CASE STUDY
05/05

Pulp traction

EECA
Energy Efficiency and Conservation Authority
Te Tari Tiaki Pūngao

Carter Holt Harvey Kinleith's five-year plan for efficiency cut energy consumption per tonne of product by 31%. Although production increased by 25%, carbon dioxide emissions stayed stable.

AS AN **INTEGRATED KRAFT PULP AND PAPER MILL**, CARTER HOLT HARVEY KINLEITH HAS GOOD OPPORTUNITIES TO MAKE USE OF **SYNERGIES** FOR **EFFICIENT USE OF RESOURCES**.

A pulp and paper mill that spends more than $50 million a year on electricity and gas can't afford to be casual about the way it manages energy.

Carter Holt Harvey's Kinleith plant balances on an economic knife-edge. Nudged by large new plants being built within its Asian markets and subject to changes in the value of the New Zealand dollar, it must operate with little energy waste.

Kinleith is an integrated kraft mill that converts radiata pines from its neighbouring plantation forests into kraft pulp and a range of packaging papers.

Kinleith was Supreme EnergyWise Award winner in the 2004 EECA EnergyWise Awards and won the Sustained Achievement category for the methodical, staged approach it has taken to improving energy efficiency.

It has drawn on advice from external experts and those on its own staff who notice ways the processes and practices can be streamlined.

The mill is Tokoroa's largest employer, with around 450 workers and a further 160 personnel employed by maintenance partner ABB Kinleith.

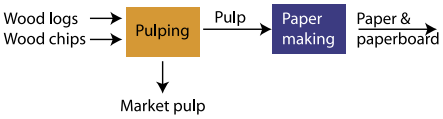
Full time energy co-ordinator Trevor Gerken leads a dedicated project and support team and has commitment from management. Operations staff are also committed to achieving or bettering production targets.

Methodical approach

Kinleith's five-year push for energy efficiency has not happened haphazardly.

Its Value Creation Project, which reviewed the entire chain from the forests to the customers' warehouses, saw a $40 million overall savings target exceeded by more

What happens at Kinleith?



The main objective of a pulp mill is to produce fibres to be made into pulp and paper.

This requires large amounts of energy and chemicals to degrade and dissolve lignin, a polymer "glue" in wood that binds its individual fibres together.

Kinleith is an integrated pulp and paper mill that treats wood chips with the kraft (from the German word for "strength") process. It makes a range of bleached and unbleached pulp and liner board paper.

The kraft process yields high-strength pulp and provides the means for efficient chemical recovery.

Wood chips are cooked to a chemical pulp with sodium hydroxide and sodium sulphide at 170–180ºC to break down the lignin.

The result is called brownstock, which is then washed with water to remove cooking (black) liquor for the recovery of chemicals and energy.

The remaining pulp slurry is screened to remove large unwanted particles and bleached to remove the small fraction of lignin remaining after cooking. A two-stage oxygen bleaching process transforms the lignin into a form that can dissolve in an alkali such as sodium hydroxide.

In the paper-making process, the fibres and fillers from a fluid pulp suspension are deposited onto a moving forming device that also removes water.

The remaining water is removed by pressing and then by drying on a series of hollow steam-heated cylinders.

Energy flows

Pulp and paper manufacturing is energy-intensive.

Pulp mills produce more energy than they need, because the waste products are sources of energy and the chemical recovery process produces heat.

But paper mills require large quantities of steam for their dryers.

At Kinleith, an integrated pulp and paper mill, energy represents 14% of the total cost of dried product.

Kinleith is 75% self-sufficient in energy. It has a cogeneration plant that produces steam and electricity from wood waste and black liquor.

The largest single energy user is the boilers, which raise steam for cooking, heating, drying, evaporating and electricity generation.

Kinleith is finding ways to be more self-sufficient in the production of steam, which can be generated by the chemical recovery process involved in pulping.

The chemical recovery process is an exothermic (heat-producing) chemical reaction that produces enough heat to gasify lignin and other volatile constituents of the black liquor.

