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NATIONAL CLEANER PRODUCTION CENTRE SA

NCPC national cleaner production centre South Africa

CONTRACT REPORT

IPA REPORT - RFF CANNING

086DG / HY7AGRO

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IPA REPORT – RFF CANNING

28 September 2007

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EXECUTIVE SUMMARY

RFF Canning does have an Environmental Policy in place for the Pniel facility, and the group as a whole. However, during the project, the position of Environmental Manager was vacant and was only filled towards the end of the report process. This policy has not been made available to the public for the Pniel facility, although the RFF Food group does have a public policy. Monthly reporting on process parameters (such as water, energy steam and effluent) are available and are monitored. Metering of these, however are not optimized.

Energy is managed by the Engineering management team, and consists of a municipal supply from Cape Town, as well as coal fired boilers to generate steam. The total energy consumption over a year period is around 16,184 KVA; 7,784,972 kWh and 30,979 tones of steam. Energy supplies cost around R2,035,886 for electricity and R3,400,244 for steam generation per year.

Water reduction, as well and steam reduction were highlighted during the quick scan report as areas where RFF would like to concentrate on over the next year, however no targets for reduction were set by management. The water feed is from the local municipality and is a metered feed. There are no boreholes or river water supplies into the cannery.

Most of the water is utilised to aid transport of raw material and cleaning throughout the plant, as well as steam generation. No costs for water were made available during the report. Hugh volumes of water were observed to be going to waste from the spinning drums and missing spray nozzles inside the cleaner unit. From this unit, hot water was observed going straight to drainage. Other observations were missing plugs in cleaning baths and hose pipes left running during cleaning operations. All this water goes to the effluent plant.

The pasteurizer was also observed to have steam leaks which were not from purge valves. Several of the water pipes leading to this unit were observed to be leaking, one of which was leaking directly into an open electrical conduit!

The effluent is treated on site at the waste water treatment plant which is situated at the Diary Farm which lies approximately 1km north of the RFF plant. The solid waste is removed from the effluent here, and then the effluent is pumped into aeration ponds, and then onto irrigation fields to the east of the dairy farm. There are currently no charges for effluent.

Product losses that were observed during the one walk through of the cannery where generally found to be both human and mechanically driven. The human factors allowed raw materials not to be utilised to their maximum, with raw material (in the form of beans) being spilt from the cannery throughout the process. These losses were observed to fall on the floor from the conveyor belts.

Focus areas that were requested to be looked into by Mr. Cobus Visser (Previous Engineering Manager for RFF) were

1. Water consumption
2. Steam consumption

No other areas were highlighted by RFF, although recommendations have been made for these areas as it was though that there were several low cost options that would greatly reduce the energy consumption of the plant. The current action plan for RFF is to not implement any options which have costs associated with them. They will however focus on water and steam consumption.

CONTENTS

1. PREFACE

The programme has been designed for the needs of companies ready to analyze and optimize their internal business processes with a view to developing Cleaner Production (CP) techniques and to implement Environmentally Sound Technologies. This will allow the companies to reduce both their operating costs and the environmental performance, thus increasing their productivity and competitiveness. The project provides opportunities for staff training and technical consulting. It is targeted at executives and technically skilled employees (such as managers with a special brief for environmental affairs).

Further information can be found on the internet www.ncpc.co.za. Before a company is analyzed in detail, a *Quick-Scan* is usually conducted. The Quick-Scan is a short analysis which assesses the quality of the crucial processes, material- and energy flows in order to identify the *potentials* for CP. I.e. with the Quick-Scan the process areas with good optimising potentials are found and a possible focus for further analysis can be defined. On the basis of the Quick Scan, the company will decide whether or not and in which process areas an in-depth analysis (the CP Assessment) shall be conducted.

2. PROCEDURE

The RFF Canning plant, part of the RFF Food Group, situated in Groot Drakenstein, Paarl, represented through its Environmental Manager at the time, Mr Cobus Visser, declared an interest in conducting a Quick-Scan performed in its premises. The Quick-Scan was performed, at the company's canning plant in Groot Drakenstein, Paarl, in the presence of the following persons.

From RFF Canning.:

Mr Cobus Visser (Environmental Manager)

From the NCPC:

Mr Spencer Oldham (BECO – Institute for Sustainable Business)
Ms. Zubeida Zwavel (BECO – Institute for Sustainable Business)
Mr. Thomas Bürki (UNIDO)
Mr Johannes Fresner (UNIDO)
Mr .Manogaran Ram Reddi, (National Cleaner Production Centre)
Ms. Budu Manaka (National Cleaner Production Centre)
Mr. André Page (National Cleaner Production Centre)

The short analysis was performed in the following order:

1. In comprehensive discussions, the TBS. presented its range of products as well as its production methods and other business processes. The crucial parameters and environmental data of the company were taken down. The most important production processes including the relevant material flows and energy consumers were identified.
2. In a subsequent tour through the premises, the employees of the NCPC and associated consultants, had ample opportunity of complementing the data they had obtained during the briefing with personal impressions and of receiving a first-hand insight into the processes of the individual production departments.
3. The further course of action was agreed in a joint meeting.

3. COMPANY DESCRIPTION

3.1 The Enterprise

The Rhodes Food Group (RFG) comprises of RFF Foods, Swazican, Wonderland Foods and Rhodes Food Africa. RGF started from humble beginnings in 1896 to today whereby the group now has factories situated in Groot Drakenstein and Swaziland trading Globally from North America through Europe to the Far East.

The RFF Foods (RFF) part of the Rhodes Food Group has been in the canning business for 90 years and is now an established global player. First it was a part of Anglo American Farms, which sold everything to the food department of Ferreira Group in 1999. And they gave RFF foods its name. The RFF Foods comprises now of RFF Foods LTD (export) and Rhodes Foods Africa (African market) which are both important players, both in South Africa and in the global markets.

The main season for RFF Canning is November through to End of March. The total annual turnover for the RFF Plant is approximately R220 million, with the employee numbers varying considerably from peak season (November – March) (1200 employees working 3 – 9 hour shifts per day, 6 days per week) to out of season (April to October) (100 employees working 2 9 hour shifts 5 days per week).

RFF produces a range of deciduous canned fruit, jams and vegetables for both the export and local markets. The total throughput of raw materials per annum is as follows: Peach 13,000 tons; apricot 5,000 tons, pear 2,500 tons; guava 600 tons; mixed vegetables 10,000 tons. The jam plant produces approximately 12 million cans per annum which equates to around 5,500 tons of canned jam. (This figure does not include the mass of the cans).

4. MANUFACTURING PROCESS DESCRIPTION

4.1 Overview

This section provides an overview of the departments of the enterprise and the processes. Complicated processes should be sub-divided into unit operations. The manufacturing process of the bean line at RFF Canning was identified and is represented in figure 1.

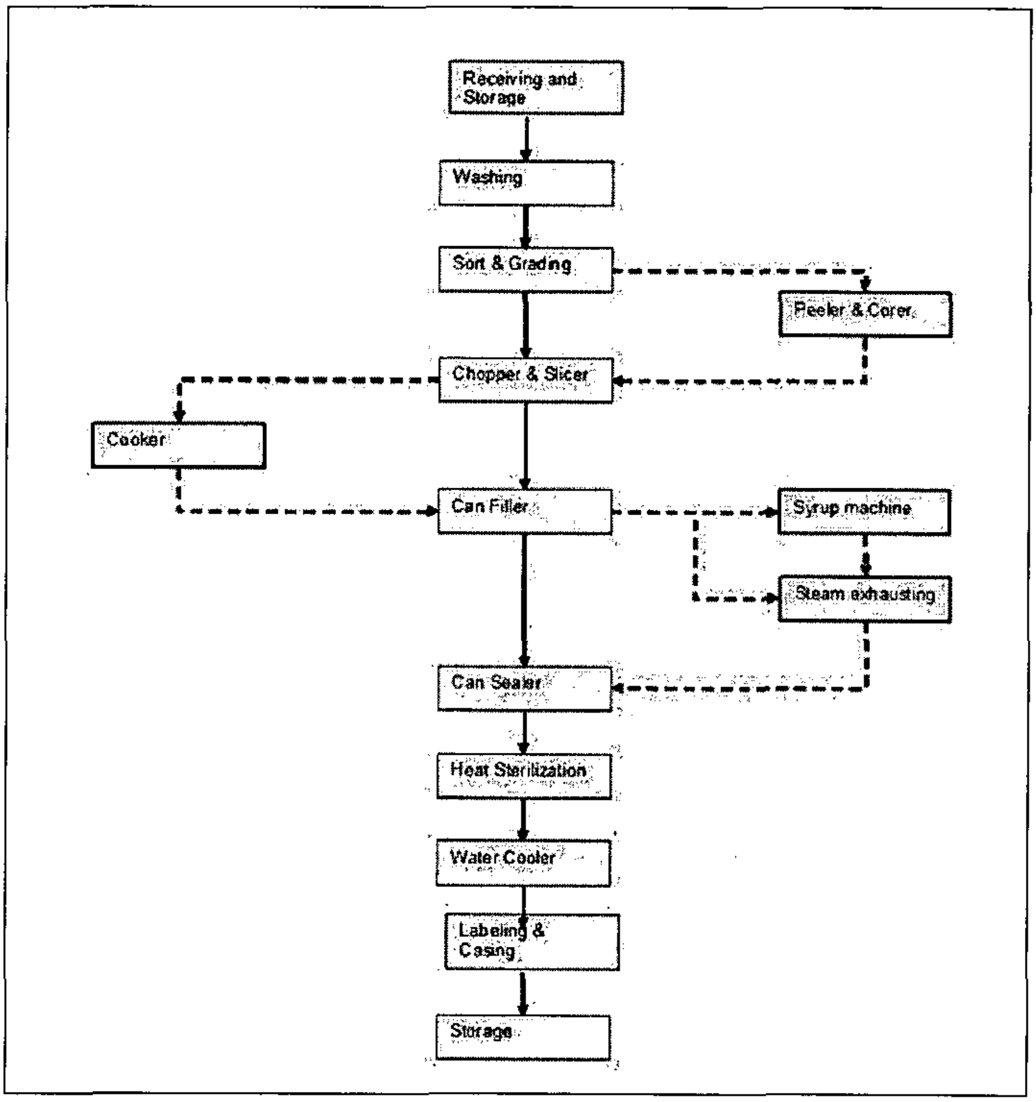


Figure 1: Overview of sections at RFF Canning

During the Quick Scan walkthrough, the plant was totally shut down due to preventative maintenance procedures that were running prior to peak season starting the following week. Due to this, only the bean line was available for the quick scan audit, hence the IPA was also restricted to this line.

