements in the way an organisation uses energy. An energy management system does not need to be complicated and should be tailored to the size of the business.

A large business should consider following the ISO 50001 international standard for energy management systems. For a smaller business this may not be practical, and a simpler version can be applied. Key components of an EnMS are:

- Form an energy team and make one person responsible for energy
- Develop an energy policy
- Monitor energy use
- Review efficiency opportunities
- Create and follow an action plan
- Review and improve

Further information on taking an energy management approach in your business can be found in the EECA Guide “Setting up an Energy Management Programme” downloadable from www.eecabusiness.govt.nz.

Form an Energy Team

Energy use cuts across all facets of business operations. It is therefore important that relevant parts of a business are involved in finding ways to use energy more efficiently. Form an internal energy team that meets regularly to review energy and progress energy initiatives. Best results have been achieved when this team includes the company CEO or equivalent, the financial manager, as well as technical staff such as operations and production managers.

Make one person within the energy team the site Energy Champion. This person monitors energy use and is the main driver for implementing energy efficiency across the organisation.

Create an Energy Policy

Developing a company policy on energy is important because it demonstrates that the organisation, including senior management, is committed to improving energy efficiency. Typically an energy policy will state how energy management aligns with the company’s broader business improvement goals, and will set a measurable target for improvement. For example, the policy might include a reduction in the amount of energy per unit of production, and a timeframe within which the goal should be achieved.

Examples of energy policies are available on the internet, such as:

EECA - www.eecabusiness.govt.nz/content/energy-policy
UK Carbon Trust – template energy policy in Guide CTG045 www.carbontrust.com


Nb. Emissions factors for electricity change every year.
Monitor Energy Use

Understanding how energy is being used in a business is a core element of managing energy and can provide many insights into the relationship between energy and productivity. Studies in the US and UK have found that simply implementing a system for monitoring energy use on industrial sites will result in average energy savings of 10\%\(^2\).

It is recommended that, as a minimum, a business tracks monthly energy use and plots this against production levels. For a textile care operator production could be either number of items processed, or kg of laundry processed. Energy vs production is known as your Energy Performance Indicator (EnPI). The Textile Care Federation has developed a simple-to-use tool for tracking energy use against production levels. This is known as your Energy Performance Indicator (EnPI). Textiles New Zealand has developed a simple-to-use tool for tracking energy use against production levels. The Excel-based tool can be downloaded from www.textilesnz.org.nz. By tracking monthly energy use against production, it is possible to identify trends and spot any variations or anomalies. Also, the use of a monitoring system allows the site to accurately track the effect of any plant upgrades, and the true energy savings achieved can be realised.

Process operation and control decisions can be influenced by assessing the energy performance indicator and investigating how different operators run the plant. Graph 1 comes from a site with a monitoring system and shows an example of how these indicators can be used to obtain plant operation savings. Through analysing the outlying days it was discovered that the main difference between these periods was the operation of the plant. Based on this information, key operating procedures have been changed and as a result will save an estimated 7.7\% of the site’s total energy use. Furthermore, additional trials are underway with new operating procedures being tested to ascertain if further energy savings can be achieved.

More detailed energy monitoring may be beneficial, particularly on large and complex sites. Temporary meters can be hired and installed in key locations for short-term monitoring. In some cases it will be appropriate to install permanent metering systems, some of which can be integrated and connected to user-friendly interfaces to allow for easy real-time energy monitoring.

Graph 1: Assessment of energy performance indicator (EnPI)

![Graph 1: Assessment of energy performance indicator (EnPI)](image)

\[ y = 1.0704x + 15768 \]
\[ R^2 = 0.75325 \]

\(^2\) Studies from US Dept of Energy and UK Carbon Trust
Assess Efficiency Opportunities

With a company energy policy in place and energy being monitored against production, the next step is to systematically assess opportunities for improving energy efficiency. Some companies choose to do this in-house.

There are guides and tools available to help self-audit a site. For example, EECA has developed an online self-assessment tool called Energy Leader: [www.eecabusiness.govt.nz/services-and-funding/energy-leader](http://www.eecabusiness.govt.nz/services-and-funding/energy-leader).


For many businesses there are not sufficient resources or expertise in-house to allow for a good quality review of energy efficiency. Even when the resources do exist in-house, many companies choose to use an external independent energy expert to assess opportunities for energy efficiency. There are many independent energy experts in New Zealand that can provide an audit or assessment of whole industrial sites, or specific processes or parts of a plant. For example, a site may choose to seek external expertise to review thermal systems such as boilers.

A list of experts and the services they provide can be found on the website of the Energy Management Association of NZ; [www.emanz.org.nz](http://www.emanz.org.nz).

Business Decisions

Further analysis is usually required before a decision is made on what opportunities to implement. Businesses will have established practices for evaluating and seeking funds for new projects. Energy efficiency opportunities that merit a more detailed analysis should use these existing processes.

It is important to develop a whole-of-business evaluation for each project. Key members of the energy team should help in refining the business case, developing recommendations and selling projects internally.

The business case should consider all relevant and measurable business costs and benefits, not just direct energy-related costs and benefits. Some of the likely costs and benefits that might be considered for each identified opportunity include impacts on production, product quality and value, health and safety, labour, public relations and waste disposal costs.

The business case should be developed to be consistent with the organisation’s evaluation methodologies and processes for capital expenditure approvals. Many companies use internal rate of return and/or net present value as investment criteria.

\[
\text{Simple payback} = \frac{\text{Initial capital cost}}{\text{Net annual saving including all business costs and benefits}}
\]

Implement an Energy Action Plan

Once a systematic review has been conducted, the findings should be converted into a plan of action to implement efficiency opportunities. The plan of action should be developed by the company energy team, drawing on expertise from throughout the business.

The action plan will allow a site to prioritise initiatives and plan for any necessary expenditure. Short-term and low-cost measures are usually a good way to start because they can make an immediate impact and generate interest in the programme. The action plan should identify staff that will be responsible for each initiative, and timeframes for making the changes. Timeframes can be divided into short, medium and long-term initiatives.

Part of the energy action plan should include communicating initiatives to staff and training them on new equipment and procedures.

Review and Improve

An organisation should periodically review the performance of the energy management programme. Revisit the targets set using the energy performance indicator data being collected.

Reassess the energy action plan to find new savings and make sure that the programme is not slipping. Minor reviews could be scheduled at three and six-monthly intervals, with a full yearly review to keep the plan fresh.
Understanding Energy

Energy is one of the largest overheads for a textiles care operation and can represent between 10 and 30% of total costs. It therefore makes sense to understand the properties of different energy sources, and how they are charged for, as this may lead to significant cost savings for textile care companies.