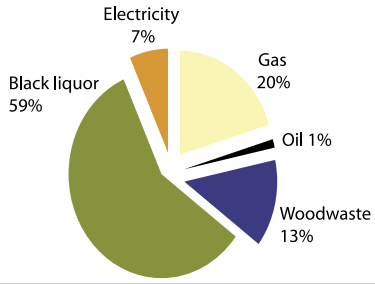
Wood pulp accounts for 70% of the black liquor. The energy derived from black liquor is enough to supply around 60% of a typical pulp and paper mill's energy needs.

Black liquor is burned mainly to recover the chemicals it contains, so the relevant boiler is called the process recovery boiler or recovery boiler.

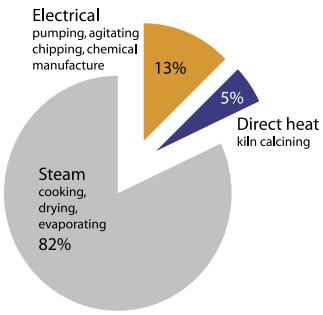
Electricity and gas account for 27% of energy inputs.

The paper is dried with giant steam cans.

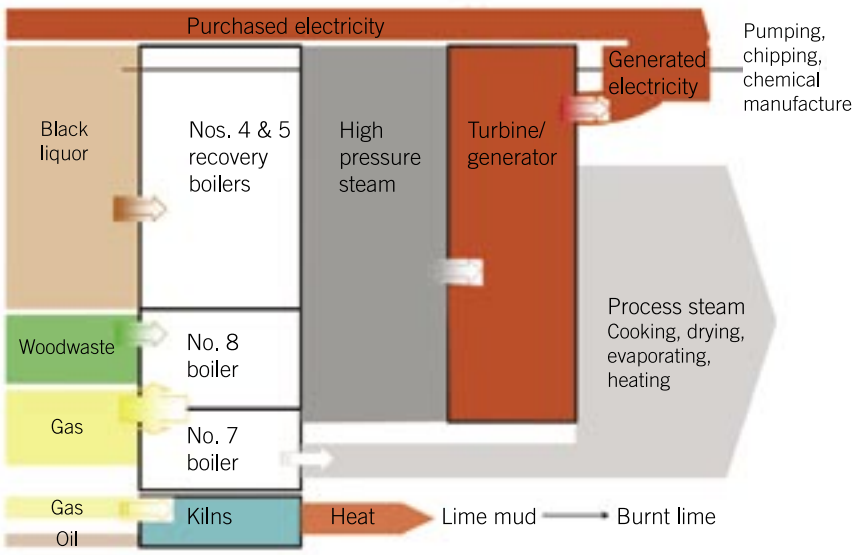
Energy inputs – 16.3 PJ a year



Energy use



Kinleith energy flow

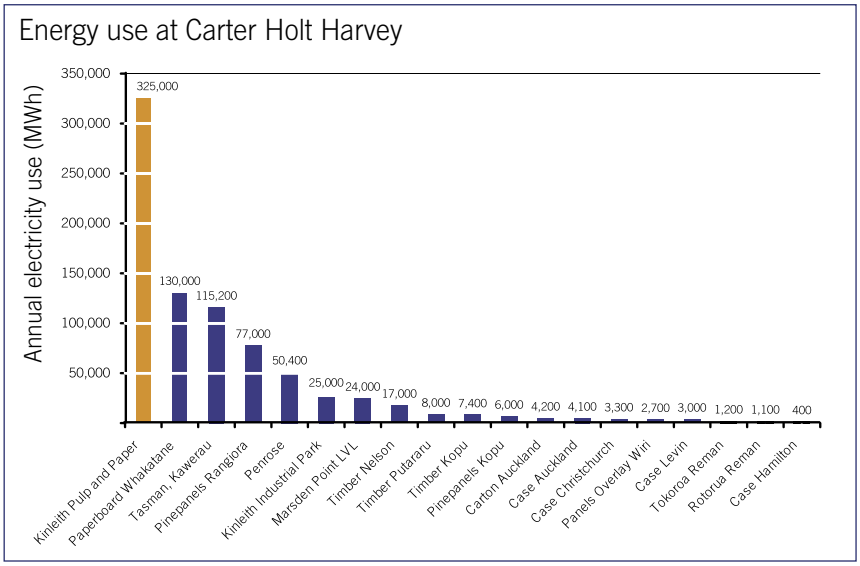


"Energy management needs interested people. All our business units have identified someone. "We have people totally focused on hot water." – Kinleith energy co-ordinator Trevor Gerken.