4.2 Processes

There are four main processes take place in the cannery. These are Puree, Jams, beans and peas & canned fruit. Due to the fact that the RFF plant was shut down during the site tour, with only the bean line running, the process that will be investigated for this report will be the bean line in the cannery. The bean line forms part of the mixed vegetable input which in turn makes up approximately 10,000 tons per annum of raw material. However, a description of each product group of all the processes is given in this paragraph. These other process lines will not be included further in this report.

4.2.1 Puree

The fruit is brought in and placed in barrels, then checked for spots before production. The fruit is then washed and there is another visual inspection for rotten fruit. The checked fruit is then cooked and pulped and transported to the finisher. To increase the preservability, the fruit is processed at a temperature of 90 °C. After that the fruit is cooled to a temperature of 5-10°C. The last process step is cooking the puree before it is stored in a storage tank in the tank farm.

4.2.2 Jam

Puree is used as the base for the jam. The puree is put into the cooking pots where pectin and acid are added. After cooking the jam is put into one of the hoppers where it will be mixed until it is used for the can filling. After the can are filled, they are closed with a lid in the seamer. The next steps are cooling in a cooling basin, and palletising for storage. After a storage period of 3 weeks the cans are labelled before despatching.

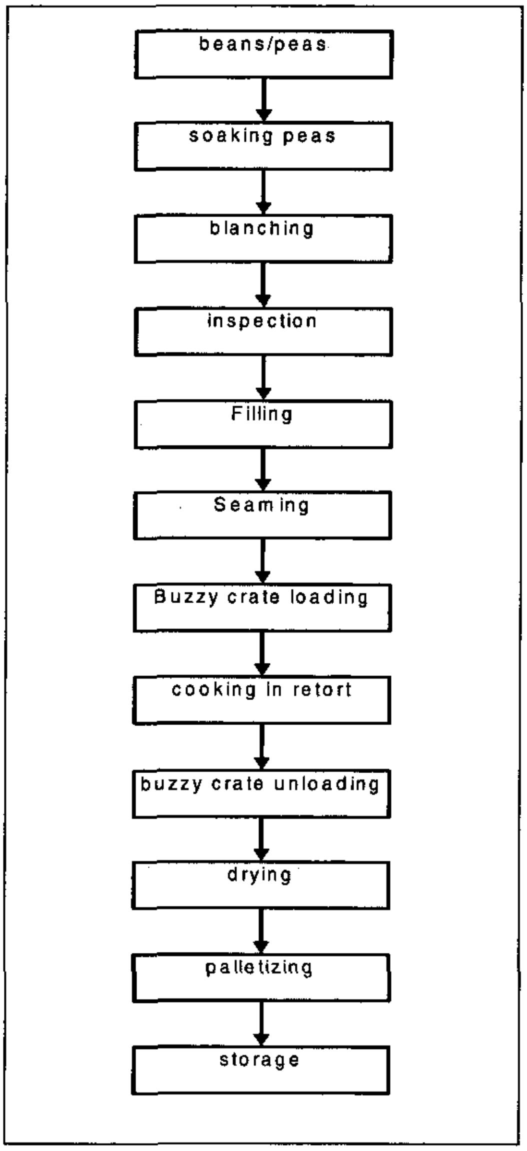
4.2.3 Beans and Peas

After the beans/peas are received, they are soaked for twelve hours in large stainless steel tanks. They are then blanched and sent for visual inspection. The defects are removed, and the rest of the beans are transported to the filling machine whereby the beans/peas are manually loaded from the transportation belt into several hoppers where the beans/peas are filled into cans. The sauce is then added. The cans are closed and cleaned before being loading into the buzzy crate loader. The cans are cooked in a retort and then cooled. They are then unloaded and dried, before palletising. After three weeks the cans have to be labelled and prepared for despatch.

4.2.4 Canned peaches, pears and apricots

This product group contains many different kinds of product such as peach halves, slices and different types of syrups and small process steps. To simplify this process, only the main process is described. The empty cans are received, washed and marked. The fruit then passes an inspection line. The fruit will be sorted per product group. Some of the fruit will be blanched, graded, inspected, and sliced. After that the fruit is packed in cans and syrup is added. The cans will be cooked, cooled and dried before they are sorted. They are then palletised and transported to the warehouse. After 3 weeks they will be labelled and despatched.

Figure 2. Bean Line



5. UTILITIES

Wherever possible, the results of the materials and energy analysis are categorized as follows:

- Solvents
- Cleaning agents
- Packing materials
- Oils and fats
- Acids and alkaline
- Metals
- Plastics
- Heating oil and gas

- Gaseous emissions
- Water/wastewater
- Mixed wastes (when no other grouping possible)

However, due to there being very little information made available from RFF Canning, due to the fact that Mr. Cobus Visser passed away after the quick scan report was completed, these material and energy analysis were neigh on impossible to complete or conduct.

5.1 Energy Management

The data gathered on both the electricity consumption and water consumption can be found in the table in Appendix 3.

One can see from the table that the Cannery consumes almost 50% of the electricity for the entire RFF plant. These figures were compiled by the engineering manager for RFF. One should also notice the high peak consumption during peak season (Nov – Mar)

There is no overall energy management system for the RFF plant in operation as a whole. The boilers have rudimentary controls which can manage certain procedures. During the project, the number four boiler experienced a fatal malfunction and had to be completely overhauled. The energy management system has been highlighted by the current management for review. At the time of writing this report, the production figures for RFF were not available to compare the energy or water consumption figures.

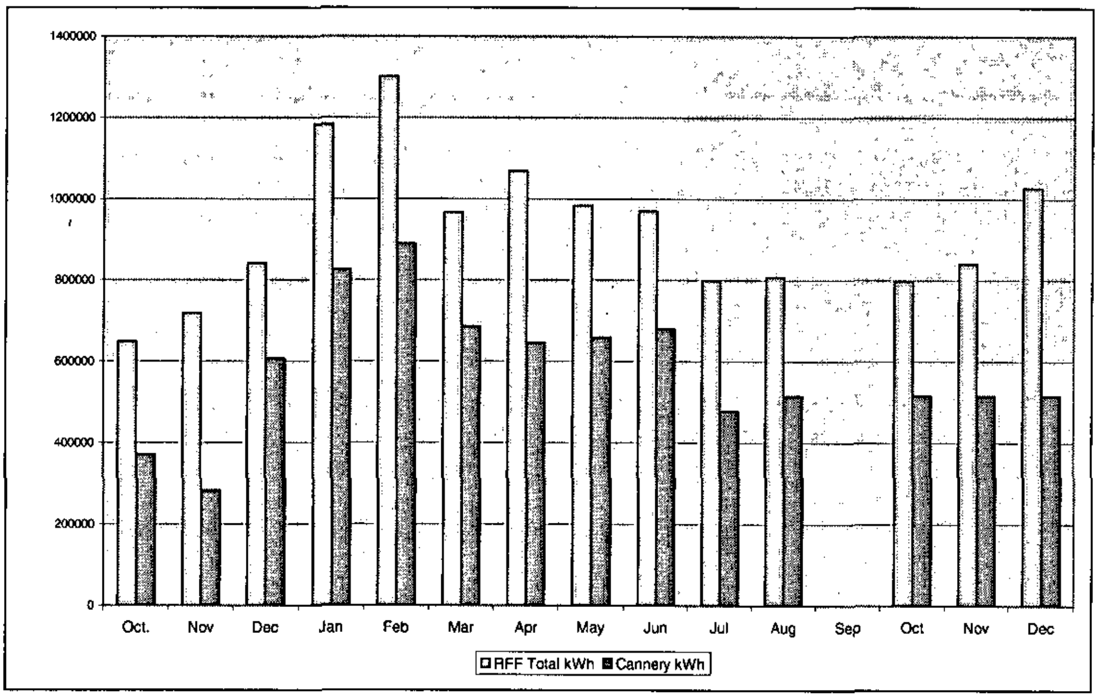


Figure 3: Electricity consumption for RFF and Cannery (kWh)

5.1.1 Energy provision – Process heat / room heating

RFF has 5 boilers on site. These are listed in the table below:

Table 1: Boiler overview

				daily consumption			
number	size	fuel	status	peak	hrs/day	off peak	hrs/day
1	10 ton	coal grade A pea	primary boiler	12 tons	24	10 tons	24
2	8 ton	coal grade A pea	primary boiler	9 tons	24	3 tons	24
3	8 ton	coal grade A pea	secondary boiler	9 tons	24	3 tons	24
4	4 ton	coal grade A pea	secondary boiler	3.5 tons	24	3.5 tons	24
5	5.6 ton	HFO	back up boiler	no figures - run on an hourly basis when required			

The boilers are used to provide steam for the RFF plant. The steam is utilised mainly in the cannery, Wonderland and the dairy. The steam is around 175 – 180 °C and runs at 8 bar. During the tour around the cannery, several steam leaks were observed on the line.