Energy Benchmarking

Once a textile care operator has started to monitor energy use and production levels (see section 1.2.3) it can be useful to benchmark performance against other operators. By comparing energy performance against similar companies, opportunities for improvement may be revealed.

Simply collect energy data as described in section 1.2.3, converting all energy use data into kWh using conversion factors that can be found in section 2.4.2. Combine this with kg of laundry processed during the same period and an energy performance indicator of kWh/kg can be produced. The Textiles Energy Monitoring Tool available at www.textilecare.co.nz provides an easy way of collecting this data.

There is limited data on the energy performance of New Zealand textile care operations. Energy assessments of four small/medium sized NZ textile care sites ($50,000 to $200,000 annual energy spend) found the benchmarking data in the table below. Because the data is only from 7 sites, it should be treated with some caution.

<table>
<thead>
<tr>
<th>Site</th>
<th>kWh/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>2.82</td>
</tr>
<tr>
<td>Site 2</td>
<td>2.64</td>
</tr>
<tr>
<td>Site 3</td>
<td>2.29</td>
</tr>
<tr>
<td>Site 4</td>
<td>2.35</td>
</tr>
<tr>
<td>Site 5</td>
<td>2.13</td>
</tr>
<tr>
<td>Site 6</td>
<td>1.98</td>
</tr>
<tr>
<td>Site 7</td>
<td>1.77</td>
</tr>
<tr>
<td>NZ Average</td>
<td>2.28</td>
</tr>
</tbody>
</table>

More comprehensive energy performance data is available from UK textile care operators and can be used to compare against the performance of New Zealand operations.

<table>
<thead>
<tr>
<th>Type of laundry</th>
<th>Current range of performance (kWh/kg)</th>
<th>Target range of performance (kWh/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very small on-premises laundries/ self-service launderettes on-site</td>
<td>3.5 – 5.6</td>
<td>3.0 – 3.6</td>
</tr>
<tr>
<td>Small commercial laundries and on-premises laundries processing fewer than 100,000 pieces/week</td>
<td>2.1 – 3.9</td>
<td>2.0 – 2.9</td>
</tr>
<tr>
<td>Medium-sized laundries processing 100,000-400,000 pieces/week</td>
<td>2.0 – 3.1</td>
<td>1.7 – 1.9</td>
</tr>
<tr>
<td>Large modern laundries processing over 400,000 pieces/week</td>
<td>1.6 – 2.8</td>
<td>1.3 – 1.6</td>
</tr>
<tr>
<td>Best laundries in the UK</td>
<td>below 1.3</td>
<td>below 1.2</td>
</tr>
</tbody>
</table>

Source: Carbon Trust UK, “Energy Saving Opportunities in Laundries”
Understanding Electricity

It is important to understand how electricity is distributed to a business because this results in some of the costs charged by energy companies. Understanding, and closely monitoring, electricity charges can result in significant cost savings. Use the sections below to get a better understanding of your electricity supply and how you are charged for it.

Basic Principles

Electricity is energy converted from another type at a power station and delivered to your site via national and local transmission and distribution systems. It is most commonly measured in kilowatts (kW) as the power drawn at any one point in time, and kilowatt-hours (kWh) as the total amount of energy delivered over a certain length of time. For example, a motor using 10 kW of power for 10 hours would consume 100 kWh of electrical energy.

Generation & Delivery of Electricity

The supply of electricity occurs in a number of stages, and payment for these services follows a completely different route. From the generator, electricity enters the National Grid, operated by state-owned enterprise Transpower. Upon exiting the transmission grid, the electricity then passes over to one of 28 local distribution companies, which each have their own territorial monopoly for some region of the country. Power is then delivered direct to the customer over this network.

With some rare exceptions, the customer pays all electricity costs direct to their chosen retailer. The retailer purchases the necessary energy from the Wholesale Spot Market, and pays any delivery costs to the customer’s local distribution company. Distribution companies incorporate transmission charges into their own charges, and pay the necessary fees for their region to Transpower.

As a user of electricity, you have no choice over who generates, transmits or distributes the energy you purchase. The only choice is in which retailer to use, and retailers have a purely administrative role in the process.
Understanding Invoices

Understanding Your Charges

Electricity invoices vary significantly in layout, complexity and methodology depending on the retailer, type of metering used, and which network region the site is in. Of these, the largest difference is between standard non-half-hour (NHH) metering — which is effectively the same as a normal household power bill — and Time of Use (TOU) metering, which is generally only used for larger customers and those with consistent 24/7 loads, and has a more complex pricing system that rewards or penalises the customer depending on when and how the energy is used.

For sites using less than perhaps $50,000 per year in electricity, TOU metering is rare and typically not of financial benefit, so standard NHH metering is normally used. Invoices of this type are relatively simple, typically consisting of little more than a single charge per unit (kWh) of energy consumed, and a single fixed daily charge. The small Electricity Levy is often shown separately, there may be multiple meters, and different retailers offer various discounts for prompt payment of the invoice, but the underlying principle is simple — you pay for the energy you use at a fixed price, so the amount of money you can save will be directly related to the energy-use reductions you can make. The following example shows the savings that could be achieved for a 2 kW reduction of power for 12 hours per day, 200 days per year:

<table>
<thead>
<tr>
<th></th>
<th>Annual Energy Reduction = 2 kW x 12 hours x 200 days = 4,800 kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Energy Price</td>
<td>= (Energy Price + Levy Price) x Discounted Rate</td>
</tr>
<tr>
<td></td>
<td>= ($0.1800/kWh + $0.0020/kWh) x 90%w</td>
</tr>
<tr>
<td></td>
<td>= $0.1638/kWh</td>
</tr>
<tr>
<td>Annual Energy Cost Reduction</td>
<td>= 4,800 kWh x $0.1638/kWh</td>
</tr>
<tr>
<td></td>
<td>= $786</td>
</tr>
</tbody>
</table>
Energy Pricing and Contracts

Make sure you have the best electricity price available, and lock it into a contract if possible.

A key area of minimising electricity costs with standard metering is to ensure that the lowest pricing is always in use. This means searching for and selecting the best pricing at the time, then when these prices go up, selecting the new best price. Changing retailer is generally required to get a better price, but many retailers offer fixed-price contracts in which the best price can be locked in for up to two years.

The difference between the best and worst retail pricing offer is generally around 10%, but can be over 20% in extreme cases. For example, a site spending $15,000/year on electrical energy could easily waste $1,500 (10%) by per year by failing to properly assess and select the best available offer, or by allowing the retailer to increase their prices without investigating better alternatives.