Success factors

Kinleith's success in energy management can be attributed to several factors:

- a specific person was appointed to champion energy management
- it set key performance indicators (KPIs) such as energy consumed per tonne of product
- it sought expert advice, both within New Zealand and internationally
- it formalised the initiative within the Value Creation Project
- it sought creative thinking from staff
- it thought laterally about alternatives to buying-in electricity and gas



KINLEITH IS CARTER HOLT HARVEY'S **LARGEST SINGLE ENERGY USER**. THE LARGEST EIGHT BUSINESSES CONSUME MORE THAN 92% OF THE TOTAL PURCHASED ELECTRICITY.

▶ than $10 million in the first two years.

Kinleith set about the Value Creation Project after the $313 million Kinleith Modernisation Project was completed in 1998.

The Value Creation Project looked at six work streams: wood, pulp, paper, procurement, energy and logistics.

Ideas generated by brainstorming were assigned to a "champion" to evaluate and carry out.

The results were reported monthly to the Value Creation manager and lead team, and entered into the Carter Holt Harvey-wide "Performer" database.

In Year One, projects that were already planned were carried out.

In Year Two, staff were asked for ideas. The process had to be managed carefully to gain and maintain the trust of the staff, who received a gift when their ideas went to a further stage and were kept well informed of progress. Those who contributed successful ideas went into a draw for a trip to the Indy 300 on the Gold Coast.

Out of all the ideas contributed, 15% related to energy.

The plant is huge and complex, but many of the energy savings boil down to finding ways to re-use heat.

Projects carried out included cutting out excessive steam use by re-directing hot water, saving $106,000 a year; a $240,000 burner upgrade that saved 20% of gas; and fitting variable speed drives on electric motors, that saved 10% of electricity worth $53,500 a year.

The Value Creation Project proved such a success it was adopted company-wide.

Big picture

Kinleith also invested in process analysis by international consultant Linnhoff March.

Pinch analysis (examining heat flow to optimise the use of energy) was used to improve processes.

This found Kinleith could reduce steam consumption on site while reducing effluent flow.

In 2001 and 2003, Kinleith took part in energy management diagnostic sessions using the One-2-Five tool sponsored by EECA.

The second session showed a marked improvement in energy management practice.

The investment is paying off. The Value Creation projects saved $17.2 million in 2001, $20.4 million in 2002 and had a target of $8 million for 2003.

Before the modernisation, the process consumed 3.49 MWh of energy per tonne of product. By 2003 this had fallen to 2.40 MWh per tonne.

Electricity use per tonne of air-dried product has dropped by 17% since 1998, and gas use has fallen by 34%.

In the same period, production increased by 25% but carbon dioxide emissions remained stable.

Kinleith has also investigated opportunities for wind energy generation, and is ramping up the use of woodwaste fuel for energy.

Now Gerken and his team are setting up metering and control to allocate energy costs among the various business units on site, so they can take greater ownership of their own energy budgets.

FROM **RAW MATERIALS** TO FINISHED PRODUCT:
1 **LOGS** AWAITING PULPING.
2 **CONTROL ROOM**.
3 **PAPER MACHINE PRESS SECTION.**
4 FINISHED **KRAFT LINERBOARD**.

Whatever the size of a business, everyone can learn from Kinleith's analytical approach, followed up by a steady stream of projects.