The energy management systems in place for the boilers are rudimentary. One of the 8 ton coal boilers had actually managed to by-pass three of the final safety shut off procedures and achieved a critical failure. It was undergoing chronic repairs during the initial site visit. RFF engineering management did acknowledge that the steam and boiler systems had large amount of leaks and would be one of the first areas that they would look at.

5.1.2 Energy provision – Compressed air

RFF have two compressors for the compressed air system. These are both Atlas Copco machines and work together to generate a accumulator pressure of 6 bar throughout the compressed air system. The compressor technical data is shown in table 3. These compressor work up to 7 bar to maintain a constant 6 bar pressure throughout the plant. These compressors are on 24 hours per day, although the running times vary between machines and season. The GA 55 runs 80% of the time in peak season and around 50% of the time in off peak season. The GA 30 runs 80% of the time in peak season and is usually turned off during off peak season.

RFF engineering management acknowledged that there were several leaks within the compressed air system, but noted that the leaks from the compressed air system were less than that of the steam system.

No external steam audits or compressor audits have been conducted at the plant.

Table 2: Compressor Overview

number	Maximum working pressure WorkPlace	Capacity FAD (1)	Installed motor power	Noise level (2)
GA 30	7.5	96	30	65
	8	93	30	65
	10	80	30	65
	13	65	30	65
GA 55	7.5	165	55	69
	8	155	55	69
	10	144	55	69
	13	124	55	69

5.1.3 Energy provision – Refrigeration

With RFF being in the food industry, refrigeration and cold storage are very important to the everyday running of the plant. There are 3 main areas of cold storage on site (excluding the Wonderland plant). These are names Room A, a 8,200 m^3 room running all year round at 5°C from end of March to November and then 0°C from November to March (during peak season). It is also interesting to note that the ambient temperature of the Groot Drakenstein area is higher during the peak season than the off peak season[1]. The installation and maintenance for the compressors is contracted out to a company called Coldex who run the compressors on a management system.

Room E can be dropped down to -7°C if one requires shutting down the freezer room for maintenance purposes. This temperature will maintain already frozen goods, but will not freeze goods. Rooms A and E had new doors fitted, although the entrance to Room A comprised of a double door main up of the main door and then vertical plastic strips which were being used to reduce the air flow out of the entrance when the main door was open. The vertical strips were often being removed by the ingress of fork lifts. The Freezer room had an air blanket installed and operating on the inside of the main entrance.

[1] Climatological data – Jan avg Temp 26.3℃; humidity 70% | July avg temp 17.5℃; humidity 80%

Table 3: Compressor Overview

Storage area	Storage volume	season	Operating temperature range	Compressor #	Compressor Kw	Coolant	Management System
Room A	8200 m^3	Nov - Mar	0°C	1	175	NH_3	yes
Room A	8200 m^3	Nov - Mar	0°C	2	110	NH_3	yes
Room A	8200 m^3	Nov - Mar	0°C	3	110	NH_3	yes
Room A	8200 m^3	Nov - Mar	0°C	4	120	NH_3	yes
Room A	8200 m^3	Mar - Nov	5°C	1	175	NH_3	yes
Room A	8200 m^3	Mar - Nov	5°C	2	110	NH_3	yes
Room A	8200 m^3	Mar - Nov	5°C	3	110	NH_3	yes
Room A	8200 m^3	Mar - Nov	5°C	4	120	NH_3	yes
Room E	3500 m^3	Nov - Feb	0°C	1	75	NH_3	yes
Room E	3500 m^3	Nov - Feb	0°C	2	45	NH_3	yes
Room E	3500 m^3	Nov - Feb	0°C	3	45	NH_3	yes
Freezer	560 m^3	all year	-15°C	1	104	Freon	yes
Freezer	560 m^3	all year	-15°C	2	104	Freon	yes

It was noted during the walk through that the freezer room was empty, but still running at its operating temperature of -15°C. The door to the freezer room was not closing properly and a window in the rear of the freezer room was missing. This has still not been repaired 4 months into the project. The tank farm consists of 85 vertical stainless steel tanks which are used to store the puree. The tanks are approximately 30,000 litres each and the room is currently being re-insulated. Several of the tanks have agitating motors attached.

5.2 Water Management

Water quality at RFF is critical for their production lines. RFF consumes approximately 700,000 kl of water per year which is sourced from the municipal water mains. RFF may not use groundwater for their production lines. RFF roughly has 70,000 tons of production which equates to a 10kl per ton product ratio. This is exceptionally high when compared to the European ratios of 4-5 kl per ton product.

The stormwater drains around the site are identified and known to management, although they are not specifically visibly identified, nor protected. The external ground around the site is swept clean, although this is not the case within the cannery plant where hose pipes are used to clean the floors. There is groundwater beneath the plant and basic precautions are taken to protect this, such as bunded areas for chemicals. A permit is not required from the local authority for effluent as the effluent from the RFF plant runs through the dairy which is owned by RFF where a water treatment plant is in operation.

