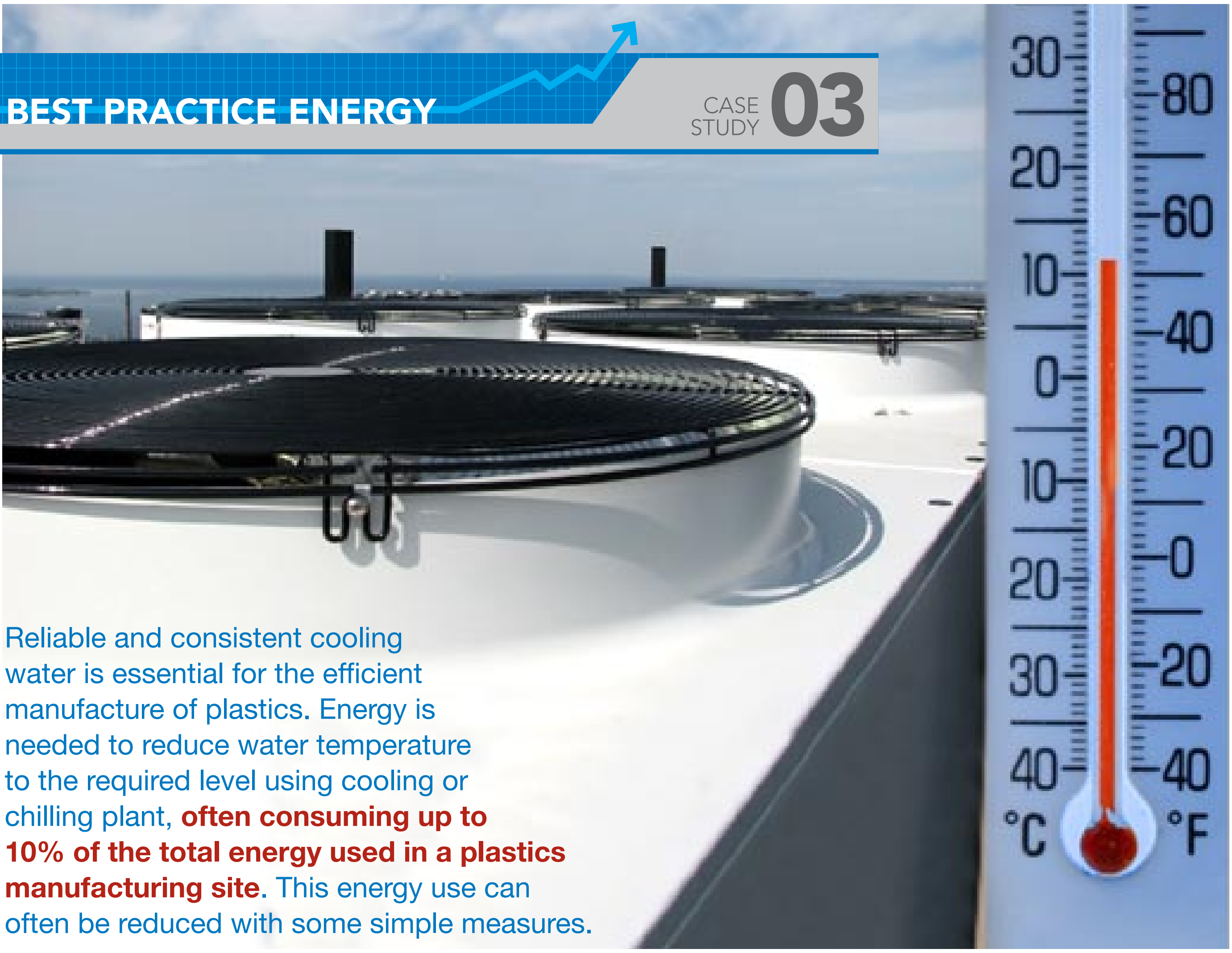
BEST PRACTICE ENERGY

CASE STUDY 03



Reliable and consistent cooling water is essential for the efficient manufacture of plastics. Energy is needed to reduce water temperature to the required level using cooling or chilling plant, **often consuming up to 10% of the total energy used in a plastics manufacturing site**. This energy use can often be reduced with some simple measures.

ENERGY EFFICIENT
Water Cooling...

Simple measures can often improve the energy efficiency of chilled water and cooled water systems significantly.

Two recommended measures are:

1. Reduce Cooling Loads
2. Optimise Chilled & Cooled Water Systems

Savings of up to 25% of cooling water costs can be easily achieved.

Cooling water is typically produced by the use of cooling towers, often in conjunction with chiller units. In rare instances cool bore water is used directly from the ground to save water and energy costs. Chiller units are used if you need to reduce water to temperatures below the capabilities of a cooling tower, or to provide stable temperatures. Typically a chiller will use 30 kWh of electricity for every 100kW of cooling capacity. Some plastics processing sites can require up to 200 kW of cooling capacity.

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1 Reducing Cooling Loads

Eliminating or reducing cooling loads will reduce running costs and improve efficiency.
The first logical step is to supply cooling only where it is needed.