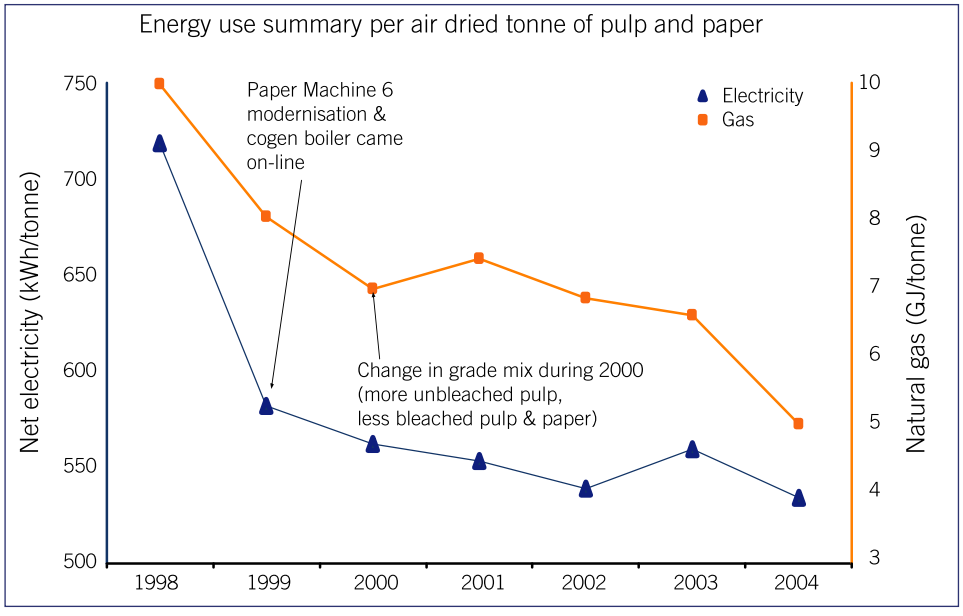
Major projects

Several major projects carried out from 2001 to 2003 helped Kinleith win the EECA awards.

- Previously, **hot water** was being dumped while steam was used for heating in various parts of the process.

  An audit using **pinch modelling** techniques – optimising the streams of utilities such as energy and water – found various opportunities to re-use the heat from the water so less heat was needed to make steam.

  Two of these projects are producing combined steam savings of 61,200 MWh and saving $736,000 a year.
- In one part of the process, **white liquor chemical** was being cooled before being added to a digester where it was reheated.
  After finding out that letting it in at a higher temperature wouldn't do any harm, it was possible to eliminate the cooling and reduce the amount of steam for reheating. This is saving around $80,000 a year.
- The same analysis found **pumps** were still being used for an activity that had become superfluous. Taking them out is saving $100,000 of energy a year.
- A project to make a boiler more reliable and available for more of the time meant a higher proportion of **wood-waste biofuel** could be used, offsetting 176,000 GJ of gas usage.
- Steam is used to blow soot from boilers.
  Fitting **high-efficiency nozzles** to the soot-blowers and **improving the instrumentation** has reduced steam usage by 53,000 MWh a year, saving $605,000.
- Upgrading a boiler to **reduce corrosion** increased the boiler's efficiency, saving 204,000 GJ of natural gas and $760,000 a year.
- By putting a reject chemical into the cooling system of evaporators, the **cooling process** became more efficient.
  This has reduced the amount of cooling water that must be pumped from the Waikato River, saving 36,000 MWh of pump energy use and $180,000 a year.
- A newly-designed **combustion system** for a **lime kiln** is estimated to reduce gas use by 14%, saving $276,000 a year.
  Its use of a blend of pitch pine and used oil has increased the kiln's efficiency by 10%, valued at $240,000 a year.



CREDITS

Carter Holt Harvey Kinleith energy co-ordinator Trevor Gerken

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MORE INFORMATION

EnergyWise News, Issue 85, May 2004

Carter Holt Harvey Kinleith, www.kinleith.com

Heat recovery opportunities at the Smurfit-Stone mill, a pulp & paper case study by Natural Resources Canada, www.nrcan.gc.ca