5.2.1 Water Consumption

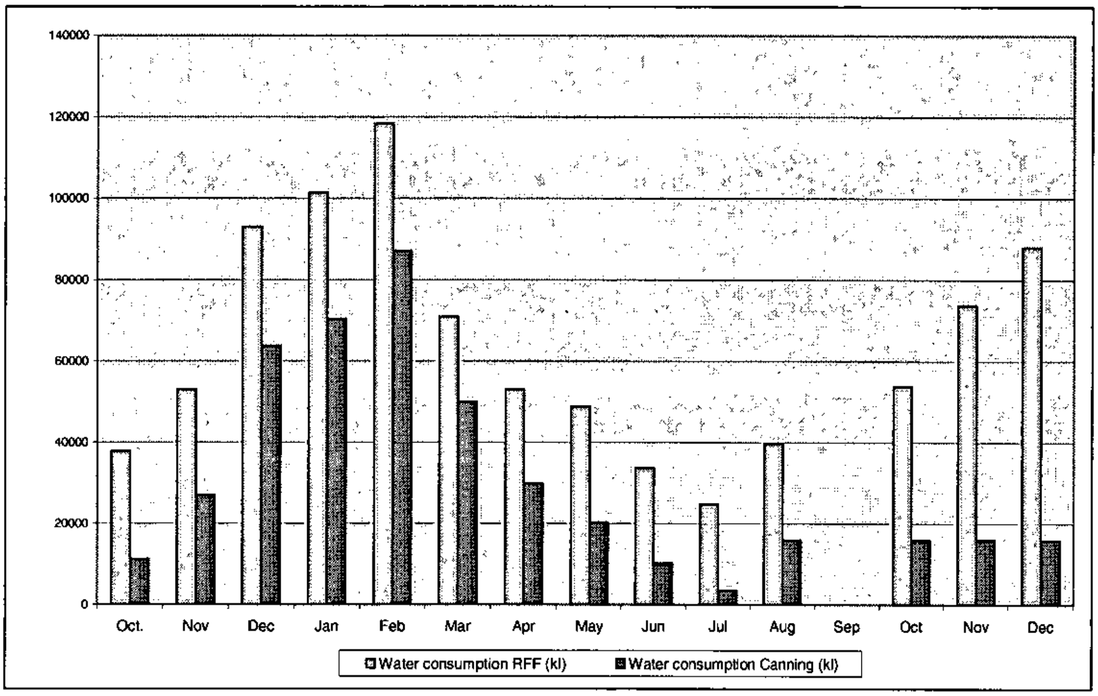


Figure 5: Water consumption Cannery vs. water consumption total

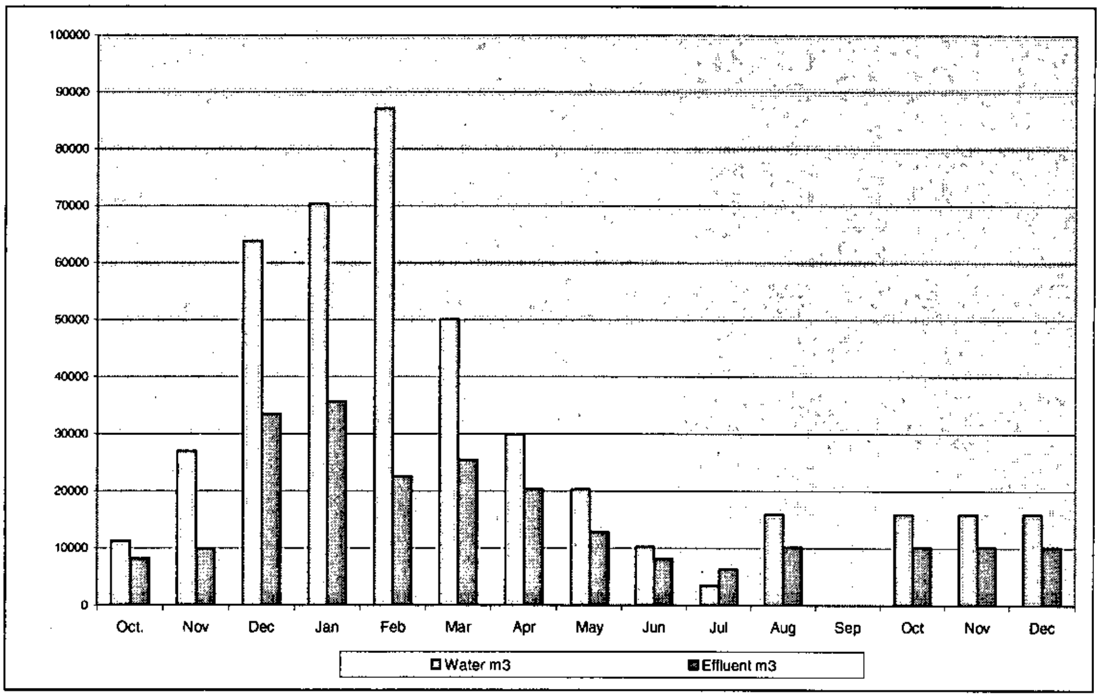


Figure 6: Water consumption in Cannery vs. Effluent flow through WTP

The cannery consumes on average around 50% of the total water consumption for RFF. Note the high consumption levels during peak season compared to out of season. One can also determine from figure 6 that the effluent generated by the canning process varies drastically from peak season to out of season. During peak season (Nov – March) on can see the water consumption rises drastically in February from 70,360 m^3 to 87,086 m^3 per month, whilst the effluent generated actually drops from around 35,687 m^3 the previous month to around 22,592 m^3. From this, one can deduct that around 50% of the water generated goes to effluent from cleaning processes and general wastage of water through poor shop stewardship and training.

5.2.2 Waste Water Treatment

RFF has its own waste water treatment plant (WTP) in the form of a farm which is situated to the north east of the site. All the effluent from RFF (including Wonderland) is piped to the WTP at the dairy, using several pumps and gravity. Once at the WTP, the majority of the solids are removed using a slow rotating horizontal drum which allows the effluent to run through, but traps the solids. The solids are then removed and used a feed for livestock which are resident on the farm. The effluent is then piped through to an aeration plant and then onto the farms fields. The effluent does not reach the river which runs to the east of the farm. RFF do not pay for effluent charges, but rather pay an annual amount to the local authority for this. It is estimated that RFF produces approximately 420,000 kl of effluent per year, with the cannery contributing approximately 200,000 kl to this.

6. FINDINGS OF THE QUICK SCAN

6.1 Data Evaluation: Estimation of CP Potentials

The data collected during the company visit were evaluated with the software-tool Eco Inspector. The CP potential of individual process steps, including those covering energy provision and storage management, was examined in accordance with the following criteria:

Inputs:
- Are there any problem materials which are hazardous to the environment or to health?
- Are large volumes of raw, auxiliary and operating materials used?
- Is the level of energy consumption high?
- Are major costs incurred on the input side (materials or energy)?

Outputs:
- Are large volumes of (problematic) waste, special waste, wastewater, wastewater components or emissions generated?
- Are high internal/external preparation and disposal costs incurred?

Technology:
- Is the applied technology state of the art?
- What is the level of automation?
- Are there losses incurred through faulty batches or scrap?
- How are the systems serviced or cleaned?
- Are high costs incurred for maintenance, cleaning, and stoppages?

Each process step was qualitatively checked on these criteria and was classified according to the following scale:

Table 4 Potential Points – Assessment of Potential Level for Each Criterion

Criterion not applicable to this process area, or no CP potential	Zero points
Moderate CP potential anticipated	1 point
Significant CP potential anticipated	2 points

The next step examines each sub-process as an entity according to the scale in Table 2 to determine the actual level of optimisation already achieved; i.e. whether or not the CP potential is already exhausted. Thus the "relevance" of the identified potentials is described and a weighting factor is defined. This is a qualitative estimate and draws on the experience of the person conducting the Quick-Scan (expert opinion).

Table 5 Scale for Estimating the Level of Optimisation of the Current Process (weighting factor)

Level of optimisation "high"	Optimisation potential largely exhausted	0 Points
Level of optimisation "high to medium"		0.5 Points
Level of optimisation "medium"	Optimisation potential not fully exhausted	1.0 Point
Level of optimisation "medium to low"		1.5 Points
Level of optimisation "low"	Non-optimised process step	2.0 Points

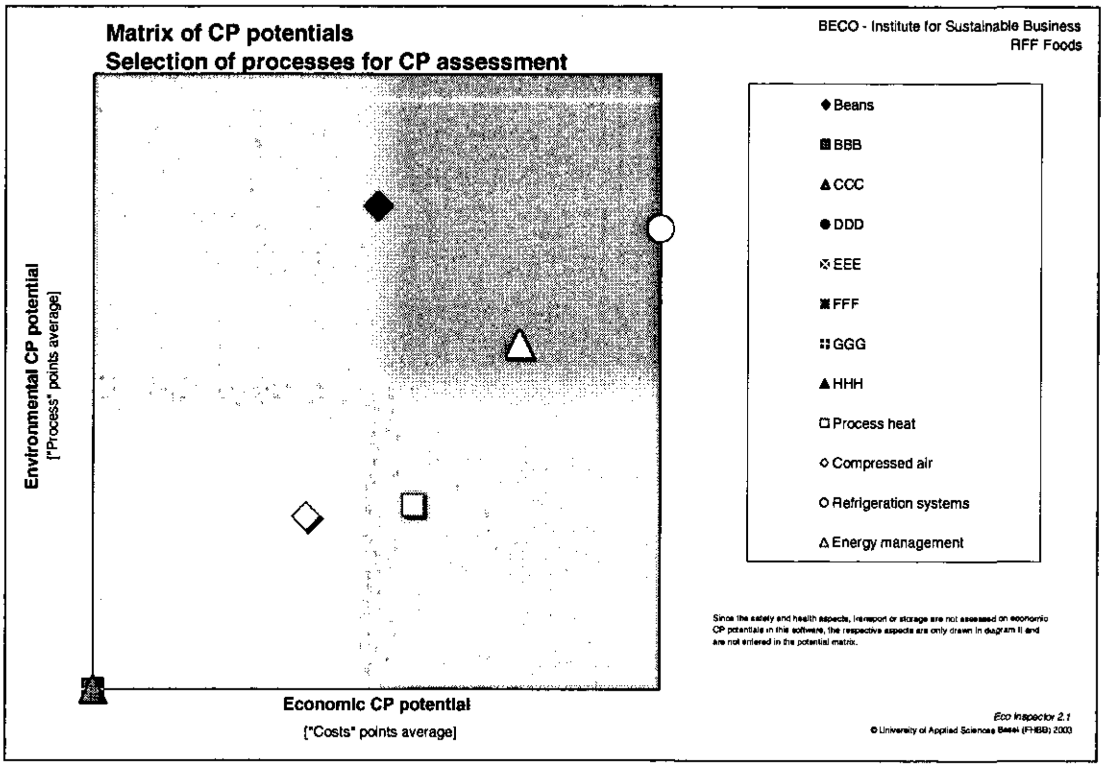
The product of the potential point and weighting factor indicates the *current CP potential* for each criterion point of each sub-process. The average of points for the individual categories (Inputs, outputs, technology and cost) gives a benchmark for the CP potential of individual process steps. This enables a rapid comparison of the sub-processes and facilitates selection of the processes for more detailed analysis.

6.2 Assessment of the S&H, material handling, transport and energy management aspects

The procedural principle for the processes is also followed when evaluating the aspects of safety, health, energy management, material handling, transport and storage. The points average gives a benchmark for the level of CP potential and is used as basis for decision to determine whether or not the relevant aspects are to be incorporated in a more detailed analysis.

6.3 Results

Figure 4: Matrix of the CP potentials at RFF Canning



The tables and charts enclosed in Appendix 6.1 shows how the individual component processes have been evaluated. Appendix 6.2 provides a summary of the results. Appendix 6.3 includes data summaries which were compiled during the project.

7. DISCUSSION OF THE RESULTS

One can immediately see from the CP matrix that the areas of greatest opportunity are to be found in the refrigeration systems and the energy management systems. There are also good simple opportunities to be fond in the bean line, specifically with process water and the management of this. From the graphs and CP assessment one can see that there are several Cleaner Production opportunities that are immediately available to RFF. The potentials that stand out are the refrigeration systems, energy management, process heat and compressed air. There is also a large potential for reduction of water consumption within the plant due to the current methodology used in the plant to clean up.

However, when these results of the quick scan report were presented to Mr. Visser, RFF made the decision the focus on the areas of water and steam consumptions.

The survey identified certain savings potentials in the areas of electricity and water management. These have been listed below in Chapter 5.

8. RECOMMENDATIONS AND FOLLOW UP

The quick scan and IPA report generated several CP options which have been listed in the table below. These are rated according to ease of implementation, technical feasibility, economic viability, environmental evaluation and implementation decision. These columns contain either, 'pos'; 'med' or 'neg' which equate to either, positive (yes), neutral (don't know) or negative (No). 22 options were generated. These CP options will be discussed during the closing presentation to be held at RFF.