Other ways of reducing cooling loads include:

Increase the water temperature setpoint	Correctly design your water distribution system	Use "free" cooling wherever possible

Optimise the temperature setpoint

Identify the optimum temperature setpoint for the chilled water used in your plant.

New Zealand plastics plants are frequently found to have the temperature of the chilled water set unnecessarily low. Temperature setpoints for plastics processing are typically in the 13-15°C range. Particular production lines may require water temperatures lower than this, so wherever possible these should be isolated from the rest of the cooling system.

As a rule of thumb – every 1°C you can raise the chilled water temperature by reduces the energy used by about 3%.

Raising chilled water setpoint saves injection moulder $2,487 in energy costs

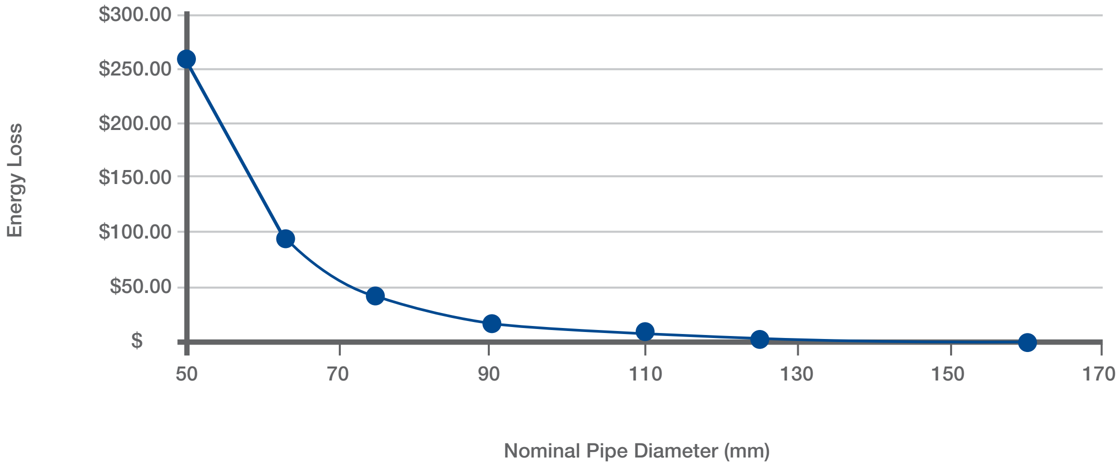
A Waikato injection moulder had been running their chilled water at an unusually low 11°C. The company increased the temperature setpoint to 15°C with no adverse effects on processing.

With zero costs to implement, this initiative saves the company $2,487 in energy costs every year.

Correctly design your water distribution system

Correct sizing and design of chilled and cooled water pipes in the setup of a manufacturing plant can have significant implications for energy use. Designing pipes too small or with too many joints or bends will increase the frictional losses.

Analysing the chilled water pipework for a new Auckland injection moulding site revealed the extent of potential energy losses from incorrect pipe sizing. The chart and table below show that energy losses decrease as pipe size increases. For this site, the optimal pipe size was calculated at between 90 and 110mm diameter. Using smaller pipe would result in greater energy losses, and using larger pipe would give diminished savings and increased pipe costs.



Nominal Pipe Diameter (mm)	Pressure Loss (m head)	Power Loss (W)	Power Loss Annual Cost	Overall Weight (kg/m)	Max Velocity (m/s)
50	38.56	5452.33	$5,095.85	1.94	4.684
75	16.89	2387.12	$2,230.81	4.37	3.344
90	9.05	1280.12	$1,196.56	6.28	2.561
110	3.98	563.82	$526.66	9.36	1.788
125	2.33	330.41	$308.42	12.10	1.412
160	0.77	108.82	$101.90	19.79	0.864

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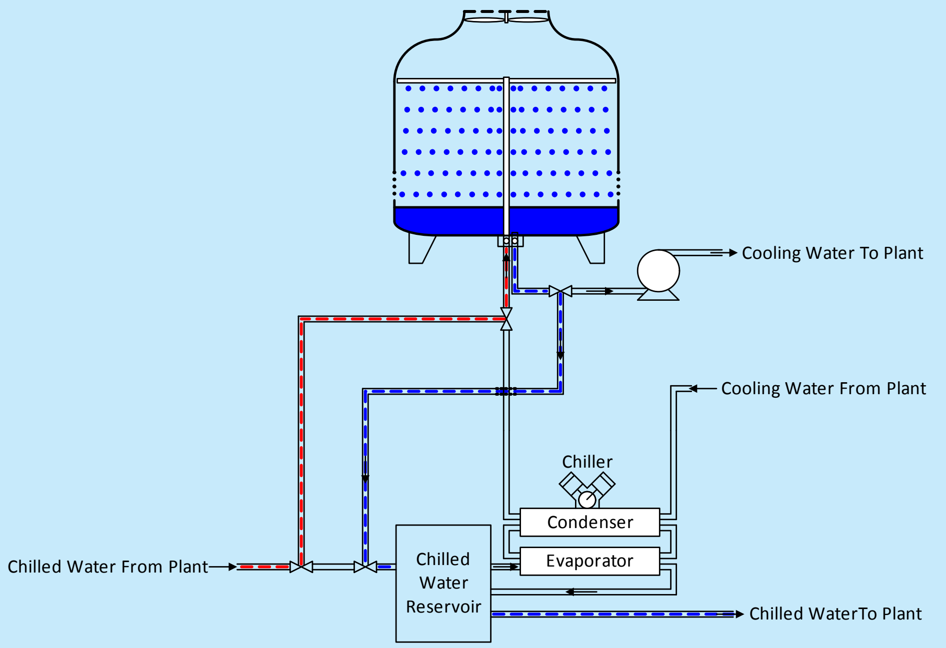
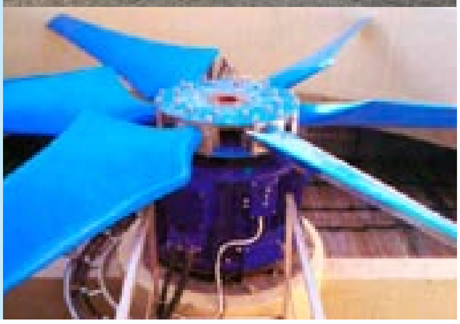
Use "free" cooling wherever possible