Determining which offer is best does require some attention to detail, as retailers also have a range of additional costs and discounts that can have a major impact on the overall economics of their offer. If in any doubt, ask the retailer what prompt payment discount they offer, and if there are any levies or other costs not included in the prices they have supplied.

Case Study A: Shopping around pays off with 10% electricity cost savings

An Auckland site with moderate electricity spend of $21,500 per year decided to investigate alternative retailers to check whether their current pricing was good. By modeling each retailer’s pricing offer against the site’s annual energy consumption, it was found that their current retailer had the worst pricing of any available — and that the best-priced retailer would save $2,120 per year. To make it even better, the best retailer offered a contract to lock in their pricing for two years, protecting against future price increases.

Prompt Payment Discount

Virtually all retailers offer a discount for prompt payment of the invoice, although the discount rate does vary. Failing to pay on time means forfeiting this discount, which is often 10 – 15% of the total bill and represents a significant cost penalty. Payment by direct debit is recommended, as it ensures that the account is paid on time and the lowest price paid.
Understanding Thermal Fuels

Many textiles companies in New Zealand utilise fuels such as gas, coal and diesel in addition to electricity. It is important to understand the properties of these fuels in order to assess potential cost savings and compare one energy source against others.

**Basic Principles**

Thermal fuels are generally significantly cheaper than electricity per unit of energy, but harnessing this energy efficiently is the challenge. Combusting these fuels to generate heat also requires specialised equipment and maintenance.

Common thermal fuels used in stationary applications in New Zealand are natural gas (North Island only), diesel, liquefied petroleum gas (LPG) and coal. Various other fuels, primarily low-grade or waste oils, are also used by some larger industrial operations.

**Efficiency of Use**

Unlike electricity, where the energy delivered to site is effectively the energy available to be used, there are inherent inefficiencies in the use of thermal fuels that increase the net price of usable energy. The first of these, which is specific to the equipment and tuning, is further examined in Section 3.1.4. The second inefficiency, which is related to the fuel chemistry, is caused by the production of water vapour when the fuel is combusted.

Water requires a significant amount of input energy in order to change from a liquid to a gas (steam), and is produced as a fundamental outcome of burning any hydrocarbon-based fuel. Consequently, any burnt fuel has some of its available energy locked away in water vapour, which cannot be recovered without expensive specialist equipment that reduces the exhaust gas temperature to a point where the water can be condensed and its energy absorbed. Without this equipment, the energy is simply lost to the atmosphere regardless of how efficient and well-tuned the system is.

The total amount of energy produced by burning a fuel is measured as its gross calorific value (GCV), which is also sometimes known as a higher heating value (HHV). This includes the energy locked away in water vapour. In contrast, the net calorific value (NCV) or lower heating value (LHV) is a measure of the available energy without condensing any water vapour. As all fuels are sold on the basis of their GCV, the ratio between the two values represents the maximum efficiency that can be achieved without using a condensing system. This ratio is shown for the common thermal fuels in the following table.

<table>
<thead>
<tr>
<th>Fuel</th>
<th>NCV/GCV Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>90.4%</td>
</tr>
<tr>
<td>Diesel</td>
<td>93.8%</td>
</tr>
<tr>
<td>LPG</td>
<td>92.2%</td>
</tr>
<tr>
<td>Coal;</td>
<td></td>
</tr>
<tr>
<td>- Bituminous</td>
<td>95.7%</td>
</tr>
<tr>
<td>- Sub-bituminous</td>
<td>93.9%</td>
</tr>
<tr>
<td>- Lignite</td>
<td>90.1%</td>
</tr>
</tbody>
</table>

The table above shows that bituminous coal, for example, produces less water vapour and is therefore more efficient than lignite coal. Diesel produces less water vapour than natural gas, thus losing less energy via this process, but the cleaner-burning nature of natural gas will often counteract this by producing less fouling in the heat exchanger. This is thermal efficiency, and not necessarily economic efficiency.
**Understanding Thermal Fuel Invoices**

Invoices for thermal fuels are generally simple, but can present energy consumption volumes in a range of different units, making it difficult to compare between products or suppliers.

Use the table below to convert different fuel types to kWh and enable comparison to electricity prices.

**Unit Conversions**

The table below shows conversions between commonly used sale units for the various fuels. Pricing is approximate, but broadly indicative for comparison between different fuel options.

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Common Measurements</th>
<th>Basic Conversion</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural Gas</strong></td>
<td>GJ</td>
<td>Multiply by 277.78</td>
<td>1 GJ = 277.78 kWh</td>
</tr>
<tr>
<td></td>
<td>$/GJ</td>
<td>Divide by 2.7778</td>
<td>$15/GJ = 5.4 c/kWh</td>
</tr>
<tr>
<td><strong>Diesel</strong></td>
<td>Litres</td>
<td>Multiply by 10.63</td>
<td>1 litre = 10.63 kWh</td>
</tr>
<tr>
<td></td>
<td>$/litre</td>
<td>Multiply by 9.4</td>
<td>$1.50/litre = 14.1 c/kWh</td>
</tr>
<tr>
<td><strong>LPG</strong></td>
<td>GJ or $/GJ</td>
<td>Same as for natural gas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Litres</td>
<td>Multiply by 7.36</td>
<td>1 litre = 7.36 kWh</td>
</tr>
<tr>
<td></td>
<td>kg</td>
<td>Multiply by 13.75</td>
<td>1 kg = 13.75 kWh</td>
</tr>
<tr>
<td></td>
<td>$/litre</td>
<td>Multiply by 13.6</td>
<td>$1.30/litre = 17.68 c/kWh</td>
</tr>
<tr>
<td></td>
<td>$/kg</td>
<td>Multiply by 7.3</td>
<td>$2.20/kg = 16.06 c/kWh</td>
</tr>
<tr>
<td><strong>Coal</strong></td>
<td>- Bituminous*</td>
<td>Tonne</td>
<td>Multiply by 8,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Divide by 80</td>
<td>1 tonne = 8,000 kWh</td>
</tr>
<tr>
<td></td>
<td>$/tonne</td>
<td>Divide by 80</td>
<td>$175/tonne = 2.19 c/kWh</td>
</tr>
<tr>
<td></td>
<td>- Sub-bituminous*</td>
<td>Tonne</td>
<td>Multiply by 6,200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Divide by 62</td>
<td>1 tonne = 6,200 kWh</td>
</tr>
<tr>
<td></td>
<td>$/tonne</td>
<td>Divide by 62</td>
<td>$125/tonne = 2.00 c/kWh</td>
</tr>
<tr>
<td></td>
<td>- Lignite*</td>
<td>Tonne</td>
<td>Multiply by 4,400</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Divide by 44</td>
<td>1 tonne = 4,400 kWh</td>
</tr>
<tr>
<td></td>
<td>$/tonne</td>
<td>Divide by 44</td>
<td>$90/tonne = 2.05 c/kWh</td>
</tr>
</tbody>
</table>

*Indicative only. Contact your coal supplier for values specific to their product.
Fuel Change

There is often potential to switch to a different fuel and provide the same level of thermal energy for a process at a significantly reduced cost. This is generally only true when the more-expensive fuels, such as diesel and LPG, are currently in use. Unfortunately, the use of some thermal fuels in New Zealand is restricted by geographic location or difficulty of use.