Description of CP Option		Directly Implemented[2]	Technical Feasibility	Economic Viability	Environmental Evaluation	Implementation Decision	Investment (€)	Savings (€)
1	Detailed Monitoring and Benchmarking	pos	pos	pos	pos		med	medium
2	Waste Product Recovery	pos	neu	pos	pos		low	
3	Pips for oil	pos	pos	neu	pos		unknown	Recycle used pips for oil
4	Recycle packaging	pos	pos	pos	pos		low	Income from packaging instead of going to landfill
5	Cooling system control	pos	neu	pos	pos		med	medium
6	Cascade rinsing	pos	neu	pos	pos		med	Water consumption and effluent
7	Magnuson Rinse optimisation	pos	neu	pos	pos		med	Water consumption and effluent
8	Review energy management policy	pos	pos	pos	pos		med	Boilers and steam generation
9	Tariff Management, load profile and peak demand	pos	neu	pos	pos		low	high
10	Steam balance and boiler efficiency	pos	pos	pos	pos		Hi	
11	Use waste biomass for boiler fuel	pos	neu	pos	pos			
12	Repair compressor leaks	pos	pos	pos	pos		low	
13	Draw air from boiler ceiling	pos	pos	pos	pos		low	
14	Exhaust gas from boiler stack used to pre-heat boiler feed water	pos	pos	neu	pos		med	Increase in air temp reduced energy consumption
15	General insulation of piping	pos	pos	neu	pos		med	Reduce energy loss through radiation
16	Variable speed drives	pos	pos	neu	pos		high	Change all fixed speed motors to variable speed motors
17	Optimise cooling towers	pos	Pos	Pos	pos		high	

Description of CP Option		Directly Implemented[2]	Technical Feasibility	Economic Viability	Environmental Evaluation	Implementation Decision	Investment (€)	Savings (€)
18	Energy efficient motors	pos	Pos	Pos	pos		high	
19	Environmental management system	pos	Pos	neu	pos		high	Update and maintain current EMS
20	Pre heat feed water for steam supply	pos	pos	neu	pos		med	Preheated water for steam feed supply reduces energy consumption
21	Floor cleaning	pos	pos	pos	pos		low	50% water used for cleaning
22	Closing doors to refrigeration storerooms after entering of exiting.	pos	pos	neu	pos		low	25% saving on energy going into cooling the stores
23	Repairing main insulated doors to refrigerated storerooms	pos	pos	neu	pos		low	Reduce energy lost through heat transfer
24	Repair windows in cold storage rooms	pos	pos	pos	pos		low	Reduce energy lost through heat transfer
25	Replace all lighting with energy efficient bulbs throughout plant	pos	pos	neu	pos		med	Reduce energy consumption through efficient bulbs.
26	Turn off lighting when not in use	pos	pos	pos	pos		low	
27	Replacing retort on main vegetable line	neg	neg	neg	pos		high	Reduce steam and water loss

9. DESCRIPTION OF CP OPTIONS

9.1 Detailed Monitoring and Benchmarking

Operations that begin monitoring their resource consumption and actively set targets find reductions of between 2 – 5% of their resource consumption in the short to medium term. To this extent, we would recommend installing live metering of the main resource usage points. These include the steam, water and electricity supply mains and inputs into the Dairy, Wonderland foods, the Cannery and the Effluent treatment plant. In most cases existing meters can be retrofitted in order to fit the sender units (water meters). The investment costs depend on the level of automation and the number of monitoring points.

9.2 Waste Product Recovery

We noted that there was a high incidence of good product falling to the floor at various stages in the process. A student assessment revealed that approximately 5.16 Ton of the incoming fruit load was being sent to puree unnecessarily. This equated to an estimated loss in value of R3000 / day (~R250 000 / season). An intensive training program was recommended to prevent this loss in value. The percentage figure of good fruit being sent to puree was unavailable.

9.3 Pips for Oil

A recommendation to extract oil from the peach pips was suggested by the National Cleaner Production Centre in South Africa (Run by the CSIR). This option should be further investigated.

9.4 Recycle Waste Packaging

Currently, plastic and cardboard are bought by recycling companies for between R200 – R1200 per tonne depending on the quality of the packaging. A similar return can be expected for paper and paper towel products. We would recommend that all plastic, cardboard, and paper waste material be separated at source and recycled. Two companies in the Cape Town currently manage solid waste streams and the recycling there-of. We would recommend that you negotiate a shared recycle fee with these companies.

9.5 Cooling System Control and Water Treatment

The bleed rates on the cold storage open evaporative condensers were exceptionally high (close to 50% of the evaporation rate). Not only does this result in wasted water but also the water chemistry would be conducive to high corrosion rates due to low hardness levels. The correct treatment and control of cooling water is essential to optimum refrigeration efficiencies. A failure to effectively control the conditions in the cooling plant may not have directly quantifiable losses, however, the indirect costs (increased resource consumption and reduced lifetime of equipment) could be considerable. Possibly, this is the reason why RFF Canneries evaporation rates and electrical consumption figures per tonne product are noticeably higher than the benchmark. Increased electrical energy and water consumption are expected when a cooling system is not running efficiently because of scaling / slime build up or through corrosion deposits on the heat exchange surfaces. We recommend incorporating an effective water treatment program in order to effectively control the levels of scaling / corrosion.

9.6 Cascade Rinsing

Implementing a system incorporating principles of "Cascade Rinsing" should conservatively realise water savings of over 30% as water of acceptable standards is reused in the process. For instance, the rinse sprays used in the size grader after lye peeling could be used for product rinsing both in the Magnuson / lye-peeler. Similarly, the rinse water from the sprayers after the Magnuson could be used in the Magnuson, the lye-peeler or even the dump tanks. Understandably, there have been microbiological concerns (Byssochlamys spp. and incidence of heat-stabile pectinase) regarding re-use systems; however, these are valid for recycling systems and not once through "cascade" applications. A more detailed feasibility study should be opted for prior to implementation.

9.7 Correct Flow Rates on Magnuson

We noted that the water utilization for rinsing in the Magnuson (36l/tonne raw material) and post Magnuson rinse (1430l/tonne raw material) was considerable higher than the other canners surveyed (total of to ranging between 300l – 700l per tonne raw material). Based on the benchmarks we would conservatively estimate that the flow in this area could be reduced by 30% (120m3 / day). The ideal rinse rate should be experimentally determined.

9.8 Energy Savings

In general, the amount of coal and electrical energy usage per tonne product (3.54 and 0.36 GJ respectively) is far higher than the benchmark (2.5 and 0.2 GJ respectively). Part of this can be explained by "economies of scale" as RFF cannery is the smallest producer. However, considering the lack of energy management systems we believe this is an area providing scope for considerable improvement in both economic (savings) and environmental (EMS and environmental reporting options) aspects of RFF's canning activities. Some of the visible improvement options are listed below.

9.9 Electrical Energy Utilisation

As stated previously, RFF Canneries electrical energy usage (0.36 GJ / Tonne product) is considerably higher than the benchmark (0.20 GJ / tonne product). Based on the energy balance conducted approximately 70% of the energy usage in the factory can be attributed to the cooling systems. Assessments on other plants of a similar process indicate that this figure should be in the vicinity of 50%. Unfortunately, we cannot discount the dairies impact on this figure, however, these observations do support our assertion that a proper water treatment system would realise increased cooling system efficiencies. Ideally, the water treatment program should be coupled to a detail investigation on the cooling system in order to determine the optimum operating conditions and loads.

9.10 Tariff Management, Load Profile and Peak Demand

The canneries average kWh cost (including peak demand) is R0.21 which compares favourably to both the fruit cannery (R0.23) and industry standards using bulk tariff rates (R0.21 – R0.28). We would still recommend, however, installing electrical energy meters for the cannery, Wonderland Foods and the Dairy that will plot the load profile of the site and various operations. In the near future, energy supply companies will be offering Demand Side Management tariffs that will provide cost effective alternatives to the current bulk tariff utilized by operations that run over a 24 hr period. In fact, municipalities need to apply for a DSM tariff in their bulk energy purchase, therefore, it may be an option to persuade the municipality to apply for the DSM tariff in order to provide RFF with the billing option. We have noted Kwh costs as low as R0.15 in operations that have incorporated DSM tariffs (this is before energy reduction options / load shedding strategies were implemented).

We estimate conservatively that RFF could reduce the overall electrical energy costs by up to 10% through implementing load shedding strategies and improved equipment control.

9.11 Steam Balance and Boiler Efficiency

The steam usage at RFF should ideally be a point of continued focus as not only is the coal consumption per ton product high according to the benchmarks (3.54 GJ as opposed to 2.5GJ) but also because the coal consumption was noted to be the largest "waste" stream from the decision making tool. From our observations, there is considerable room for improvement in the monitoring and control of the steam systems. We noted a few areas that would realise considerable savings, these are:

1. Condensate return from the Jam plant – The condensate from the jam plant was being released to effluent at a rate of approximately 50 L / min (3m3/hr). Typically, one ton of coal will produce eight tons of steam. One ton of lost condensate will cost approximately R50 – R100/hr in terms of increased coal usage in heating the boiler feed water (incoming at 25□C). As a rule of thumb, for every 6□C increase in hot well temperature there should be a 1% reduction in boiler fuel utilisation.