In some cases it is possible to do away with the chilled water system and only use cooled water from a standard cooling tower. By utilising the wet-bulb ambient temperatures you can achieve "free" cooling.

Using a chiller with a new or retrofitted free cooling circuit can show large reductions in operating costs due to shorter chiller running times, lower maintenance costs, and extended chiller life.

Example of a Chiller Installation with Cooling Tower Bypass





Replacing chilled water system with a cooling tower saves Auckland firm $6,338 every year

Chilled water at an Auckland plastics factory was supplied by 4 separate ring main systems using 4 pumps. Water for the whole system was chilled to 14°C by an 11kW chiller.

Only one chilled water loop required water to be at 14°C. Using the chilled water in other parts of the plant was also causing production issues due to condensation.

Installing a cooling tower to cool the water in three of the loops cost approximately $13,000 and saves $6,338 in energy every year. **This initiative will pay for itself in about 2 years.**

2 Optimise Chilled and Cooled Water Systems

Minimising the load allows a better assessment of the system design and particularly how it responds to part loads. After you have minimised the loads for your cooling water system you should look to optimise the system you have in place.

Use the most suitable refrigerant and optimise the system for high part-load and winter efficiency. This is particularly important when additional chillers have been added to the system.

Tuning cooling water pump (VSD) delivers instant payback

An audit of a plastics site with a variable speed drive (VSD) unit on their cooling water pump found significant pump speed oscillation due to a high PID gain setting. Reducing the gain setting on the VSD unit reduced the power consumed by the pump from 15.8kW to 13.5kW.

With zero costs to implement, this initiative is saving the company $1,792 every year.

Use VSD on pumps and fans

If your cooling tower has no way of controlling the operation of the fan on the tower then valuable energy is being wasted as the fan will run continually whenever the plant is operating. This means that even during winter, when the water is much cooler than required, the cooling tower fans will be running unnecessarily and wasting energy.

Cooling tower fans should be controlled using either a temperature switch that turns the fan on or off depending on the cooling tower water temperature, or a temperature transducer and variable speed drive (VSD) that controls the fan's speed.

Installing a VSD on cooling tower fan saves plastics firm $2,436 in energy every year

An Auckland firm has a MST MSX-250 cooling tower on site. The cooling tower fan has no control on its fan and the fan uses 32,537kWh of energy every year.

By installing a 7.5kW VSD at a cost of $5,000 they will save 22,455kWh of this energy. This will save $2,436 every year and pay for itself within 2 years.

VSDs installed on cooling tower fans can produce significant energy savings. The relationship between energy consumption of a fan and its speed is cubic. If the fan speed is reduced to 50%, the energy used is reduced to $0.5^3 = 0.125$ or 12.5% of the nominal energy consumption. For example, if you have a 7.5kW fan motor and you are able to reduce the motors speed by 20% it will consume 3.84kW, and if you can reduce the speed by 50% the motor will be using just 0.94kW.

Additional benefits from installing VSDs are:

- less variation in the cooling water temperature
- a reduction in noise from the cooling tower, and
- less stopping and starting, therefore less wear and tear on the fan motor

Maintain the System

Cooling systems often operate at low efficiency due to a lack of routine maintenance.

- Service chillers regularly and keep records of plant conditions.
- Clean evaporators, air blast coolers and heat exchanger surfaces regularly.
- Check flow/return temperatures and system flow rates to verify these are correct and optimised.
- Set all systems components to turn off automatically when not in use.

Cooling water solutions vary according to the needs and setup of an individual plant. Cooling water solutions should ideally be developed as part of an overall site energy efficiency project. We recommend that companies undertake a detailed, Level 2 energy audit under the Plastics New Zealand Best Practice Energy Programme. Contact Plastics New Zealand to find out more.

Best Practice Energy Programme

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

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

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

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