Initiative 1: Consider Thermal Fuel Alternatives

Investigate thermal fuel alternatives such as wood-waste. This may be especially cost-effective for companies who are currently using expensive fuels such as diesel or LPG.

In North Island urban areas, the simplest replacement option is typically reticulated natural gas, as this is available throughout virtually all main towns and cities. Natural gas has the advantages of being clean-burning and easy to maintain, minimising consent requirements and ongoing maintenance costs, as well as being as little as one-third of the price per unit of energy as diesel or LPG. In many cases the cost to connect the site to the gas network is zero, requiring only pipework and possibly burner upgrades to be paid for.

Where natural gas is not available, such as in the South Island, lower-grade fuels such as coal, wood-waste or recycled (waste) oil will give a lower fuel price. Although these can generally be obtained at very low price, all have difficulties inherent in their use. For example, they typically require significant maintenance due to production of soot, ash or other wastes, and can require much greater investment in storage, handling and combustion facilities. Local air-quality codes can also mean that their use is restricted or banned outright in some areas. In general, changing to such low-grade fuels will only make economic sense when the current thermal-fuel expenditure is large. For example, tens of thousands of dollars in annual fuel spend may not justify the change, whereas hundreds of thousands almost certainly will.

Case Study A: Southland textiles company reduces fuel bill by 64%

A Southland textiles company trialled waste oil and visited lignite and wood-mass burning sites before deciding on a wood-mass solution to replace their LPG boiler. The solution involved a specially designed 3.4 MW boiler, wet scrubber system with heat recovery, and two dry fuel bins. The total fuel savings achieved were $323,000 p.a. at a total project cost of $674,000, resulting in a payback period slightly over two years.

Source: Energy NZ Ltd
Energy Efficiency Opportunities

This chapter sets out the common opportunities for energy efficiency found in textiles care operations.

**Thermal Systems / Process Heating**

Thermal systems are essential to textile care facilities as they provide heating for the washing, drying and finishing stages of the laundering process. These processes include distributed boiler systems, as well as direct-heating systems such as for electric tumble dryers. Thermal energy consumption is the largest end-use energy consumption at textile care sites, usually accounting for well over 50% of a site’s total energy consumption. Thermal systems should therefore be targeted as a priority for energy reductions as they present a large opportunity significantly improve the site’s energy efficiency.

Assessing the efficiency of a site’s thermal systems involves four steps:

1. **Assess the demand side of the system.** It is important to investigate the demand side of a system before any optimisation of the supply side. Avoid investigating supply-side improvements without first considering measures to reduce the demand.

2. **Assess heat recovery opportunities within the system.** Once demand requirements are assessed, potential heat recovery opportunities can then be investigated to help meet some of these demands.

3. **Assess the distribution effectiveness of the system.** For distributed systems, such as steam systems, the network should also be investigated to ensure heat is transported effectively with minimal losses.

4. **Assess the generation (supply side) of the system.** Once the demand side and network issues have been addressed, the thermal system generation side should then be investigated. This involves ensuring that the heat generation plant is suitable and operating correctly to meet demand requirements.

**Reduce demand and assess heat recovery opportunities**

**Initiative 1: Isolation of Heat Users**

Minimise unnecessary heat loss by ensuring that all heat users are isolated when they are not in use.

Encourage staff to manually isolate machinery, such as dryers, from the heating network when not in use. This may require the additional installation of valves, although valves are often already in place for maintenance purposes. This can also be automated so that machinery is always isolated when not operating.
Assess heat recovery opportunities

Initiative 2: Thermal System Heat Recovery

Recover heat from the thermal system or other utilities for use in other sections of the thermal system.

This refers to heat recovery from within the thermal system or from waste heat produced from other utilities. There may be several heat recovery opportunities such as boiler blowdown heat recovery, economiser heat recovery, condensate recovery, and hot water waste heat recovery.

Case Study A: Washing machine discharge hot water heat recovery saves $10,763 per year

A New Zealand laundering company discharged washing machine hot water (“greywater”) from the site. A typical 90 kg load accounts for over 1,500 litres of water at an overall average temperature of 40°C. Based on average number of loads per day, using this greywater to preheat the domestic boiler feedwater via heat exchanger saves close to 175,000 kWh per annum.

Determine the effectiveness of the distribution system

Initiative 3: Insulation

Ensure all steam, hot water, and condensate lines are insulated effectively, including exposed valves and flanges.

Insufficient insulation on supply and return piping, valves, flanges and heat users can result in significant heat loss. Removable insulating jackets are an effective solution for sections such as exposed valves. Thermal imaging is a common method for finding exposed sections or damaged insulation.

Case Study B: Insulating steam and hot water lines saves $3,681 per year

A South Island dry cleaning company had a number of uninsulated steam and hot water lines. These uninsulated sections accounted for a significant amount of waste heat. Through insulation of these sections, the dry cleaners saved $3,681 per year in diesel costs and improved health and safety by reducing the hot surface risk to workers.
Initiative 4: Steam Trap Testing and Hot Water Leaks Repair

Regularly survey steam traps to ensure their correct functionality and maintain the distribution network to minimise any fluid leakage and therefore heat loss.

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**ADDITIONAL BENEFITS:** Improves the reliability and consistency of heating throughout the network

Steam trap leakage is often the cause of significant heat loss, with the majority of heat loss in the form of latent heat. Hot water leakage from the distribution network results in lost fluid along with the energy content associated with it.

A steam trap management programme should be in place to avoid large energy losses, and it is also important to find and repair hot water leaks as soon as possible.

**Case Study C: Steam leak repair saves $826 per year**

At a relatively small dry cleaning facility, a number of steam leaks were observed in the network feeding the industrial dry-cleaning machine. Repairing these leaks cost around $500, reducing the boiler’s energy consumption by close to 14,000 kWh.

Initiative 5: Pipe Sizing and Network Design

Optimise the pipe sizing and arrangement to minimise dynamic losses in distributing the heat-transfer medium.