2. Dairy Sterilisation - Currently the diary sterilizes its piping through the use of steam. We would recommend implementing a hot water tank that can be circulated at 80□C for 10 minutes or alternatively changing to a liquid sanitizer. This should have an additional benefit of reducing the wear on the system.

3. Monitoring system – systems monitoring steam utilisation and condensate return in the different areas should be installed.

A 2-5% reduction in fuel consumption equates to R40 000 – R100 000 saving. Associated water treatment costs should also be factored into this. We would recommend conducting a detailed steam balance (as per the energy and water balances) in order to identify control points and parameters.

9.12 Use Waste Leaves / Stalks / Pips as a Fuel Source

It is possible to use the waste leaves / stalks and possibly even pips as a combination fuel source in the boilers. "Non-product" waste comprises ~ 10% of the fruit intake mass and can thus be estimated to be approximately 21 tonnes / day. Wood waste biomass reactors (http://rictec.com.sg/products/wood-waste-biomass-generator/) claim to be able to achieve 2 kW calorific from 1.3 kg of biomass (20% moisture) and therefore 1 tonne biomass should produce approximately 3.6 GJ calorific (assuming conservative conversion of 1000kg raw □ 1000 kW calorific and 1000kW calorific □ 3.6 GJ). Thus 21 tonnes per day should supply 75.6 GJ which equates to 3 tonnes of coal (26 GJ / tonne coal). Thus, cogeneration could attain coal savings of ~R1350 / day (assuming R450 / tonne coal).

9.13 Compressed Air Leaks

The cost of compressed air leaks is the energy cost to compress the volume of lost air from atmospheric pressure to the compressor operating pressure. The amount of lost air depends on the line pressure, the compressed air temperature at the point of the leak, the air temperature at the compressor inlet, and the estimated area of the leak. An estimation of the leak area is based mainly upon sound and feeling the airflow from the leak. An alternative method to determine total losses due to air leaks is to measure the time between compressor cycles when all air operated equipment is shut off. Companies that actively monitor their compressed air leakage rate aim for approximately 10% leakage rate. Companies that do not monitor their compressed air leakage rate tend to range between 20 – 30% leakage rate. Reducing the air-compressor leakage rate will result in an annual reduction of approximately 26,000 Kwh and a small but significant reduction in peak demand.

9.14 Draw Air from Boiler Ceiling

There is normally a considerable temperature deviance between the air close to the ground and air close to the ceiling in the boiler room. If air close to the ceiling is utilised as feed for the burner then the combustion efficiency will increase. As a rule of thumb, for every 10 □C increase in combustion air input realises a 0,5% reduction in the coal usage. This equates to an annual saving of R10 000.

9.15 Exhaust Gas used for Preheating the Boiler Feed Water

There is significant loss of heat to the stack in the form of emissions. As a rule of thumb, every 20 □C reduction of the exhaust gas temperature-used to heat the hot-well saves about 1% of fuel consumption. The exhaust gas temperature is approximately 215 □C for a steam temperature of 175□C. Thus, a 100 □C reduction in the exhaust gas could realise a 5% savings on the coal usage (~R100 000). It would probably prove to be economically viable if the main boiler stack (high utilisation) was retrofitted rather than all three boilers.

9.16 Insulating Valves and Flanges

We noted both in the boiler room and also further on in the steam system, that large amount of valves and flanges were not insulated. A valve without insulation looses as much energy as 2-meter pipe of the same diameter. Similarly, a heat loss compared to a 0,6 meter pipe is valid for a non-insulated flange. Thus, a valve in a 100 mm pipe with steam of 175 □C looses about R5 000 per year on energy whereas the insulation of a valve only costs about R1 000. This investment has a pay back time of a few months.

Energy Savings (Btu/hr) from Using Removable Insulated Valves. Install Removable Insulation on Uninsulated Valves and Fittings During maintenance, insulation over pipes, valves, and fittings is often damaged or removed and not replaced. Uninsulated pipes, valves and fittings can be safety hazards and sources of heat loss. Removable and reusable insulating pads are available to cover almost any surface. The pads are made of a non-combustible inside cover, insulation material, and a non-combustible outside cover that is tear- and abrasion-resistant. Materials used in the pads are oil- and water-resistant and can be designed for temperatures up to 1,600°F. The pads are held in place by wire laced through grommets or by using straps and buckles.

Insulation for Steam Traps
Effectively insulate inverted bucket traps with removable and reusable snap-on insulation are available from suppliers. Thermostatic and disk traps should be insulated according to manufacturers' recommendations to ensure proper operation.

9.17 Variable Speed Drives for Pumps and Fans

Variable-speed drives (VSD's) are an efficient and economical retrofit option and should be considered for all flow systems. VSD's allow the motor speed of your equipment to vary depending on actual operating conditions, rather than operating at one speed. Varying the speed of your fans allows them to match more closely the actual load required. As indicated in Figure 7, reducing a fan's speed by 20 percent can reduce its energy requirements by nearly 50 percent. Installing a VSD on your fan motor allows the fan to automatically match this reduced capacity, slowing down in response to reduced demand, thereby saving energy. A VSD is not actually a motor, but rather an electronic device that varies the frequency of the electricity to the motor. It is installed "upstream" of the motor, between the transformer and the motor. VSD's make economic sense when installed on motors that operate many hours per year at fluctuating loads, and especially on larger motors.

9.18 Optimise the Cooling Towers

The cooling tower fans typically run at a constant speed (50 Hz) or a two-speed motor may drive them. Depending upon the ambient weather conditions (Wet Bulb Temperature) at the tower location and the cooling loads placed on the tower, the installation of VSD's on the cooling tower fan motors can produce significant energy savings. Air is forced or drawn through the tower in order to cool the incoming water. The Wet Bulb Temperature is an indication of the amount of moisture in the air that flows through the tower. The VSD's will vary the fan speed to maintain the set-point temperature of the cooling water leaving the tower. During periods when the cooling demands are at a minimum, the tower fans run at minimum speed and consume less energy. The tower fans can be turned off during periods when the ambient air conditions will sufficiently cool the later without the aide of the fans. The energy consumption is reduced to just the cost of circulating the water through the tower.

Additional energy improvements for the cooling towers are:

- Replace the tower fill material with cellular film fill to improve the heat transfer efficiency.
- Install non-clogging, non-corroding spray nozzles to improve water distribution through the tower.
- Install energy efficient airfoil fans.
- Install energy efficient motors on the cooling tower fans and pumps.

Ideally, the cooling tower efficiency should be monitored according to manufacturer specification. Unfortunately, these guidelines are dependent on the degree of humidity and thus daily monitoring would be futile.

9.19 Replace Motors with High Efficiency Motors as the Motor Wears Out

Rather than rewinding the motors or purchasing new standard efficiency motors, the existing motors should be replaced with high efficiency motors when the motors wear out.

A common practice for many facilities is to rewind an existing motor when it burns out rather than purchase a high efficiency replacement motor. However, a rewound motor is typically less efficient than a new model. The loss of efficiency is due to the age of the failed motor and degradation of its stator core during failure, or as a result of the rewind process. The typical efficiency loss ranges from 1% to 5%. For smaller motors (15 kW or less) the cost to rewind is a significant fraction of the cost of a new energy efficient motor and the increased efficiency of the new motor may provide adequate energy (and thus cost) savings over the rewound motor to justify its purchase. Hours of operation and the usage factor of an existing motor will also help to determine which option (rewind or purchase new) appears most favourable.

Energy efficient motors are constructed with better bearings and windings than standard efficiency motors to reduce frictional and electrical resistance losses. Depending on the horsepower rating of a given energy efficient motor, operating efficiencies may be from 1% to 10% higher than the operating efficiencies of the existing motors. In general, the larger the motor, the smaller the efficiency increases.

9.20 Management Systems

This section gives some general information about good management practices.

Energy / Water Audits: Because energy / water efficiency technologies are a rapidly changing field, you should designate a staff member to keep up with changes and you should consider scheduling an energy / water audit every two years.

Accounting System: We would recommend that RFF tracks the resource usage per tonne of product. This should include all the resource inputs in order to gain a holistic view of the operation. The resource accounting system should be compiled as a part of the corporate governance reporting.

Implement an effective EMS
RFF should address specific environmental issues and achieve improved environmental performance through implementing an environmental management system (EMS). This can be either an informal system or one that involves formal certification/verification to a recognised standard such as ISO 14001 or the EC's Eco-Management and Audit Scheme (EMAS). You do not need to have ISO 14001 to have an effective EMS.

Whichever route your company chooses, it is worth remembering that a sound, well-conceived EMS is a practical management tool that can help your company to:

- reduce waste and hence operating costs;
- gain a competitive advantage;
- establish and demonstrate a system for continual environmental improvement;
- demonstrate compliance with its legal obligations;
- improve its public image.

An informal EMS (like in the waste minimisation program) costs as low as R30 000 per annum as long as the company implements the system. Formal EMS conforming to standards like ISO14001 range between R200 000 – R500 000 for a company like RFF depending on the level of involvement of the company.

Water Savings
Increasingly RFF will find itself in a position where resource consumption will need to be prioritised for reasons other than direct economic benefits. To this extent, investing in resource monitoring infrastructure and systems will be worthwhile in adopting a culture of resource conservation. Currently, this culture is not evident as the perceived cost of water at RFF is that of a free resource. An investigation into the indirect costs of water should be considered as energy, manpower and infrastructure is allocated for every m3 utilised in the plant.