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**ADDITIONAL BENEFITS:** More effective distribution of heat throughout the network

Pipe network design software can be used to analyse the system’s distribution effectiveness. This will identify areas with excessive frictional/pressure losses resulting from undersized pipework, and incorrectly installed valves or pipe configurations. It is much more cost-effective to undertake this in the design stage than retrospectively.
Optimise the heat generation system

**Initiative 6: Boiler Suitability**

Ensure boilers are well suited to their application and sized accordingly.

A boiler may be operating efficiently compared to its design performance, yet is not the most efficient boiler for the application. This is a common problem for oversized boilers that short-cycle. Replacing a boiler is a large cost, but the potential savings in energy and maintenance costs can be worthwhile.

**Initiative 7: Combustion Efficiency**

Perform combustion efficiency tests on boilers and minimise excess oxygen to maintain adequate efficiency.

A hot water heater or steam boiler’s combustion efficiency is very important, as it ultimately determines how much fuel is used and therefore the cost to operate the heating system. Boiler/burner systems should undertake regular combustion testing to minimise excess oxygen. For instance, an efficient natural gas burner requires only 2% to 4% excess air in the flue gas. CO and oxygen sensors can be used to continuously optimise the fuel/air mixture.

**Case Study D: Boiler pressure reduction and boiler tuning saves $3,131 per year**

At a North Island laundering company site, shifting the ironing processes to another site reduced the requirement for steam. This enabled the lowering of the pressure setpoint. Lowering this setpoint increased the rate of energy transfer between the combustion gases and the steam, reducing the boiler’s exhaust temperature and hence decreasing stack losses and improving efficiency. The site also had no regular combustion testing, which was also undertaken. Through pressure reduction and boiler tuning, the combined natural gas energy reduction equated to 52,509 kWh.

**Initiative 8: Managing Fouling and Scaling**

Reduce the amount of fouling or scaling within boiler tubes.

It is important to manage the fouling of the fireside and scaling of the waterside of boiler tubes. This can affect the heat transfer from the combustion gas into the heating medium, which negatively affects the efficiency of the system. Fouling and scaling can account for between 2% and 5% of a boiler’s energy consumption.
Initiative 9: Blowdown Optimisation

For steam systems, minimise the duration of blowdown cycles.

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**ADDITIONAL BENEFITS:** Correct selection of treatment chemicals maintains heat-exchanger surfaces within the boiler and throughout the system.

Unless there is blowdown heat recovery, a moderate amount of energy is lost during blowdown cycles when water is dumped. Automated systems monitor total dissolved solids and minimise the frequency of blowdown cycles.

Initiative 10: Boiler Economiser

Preheat boiler feedwater via heat recovered from boiler exhaust gas streams.

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**ADDITIONAL BENEFITS:** Increases the capacity of existing boiler(s)

Preheating of the boiler water supply reduces the amount of heat input necessary to generate a given temperature setpoint, and therefore reduces the fuel input required. An economiser can often improve system efficiencies by 5% to 10%. Although this is technically a form of heat recovery, it is addressed separately because it is a common boiler retrofit technology.
Pumps and Fans

Pump and fan systems are used throughout textile care sites, usually as part of other systems such as thermal systems or HVAC systems. Pump systems perform tasks such as circulating hot water, while fan systems provide for ventilation, extraction, and air conditioning. Pump and fan systems typically use 5 – 10% of a textile care site’s total energy consumption. Systems are often oversized or have been modified to operate as they were not originally designed, and therefore represent a significant opportunity for energy savings through efficiency improvements.

Assessing a pump or fan system’s efficiency involves three steps:

1 **Assess the demand side of the system.** It is important to investigate the flow and pressure requirements of a pump or fan system and determine whether or not the role of the system in the plant process is being achieved.

2 **Assess the distribution effectiveness of the system.** For both pump and fan systems, the pipe network or ducting should also be investigated to ensure frictional losses are minimal.

3 **Assess the supply side of the system (pump or fan).** Once the flow and pressure requirements are defined, and the distribution system is optimised, the supply side of the system should then be investigated. This involves ensuring that the pumps and fans are designed for their application and controlled effectively.

Reduce Demand

**Initiative 1: Switch off Unused Pumps or Fans**

Auxiliary services such as pumps and fans should be turned off when not required.

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**ADDITIONAL BENEFITS:** Improves the longevity of the pumps or fans, reducing maintenance costs

Pump and fan systems are often left on when not required, such as over smoke breaks or between operating periods. In most cases these can either be turned off manually or automatically shut off. It is best practice to use interlocking pump and fan systems so that they turn off with other systems.

Source: Simon Wilkinson
Initiative 2: Reduce Flow and Pressure Requirements

Reduce the average flow and/or pressure through a pump system’s pipework or fan system’s ducting.

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**ADDITIONAL BENEFITS:** Savings are amplified significantly with the use of VSD control

Flow reduction can be achieved by throttling or dampening flow while still meeting the system requirements. In particular, bypass loops and other unnecessary flows should be eliminated. Pressure reduction can be achieved by reducing process static pressure and frictional losses throughout the system; in particular, throttling and dampening flow should be avoided as this artificially increases the system pressure. Note that the savings potential is intrinsically related to the control of the pump or fan, with variable speed control offering the largest energy savings from flow and pressure reductions (discussed in 4.2.3, initiative 5).

Determine the effectiveness of the distribution system

Initiative 3: Pipe / Duct Size and Configuration

Optimise the arrangement and size of pump pipework and fan system ducting to minimise frictional losses.

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Software specific to pipe or ducting network design can be used to determine the system’s delivery effectiveness. This will determine areas with pressure losses as a result of incorrectly installed valves, undersized pipework/ducting or suboptimal configurations.

Optimise the supply pumps or fans

Initiative 4: Pump and Fan Maintenance

Perform regular maintenance activities on pumps and fans.

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**ADDITIONAL BENEFITS:** Prevents premature failure of pumps or fans, reducing overall life-cycle costs

Maintenance activities include replacement of worn impellers/blades, bearing inspection and lubrication, and seal inspection. Typical energy savings of between 5% and 10% of a pump or fan system are achievable through regular facility maintenance.
Initiative 5: Pump / Fan Control

Control the pumps or fans to adequately and efficiently meet demand requirements.

Pump and fan control is particularly relevant to variable-demand applications. The energy use of a pump or fan is roughly proportional to the cube of the flow rate, so reducing the speed of a pump or fan to meet flow demands (as opposed to throttling or dampening) can achieve significant savings, often between 20% and 50% of a system’s total consumption. While VSD speed control of pumps and fans will achieve the highest energy reductions, other, less-costly forms of control can also achieve moderate savings.

Note: The figure depicted is for backward-curved centrifugal pumps and fans only.

Case Study A: VSD on hot water circulation pump saves $9,300 per year

A site with a hot water system previously had a circulation pump that was controlled to meet a pressure setpoint using bypass valve control. This effectively meant that water was circulated unnecessarily around the system’s primary loop for no operational benefit. The pump was then put on VSD control to maintain the pressure setpoint by decreasing the pump’s speed. This eliminated the requirement for recirculation and saved over 75,000 kWh per annum as a result of operating at a much lower average speed.
Compressed Air

Compressed air accounts for up to 5% of a textile care site’s annual energy use. Compressed air is often referred to as the “forgotten utility”, as the true cost of generating compressed air is usually overlooked. At only 10% – 15% efficiency, every unit of compressed work output requires eight units of energy input at the air compressor. It is therefore important to use compressed air in an efficient manner and design the system accordingly. Small reductions in compressed air use can often result in large energy savings.

Assessing a compressed air system’s efficiency involves two steps:

1 **Assess the demand side of a system (compressed air use).** Often, compressed air demand savings provide the greatest benefit with the lowest implementation costs, since generating compressed air is such an inefficient process by nature.

2 **Assess the supply side of a system (compressed air generation).** Once the compressed air demand side has been addressed and all initiatives implemented, the compressed air supply side can be investigated. This involves ensuring that the air compressor is set up optimally to meet the plant’s demand.

Eliminate Unnecessary Compressed Air Use (demand-side initiatives)

**Initiative 1: Compressed Air Misuse**

Mitigate compressed air misuses by implementing less-energy-intensive alternative processes or technologies.

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Compressed air is frequently used as an easy means of solving a problem since the use of compressed air can have a small capital cost. However, the ongoing energy costs are much higher. If the use of compressed air is deemed necessary, it should be done so efficiently through the use of high-efficiency pneumatic devices.

**Initiative 2: Pressure Regulation**

Ensure compressed air users are regulated down to the lowest working pressure.

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**ADDITIONAL BENEFITS:** Potential to decrease the pressure setpoint of the air compressor(s)

Reducing the operating pressure of compressed air devices reduces their compressed air use. Many devices already have pressure regulators, so optimising the pressure setpoints can often be done easily.
Initiative 3: Compressed Air Leaks

Conduct air leak detection surveys to minimise air leakage.

### ADDITIONAL BENEFITS:
- Reduces pressure drops across the compressed air network, improves functionality of pneumatic devices and can significantly reduce plant noise.

Compressed air leaks commonly account for between 20% and 50% of a textiles manufacturing site’s total compressed air use (best practice is 10%). Repairing these leaks always has a very short payback period and should be part of a preventive maintenance strategy. Smaller sites should carry out routine audible air leak checks, while large sites should consider regular ultrasonic leak surveys.

**Case Study A: Air leak repair saves $365 per year**

An air leak survey at a small site revealed several compressed air leaks. The air leaks accounted for over 20% of the site’s compressed air use. Their repair reduced the loading on the compressor significantly, saving 1,886 kWh per annum.

Source: Energy NZ Ltd

Optimise the supply system (supply-side initiatives)

Initiative 4: Compressor Supply Pressure

Minimise the supply pressure of the air compressor(s).

### ADDITIONAL BENEFITS:
- Reduces air use through unregulated compressed air users

Most compressed air devices are designed to operate at 6.0 bar (g). An air compressor pressure setpoint of 6.5 bar(g) is recommended for most systems, which allows a total pressure drop of 0.5 bar over the dryer, filters and network. As a rule of thumb, for every 1 bar overpressure, the air compressor efficiency drops by 7%. It is common for facilities to have a supply pressure of between 7.0 bar(g) and 8.0 bar(g), resulting in an air compressor efficiency penalty of between 3.5% and 10.5%.
**Initiative 5: Compressor Capacity Control**

Optimise the air compressor’s capacity control.

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**ADDITIONAL BENEFITS:** May provide a more stable pressure to the network

There are many forms of compressor capacity control, which vary in efficiency based on the type of air compressor and their turndown rate. For rotary screw air compressors (the most common industrial compressor), inlet modulation is generally the least efficient form of control, followed by load/unload control, with VSD and variable capacity being the most efficient (particularly for highly variable loads). However, due to the cost of a new air compressor, outright purchase of a new, more efficient compressor is seldom justified, but should be considered when a new compressor is being purchased regardless.

**Motorised Systems**

Motorised systems, including laundering machinery, pumps, fans, and compressed air typically account for around 20% of a textile care site’s annual energy use. Although there are often a wide variety of applications, common savings can be found across all motorised systems.

**Initiative 1: High Efficiency Motors**

Replace old motors with new MEPS (minimum efficiency performance standards) compliant motors.

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**ADDITIONAL BENEFITS:** Newer, more reliable motors

New MEPS-compliant motors often have higher efficiencies than those of older motors. As a general rule, a 2% efficiency gain can be assumed from changing to a MEPS-compliant motor, with higher efficiency gains possible if the motor being replaced is in particularly bad condition and may have been rewound several times.

Payback periods of 24 months or less can be achieved through replacing a motor that is running 24/7. However, motors with lower run hours typically have longer payback periods, and replacement is only economical if the motor has failed and requires repair.

**Cautionary Note:** MEPS motors often have a higher synchronous speed, which can actually result in a higher energy use if used on non-static torque loads such as pumps and fans. Check the synchronous speeds of the new MEPS and old electric motors to ensure that this is not an issue.
Initiative 2: Resize Electric Motors

Replace all lightly loaded electric motors with more suitably sized alternatives.

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Electric motors are typically efficient over a wide range of operating loads, although below 50% of rated load the efficiency can drop away dramatically, as shown in the graph below.

Where electric motors have constant low loading (such as for large washers or tumble dryers) it is often cost-effective to replace these with motors that are more appropriately sized.

Source: La Nuova
Initiative 3: Drive Belt Replacement

Replace standard V-belts with either cogged or synchronous belts.

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<thead>
<tr>
<th>Belt Type</th>
<th>V (or Vee) Belt</th>
<th>Cogged (or Toothed) Belt</th>
<th>Synchronous Belt</th>
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<tbody>
<tr>
<td>Typical Efficiency</td>
<td>93% - 97%</td>
<td>95% - 98%</td>
<td>98%</td>
</tr>
<tr>
<td>Slippage</td>
<td>Some</td>
<td>Little</td>
<td>None</td>
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<tr>
<td>Maintenance</td>
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<td>Medium</td>
<td>Low</td>
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<td>Life Expectancy</td>
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<td>Better</td>
<td>Best</td>
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<td>Operating Noise</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
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<tr>
<td>Suitable for Shock Loads</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>Low – Medium</td>
<td>High</td>
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**Cautionary Note:** Higher efficiency belts have less slip and can actually result in a higher energy use if used on non-static torque loads such as pumps and fans. To counteract this, pulley sizes could be changed or the system put onto a VSD.