9.21 Pre-heat Feed Water for Steam Supply

Pre heating the water used in the boilers to generate the steam throughout the plant reduces the amount of process energy in the from of coal burned. A 3% - 4% fuel savings can be achieved by installing an economizer on the top side of the boiler, between the boiler and the exhaust stack as seen in Figure 1. The economizer would transfer heat from the exhaust gases to the boiler feed water. A 40ºF decrease in the stack temperature or a 10ºF increase in feed water temperature corresponds to an increase in boiler efficiency of approximately 1%.

9.22 Cleaning of Floors

Cleaning can account for as much as 70% of a site's water use. Changing cleaning routines to optimise water use will not only cut your water supply bills but can have the added benefits of reducing the volume and concentration of effluent. Remember, too, that excessive use of water for cleaning brings many additional costs, such as labour, downtime, lost materials, cleaning chemicals and energy for heating and pumping.

Cleaning is vital to ensure food safety, but overuse of water for cleaning tasks is common. It is also the case where there are concerns over hygiene that staff would rather be 'safe than sorry'.

During cleaning, large quantities of water from hoses are frequently used to wash slurries from floors and walls down the drain. Hand-held scrapers will move most of the slurry across the floor efficiently. The combined use of scrapers, brushes and hoses can reduce the time taken to clean an area.

Removing slurries from surfaces before they start to dry or pre-wetting dry areas can reduce:

- the volume of water needed for wash down;
- the time taken.

Pipelines can often be cleaned effectively using **'pigging'** systems. A **pig** is typically an engineered plug or ball which fits inside the pipe and is pushed through mechanically or hydraulically to clear material ahead of the pig.

9.23 Refrigeration System Doors

The RFF plant has 3 cold storage facilities (8,200m^3 + 8,200m^3 and 3,500 m^3 which usually run around 0°C) which run 24/7 in season, and one freezer room (560m^3) which runs all year round at -15°C. All of these cold rooms apparently run on a management system which is used to monitor and management the refrigerate compressors which supply the cold air to these rooms.

As the cold storage area was not identified as an area of concentration by Mr. Visser, it was not closely observed. However, two quick walk through's (one during the quick scan, and one 4 months later) identified a very easy and no cost option that will help reduce the energy consumption of these cold rooms by easily by a factor of almost 20%!! That would be to CLOSE THE DOORS BEHIND YOU WHEN YOU ENTER AND LEAVE THE COLD ROOM!!! It was observed on every visit to RFF over a period of 5 months. These doors were observed to be constantly left open or not closed properly by the employees who were entering and leaving on fork lifts. With the average outside temperature recorded at being 35°C, the temperature gradient between the inside and out side on the door ranged between 35°C and 50°C!!.

9.24 Insulation Systems on Refrigerated Storage

It was also observed over a period of 5 months that the main doors to these cold storage rooms, especially the sliding door to the freezer room, were inadequately insulated and poorly fitting. It was pointed out on the first walk though in September 2006, that a large hole was present in the lower left hand corner of the main freezer door. It was also observed that very cold air was escaping through this hole and that ice had actually formed around the hole. This hole was still there 5 months later.

It is very important that all doors on a cold room are insulated and fit correctly.

9.25 Repairing Broken Windows in Cold Storage

It was observed on the first walk through that the rear window in the freezer room was broken and cold air was escaping into the adjoining room, whose temperature was around 10°C (a temperature difference of around 25°C). This window had still not been repaired during the last walkthrough.

9.26 Replace Lighting with Energy Efficient Lighting

Higher efficiency lighting has been a focus for many lighting manufacturers in recent years. New technology has led to innovative lamps that have a longer rated life and require less wattage with a minimal reduction in overall lumen output. Most of these lamps were designed as direct replacements for the old inefficient lamps, so the existing fixtures can be used in most cases.

Fluorescent Lighting
Electronic ballasts are currently available which when used with the proper 32W T-8 fluorescent lamps (the T rating refers to lamp tube diameter in 1/8ths of an inch) provide a very high quality light while using significantly less energy than the existing magnetic ballasts and 40W T-12 fluorescent lamps. The T-8 lamps provide a high quality light that renders color significantly better than the existing T-12 lamps thus providing excellent lighting for office and production areas. An added benefit to electronic ballasts is the high frequency at which they operate, eliminating the flicker often associated with standard fluorescent lighting. In addition, electronic ballasts are available that operate four lamps; therefore, a four lamp fixture that previously required two magnetic ballasts operating two T-12 lamps each can utilize a single electronic ballast operating all four T-8 lamps.

Lighting fixture identification codes and corresponding fixture specifications along with possible replacement codes for fluorescent lamps are given in the table below. The fixture power is the combined ballast and lamp power draw. The Color Rendering Index (CRI) is a scale from 0-100 of how well a given lamp renders color. A lamp with a CRI of 100 makes objects appear as they do in sunlight. It is important when replacing lighting to ensure that adequate light levels are maintained. The projected light level of a replacement lamp/ballast combination can be determined by comparing the lumen outputs of the existing and replacement lighting fixtures.

Incandescent lighting
Compact fluorescent lamps are the recommended replacement for incandescent lamps up to about 100 W. These energy efficient lamps provide more lumens than their equivalent incandescent lamps, have a life ten times that of incandescent lamps, and reduce power consumption by about 75%. The following table lists possible replacements for several wattages of incandescent lamps.

High Intensity Discharge Lighting (HID)
The appropriate use of HID lamps, which include metal halide (MH), mercury vapour (MV), and low and high-pressure sodium (HPS), is dependent on several factors. When choosing an HID replacement lamp the application of the lamp will ultimately determine its suitability. For example, in areas where color differentiation is important the use of a HPS lamp may not be feasible due to its low CRI value. The efficacy values of the most common lamp types are shown in Figure 1. The efficacy of a lamp is a measure of the lamp's ability to convert electrical power into visible light. The quantity of light emitted (lumen output) is divided by the input power of the lamp to determine the lamp's efficacy and is a measure of energy efficiency expressed in Lumens per Watt or LPW. A listing of efficacies, CRIs, and lamp life for HID lighting is shown in the following table.

Because use of HID lamps is so common in industry, progress is constantly being made toward higher efficiency. For example, one of the latest advancements in HID technology is pulse start metal halide lamps. Pulse start metal halides have a separate igniter from the ballast, which optimizes performance, and a lower crest factor that improves lamp life and maintenance. Other advantages over standard metal halides, high-pressure sodium, and mercury vapour lamps are more lumens per watt, improved lumen and color maintenance, longer lamp life, and shorter warm-up times. This results in fewer fixtures needed, less energy consumed, and reduced maintenance costs. As an example, standard 400 W metal halide fixtures consume a total of 458 Watts, including the ballast. Comparatively, 320 W pulse start metal halides consume a total of about 350 Watts. Replacing the standard fixtures with pulse start metal halides would save approximately 108 Watts per fixture, while still producing about the same lumen output.