V-belts are commonly used to transfer energy from an electric motor to the end user. Although V-belts are very cheap and are widely use to drive washers and dryers, higher efficiency options are available which also come with less maintenance.

The cost differential between a standard V-belt and a cogged belt is often very little, and in some cases the cogged belt may even be cheaper. It is recommended that the right belt for the application is chosen from the outset or re-evaluated when a belt is due for replacement.
Lighting

Lighting is an ever-present “base” load for a site. It is a constant load unrelated to production levels and thus continues to cost the same amount of energy and money regardless of whether the plant is idle or at full production. This constant load, combined with the easily predictable energy input into lighting systems, makes the energy savings from a lighting upgrade reliable and quantifiable.

The two main aspects of lighting system efficiency are lighting types and lighting control systems. Control systems are typically the more complex upgrade and are largely reliant on the lighting type to be able to achieve savings. For example, metal halide lamps cannot be regularly switched off and on in response to occupancy, and cannot dim in response to natural light levels without expensive new control gear. Alternatively, LED lighting can be switched off and on almost without limitation, and most systems can be easily dimmed, but the cost of this lighting type is substantially more expensive initially. Choosing an appropriate replacement lighting type is a balancing act between ongoing energy savings, changes in maintenance costs, implementation cost, and ensuring that the necessary light levels are achieved or maintained in all areas.

Use High-Efficiency Lighting

Initiative 1: Upgrade High-Bay Lighting Types

Improve lighting efficiency in warehouses, production halls and other large indoor areas.

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**ADDITIONAL BENEFITS:** Improved light quality, reduced fire risk, and the opportunity to improve lighting levels in areas that do not meet AS/NZS 1680 standard

Older lighting types suffer from a range of inefficiencies, even if they are in good condition and lamps are changed on schedule. Most of these inefficiencies cannot be identified simply by reading the rated light output of a lamp.

A number of newer lighting types offer significantly higher efficiency and, in many cases, increased life expectancy. The following table compares generic cost and performance figures for a number of different lighting technologies. Older, or poorly maintained, lighting often has efficiencies of less than half those shown. Note that high pressure sodium lighting has been excluded due to their specialised use and poor quality of light produced.

<table>
<thead>
<tr>
<th>Lighting Attribute</th>
<th>Mercury Vapour</th>
<th>Metal Halide</th>
<th>T5 Fluorescent</th>
<th>CFL</th>
<th>Induction</th>
<th>LED</th>
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<tbody>
<tr>
<td>Rated Efficiency (lumens/watt)¹</td>
<td>48</td>
<td>86</td>
<td>88</td>
<td>70</td>
<td>81</td>
<td>105</td>
</tr>
<tr>
<td>Lumen Maintenance at Rated Life²</td>
<td>50%</td>
<td>60%</td>
<td>90%</td>
<td>75%</td>
<td>65%</td>
<td>70%</td>
</tr>
<tr>
<td>Optical Efficiency³</td>
<td>80%</td>
<td>80%</td>
<td>92%</td>
<td>80%</td>
<td>80%</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Overall System Efficiency (lumens/watt)⁴</td>
<td>19</td>
<td>41</td>
<td>73</td>
<td>42</td>
<td>42</td>
<td>66</td>
</tr>
<tr>
<td>Rated Lamp Life (hours)</td>
<td>24,000</td>
<td>20,000</td>
<td>20,000</td>
<td>10,000</td>
<td>100,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Controllability</td>
<td>Poor</td>
<td>Poor</td>
<td>Good</td>
<td>Average</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td>Annual Energy Cost, per 10,000 lumens⁵</td>
<td>$314</td>
<td>$145</td>
<td>$83</td>
<td>$143</td>
<td>$142</td>
<td>$91</td>
</tr>
<tr>
<td>New Lamp and Fitting Cost, per 10,000 lumens</td>
<td>$240</td>
<td>$170</td>
<td>$190</td>
<td>$340</td>
<td>$920</td>
<td>$560</td>
</tr>
</tbody>
</table>

¹ Initial efficiency of lamp and control gear. Lumens is the standard measure of light output from a lamp.
² Proportion of initial lamp output that remains as the lamp approaches its rated lifetime.
³ Efficiency of reflector. Values assume a brand-new fitting from a quality manufacturer.
⁴ A combination of all efficiency factors. It is this value that is most important for sizing a lighting system.
⁵ For 4,000 hours of annual operation and an energy price of $0.15/kWh.
Case Study A: Upgrade to high-bay fluorescent saves small manufacturer $3,144 in energy costs

A small manufacturing plant upgraded its 15 existing 400 W metal halide light fittings to 4 x 54 W T5 fluorescent high-bay fittings, saving $3,144 in annual energy costs at an implementation cost of $6,600, giving a simple payback period of 2.1 years. This upgrade also improved light levels and uniformity throughout the plant, and allowed the lights to be safely switched off and on without delay.

Initiative 2: Improve Fluorescent Lighting Systems

Replace old fluorescent systems.

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ADDITIONAL BENEFITS: Increased lamp life and reduced maintenance requirements

Older fluorescent systems are significantly less efficient than good-quality modern systems. Modest savings can be found in lamp efficiency, but larger savings can usually be found in distribution efficiency due to poor-quality or poorly maintained old fluorescent reflectors. Options to improve this include installing new T5 fluorescents with high-quality reflectors, or installing LED tubes which emit light downwards and eliminate the reflector inefficiency altogether.

Install Suitable Lighting Controls

Initiative 3: Control Lighting to Reduce Unnecessary Operation

Install controls to reduce light output when areas are unoccupied or have available natural light.

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An efficient lighting system should ensure that lights are switched off or dimmed when not needed. However, retrofitting such controls into an existing lighting system can be costly, inflexible, and require many compromises, so advanced controls are best considered as part of a broader lighting upgrade.

Many new high-efficiency lighting systems have inbuilt sensors or are designed to integrate easily with sensor controls in order to dim or switch off when not required. By using a well-controlled modern lighting system, both energy efficiency and energy conservation can be maximised.
General Measures for Energy Efficiency

A large part of optimising energy efficiency relates to making best use of the equipment available, rather than solely investing in new technologies and systems. Some energy-efficient operational behaviours and procedures specific to the textile care industry are outlined in this section.

Initiative 1: Load Equipment to Maximum Capacity

Ensure that all equipment is loaded near to maximum capacity for the majority of the time.

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**ADDITIONAL BENEFITS:** Reduced water consumption per number of units cleaned

An under loaded washer extractor or CTW uses the same amount of water, steam and power as a fully loaded one. It is therefore more cost-effective for these machines to be fully loaded than under loaded. Likewise, an ironing machine that is entirely covered with textiles is always better than one with several gaps, and efficiency is better if a garment tunnel finisher has a garment on every peg rather than every other peg.

Initiative 2: Work Classification

Correctly classify the work to improve efficiency.

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If dirty textiles are washed in a process that is too mild then they will need to be rewashed, thereby at least doubling the wash energy consumption. Another example would be printed curtains that are washed at 75°C rather than 40°C; heating the extra 35°C would be unnecessary and a waste of heat energy.

Source: La Nuova
**Initiative 3: Optimise Hydro Extraction**

Optimise the hydro extraction process to minimise the moisture content of textiles prior to drying.

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Studies have shown that it costs five times more in energy to evaporate water from a sheet on an ironing machine than to squeeze or spin it out through hydro extraction. If there is over 500 g of water for every 1 kg of dry textile, this is an indication of sub-optimal hydro extraction. Potential problems include the ultimate press pressure being below specification, the press spending insufficient time at full pressure, and textile temperature having not been optimised.

**Initiative 4: Minimise tumble drying**

Minimise the use of tumble drying as much as possible.

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It can be a waste of tumble dryer time and energy use to leave bed sheets for four or five minutes longer in a tumble dryer in order to run the ironing machine faster. Optimising mechanical hydro extraction and then properly tuning the ironer to finish drying the sheets will achieve the highest efficiency.

Source: ALSCO
New Technology and Processes

With energy prices continually on the rise, it is important that the textile care industry adopts new strategies and technologies that will allow it to remain efficient and profitable. Some of the options outlined in this section could assist in reducing energy consumption within the textile care industry.

General measures for energy efficiency

Initiative 1: Fabric Selection

Select polyester or polyester cotton over cotton materials.

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Cotton fibres absorb much more water than polyester fibres and hence leave the washing machine wetter and more creased than polyester, requiring more energy for subsequent drying. Launderers that supply their own fabrics should consider choosing polyester or polyester cotton over cotton fibres, when possible, to reduce energy use. Many recent innovations allow a blend of polyester and cotton (and sometimes pure polyester) to achieve the same look, feel and breathability of a pure cotton fabric.

Initiative 2: Lowering Washing Temperatures

Wash at lower temperatures to reduce heating costs.

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Low-temperature washing is an option for energy reduction; however, this also means an increased complexity and cost of chemicals because advantages of high-temperature washing are lost. Additionally, strict health and safety standards must be met and may disqualify any potential to reduce the temperature of washing. These standards must therefore be clarified first before implementing this strategy for any specific textile care industry.

Source: La Nuova
Existing equipment upgrades

Initiative 3: Washer Extractors

There are three essential modifications to improve the performance of washer extractors.

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1. Install a variable speed drive (VSD) for the main motor to enable reduced electrical use through optimal final speed selection.
2. Install a microprocessor controller to minimise heat energy used for each wash, allowing different water levels and temperatures to be programmed for each wash cycle.
3. Install a damped dip tube mounted alongside the machine to verify correct water levels. This allows detergent dosage to be adjusted accordingly. These tubes can be purchased but many businesses have chosen to make their own. Savings in wash energy typically equate to about 30%.

Initiative 4: Continuous Tunnel Washers (CTW) Conversion

Convert a laundry of washer extractors to continuous tunnel washers.

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The CTW design already contains internal recycling of heat, water and chemicals and thus will immediately lower energy use of a laundry if converted from washer extractors. The heating requirements for washing can become so low that many CTWs can be heated with waste heat from the steam condensate main (supplying steam-heated ironers) in the form of flash steam. This initiative could potentially reduce heating consumption by 50%.

Initiative 5: Effluent Heat Recovery

Implement a heat recovery system to extract heat from the wastewater.

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**ADDITIONAL BENEFITS:** Typical reduction in water consumption by 30% if correct water levels are set

Before installing an effluent heat exchanger, the water consumption should first be minimised because typically this will reduce the size and cost by 30% and 15% respectively. Transferring waste heat from effluent to preheat cold feedwater can potentially save 5 – 10% of total demand for heat energy. This heat recovery can be further enhanced by also applying flash steam from the condensate main, which could save 10% of the total laundry energy demand.
**Initiative 6: Tumble Dryers**

Automate dryers with end-of-cycle terminators.

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Retrofit a dryer with an automatic end-of-cycle terminator to eliminate over-drying and excess energy consumption. For instance, leaving 8% moisture in a towel produces optimal results because a completely dry towel will absorb humidity from the atmosphere.

**Refurbishing with new equipment**

**Initiative 7: Washer Extractors**

Laundries that are processing cotton should buy washer extractors with high G-force in the final extract stage.

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Laundries that process cotton textiles should purchase washer extractors with high G-force in the final extract stage, with higher being better. It is preferable if it is over 350 G as this will minimise the moisture retention after the spin cycle and also minimise the necessary drying energy use.

**Initiative 8: Hydro Extraction Presses**

New hydro extraction presses are able to squeeze out more wash water from textiles.

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The maximum hydro extraction press pressures have now exceeded 50 bar - this means that the required heat energy use and drying time are both reduced, thereby improving tumble dryer productivity.
### Initiative 9: Tumble Dryers

Select garment tunnel finishers or dryers with axial air flow and direct gas-firing.

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It has been found that axial air flow dryers are more effective than traditional radial air flow dryers because the air path is longer and better controlled, using less energy. Similarly, direct gas-fired dryers and garment tunnel finishers use about one third less energy than steam-heated dryers because they avoid steam distribution and boiler flue losses.

### Initiative 10: Ironers

Install thin flexible bed ironers as opposed to rigid steam chest designs.

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The majority of ironers now come with energy-retaining hoods which improve energy efficiency by 5%. The greatest improvement of current ironer designs would be the replacement of rigid steam chest with a thin flexible bed. This replacement means that the wet material to be ironed is drawn between the clothed roll and flexible bed. Consequently, heat transfer is also optimised because the bed follows the shape of the roll precisely.

Source: La Nuova
Further Reading

General Energy Information Resources

Energy Efficiency and Conservation Authority (New Zealand)
www.eecabusiness.govt.nz/

U.S. Department of Energy
www.eere.energy.gov/

Specific Material

UK Carbon Trust   Sector Guide CTV040 Energy saving opportunities in laundries

US Department of Energy Improving Steam System Performance: A Sourcebook for Industry


Textiles NZ Textiles Energy Efficiency Guidance Note 01: Compressed Air

Textiles NZ Textiles Energy Efficiency Guidance Note 02: Efficient Thermal Systems