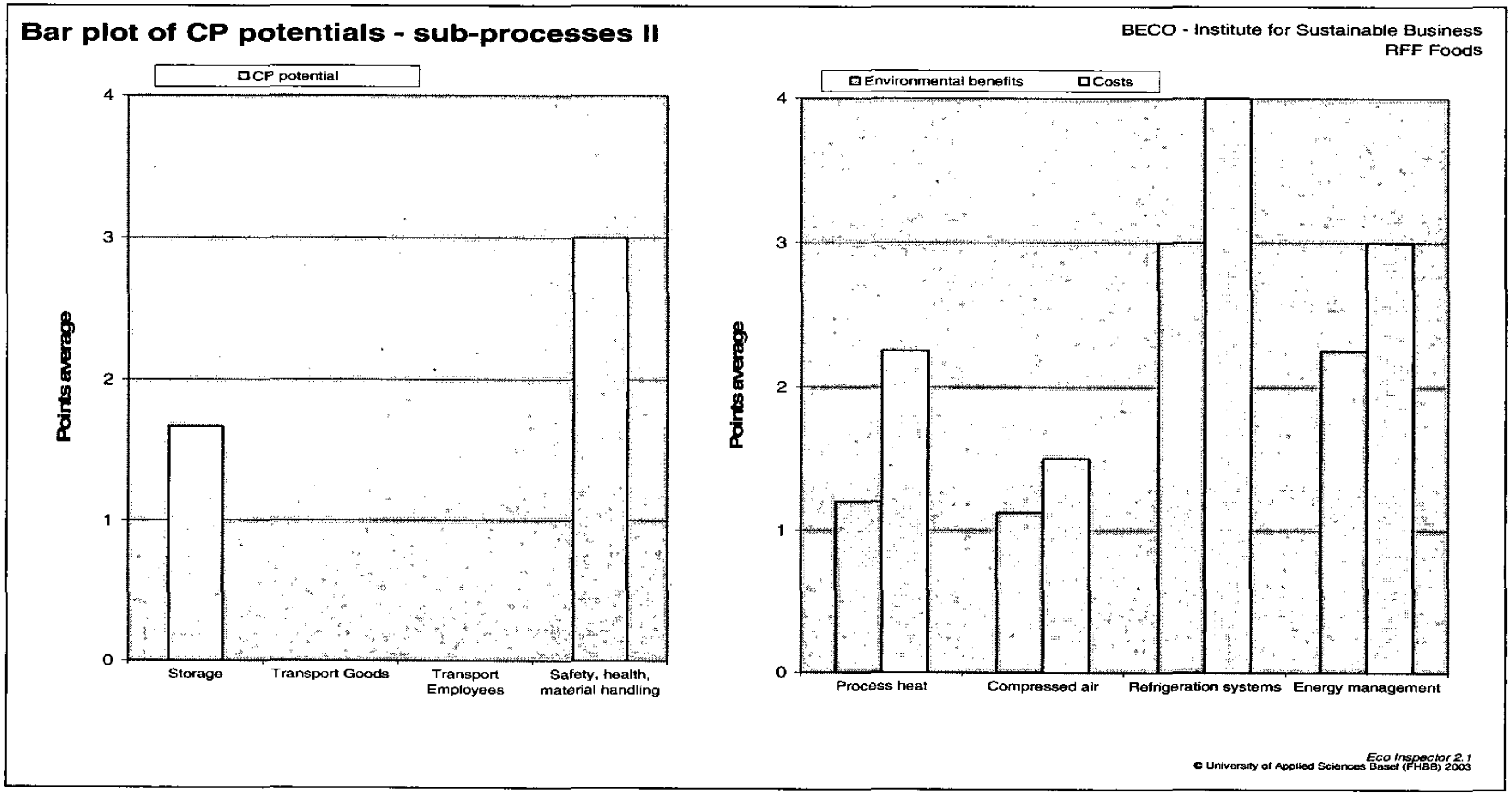
Exit Signs

Incandescent exit lamps can be replaced by either compact fluorescent or LED exit lamps. Both replacement lamps offer a longer life (10,000 hours for compact fluorescent lamps and 218,000 for LED lamps). Both replacements also use less power per fixture while meeting specifications on light output, offering substantial energy savings. The LED exit lamp can only be used with a red-shielded exit sign or a green/white sign whose shield can be replaced with a red shield. The labour required to replace the existing lamps is assumed to be equal to that required to replace fluorescent lamp ballasts

9.27 Turn Off Lighting when not in Use

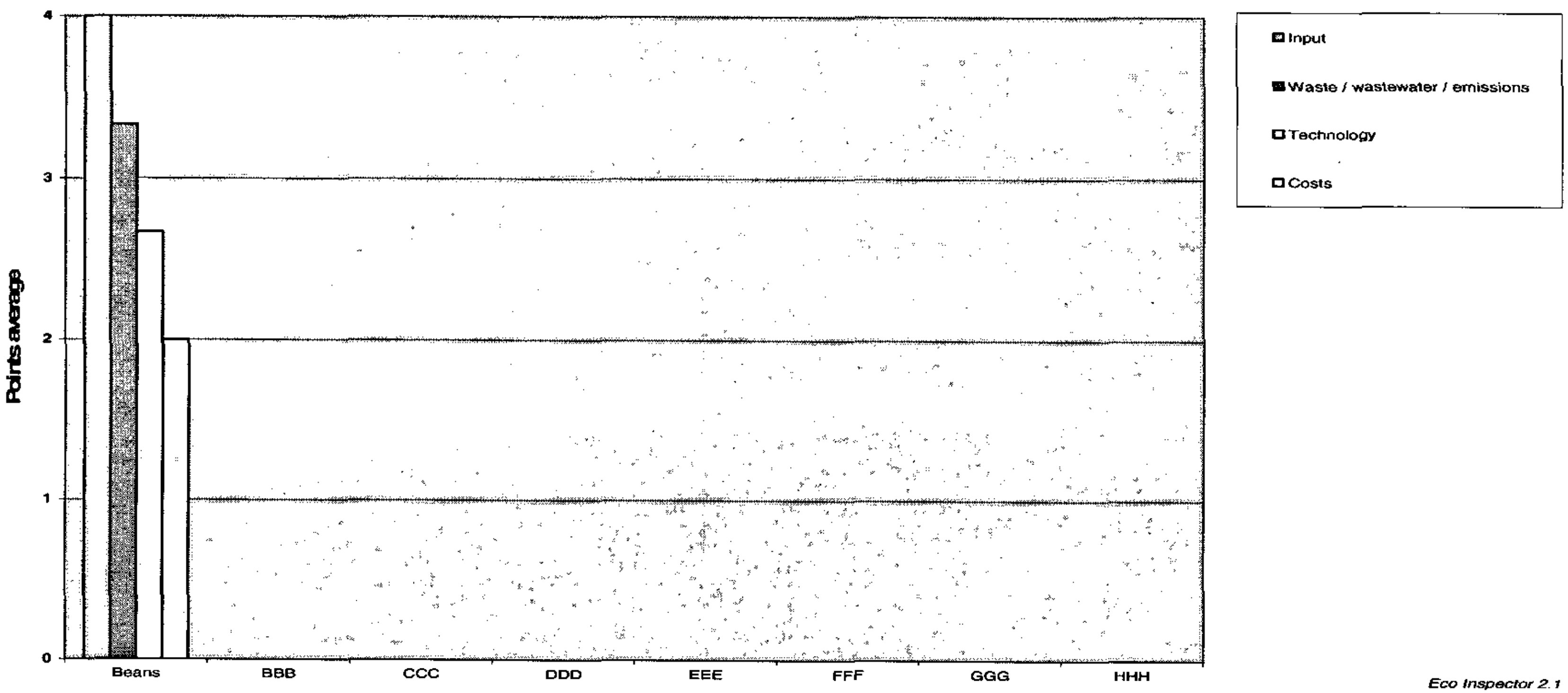
This is a very easy, no cost CP option aimed at reducing the energy spent on lighting when no-one is on the premises or within a room. External security lighting falls into this option and should be retrofitted with photo sensor cells which turn the external security lights off during daylight hours. During several walk through on the plant. The external security lighting was always on.

APPENDIX 1: ESTIMATED POTENTIALS OF COMPONENT PROCESSES



Bar plot of CP potentials - sub-processes I

BECO - Institute for Sustainable Business
RFF Foods



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APPENDIX 2: SUMMARY OF RESULTS

Summary of results RFF Foods

BECO - Institute for Sustainable Business

Process	CP potential environmental benefits (process)												CP potential economic benefits			Estimation of CP potential*			
	Input			Waste / wastewater / emissions					Technology				Costs						
	(Eco-) toxic problem materials	Raw, auxiliary, operating materials	Energy consumption	Solid waste	Special waste	Wastewater (flow, amount)	Wastewater components	Airborne emissions	Status of technology	Level of automation	Faulty batches, scrap	Maintenance, servicing, cleaning	Input materials, energy	Disposal, preparation	Maintenance, stoppages	Points average of environmental benefits (process)	Points average of economic benefits (costs)	Environmental CP potential **	Economic CP potential **
P1 Beans	-	-	4	4	-	4	2	-	2	-	2	4	2	2	2	3.1	2.0	XXX	XX
P2 BBB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0		
P3 CCC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0		
P4 DDD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0		
P5 EEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0		
P6 FFF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0		
P7 GGG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0		
P8 HHH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0		
P9 Storage	Moderate CP potential anticipated. Additional investigation recommended into storage and stock management.															1.7		XX	
P10 Transport Goods	No CP potential anticipated															0.0		-	
Employees	No CP potential anticipated															0.0		-	
E1 Process heat	Moderate CP potential for environmental benefits or financial savings. Additional analysis of the process(es) 'heat provision' recommended.															1.2	2.3	X	XX
E2 Compressed air	Moderate CP potential for environmental benefits or financial savings. Additional analysis of the 'compressed air provision' processes recommended.															1.1	1.5	X	XX
E3 Refrigeration systems	High CP potential for environmental benefits or financial savings anticipated. More detailed analysis of the 'cooling energy provision' processes urgently recommended.															3.0	4.0	XXX	XXX
E4 Energy management	High CP potential for environmental benefits or financial savings anticipated. More detailed analysis of the energy management system recommended.															2.3	3.0	XX	XXX
Safety, health, material handling	High CP potential anticipated. More detailed analysis of the safety, health and material handling aspects is urgently recommended															3.0		XXX	

* Estimation of CP potential

X	low CP potential	Points average "environmental benefits" or "economic benefits"	0.0	to	1.3
XX	moderate CP potential	Points average "environmental benefits" or "economic benefits"	1.3	to	2.7
XXX	high CP potential	Points average "environmental benefits" or "economic benefits"	2.7	to	4.0

** The value of "Process points average" corresponds to the environmental CP potential, the value of "points average of environmental benefits" corresponds to the "Economic potential"
The calculation of the points average covers all positions with a value. Positions without CP potential (value = "-") are not taken into account.

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APPENDIX 3: PROCESS DATA

Engineering Services Report Figures 2005/2006

Cannery	Oct.	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (year)
Elec. Rand	R 106,620.00	R 83,753.64	R 158,949.93	R 206,350.80	R 219,641.27	R 195,381.55	R 171,446.06	R 173,215.63	R 176,611.21	R 136,052.94	R 138,573.67		R 135,619.50	R 131,568.90	R 192,474.90	R 2,035,886.36
Elec. KVA	907.00	734.46	1 228.00	1,506.00	1,578.00	1,653.00	1,347.00	1,344.44	1,353.00	1,149.40	1,104.00		1,751.00	685.00	1,486.00	16,184.84
Elec. KWH	371,787	282,430	607,185	825,672	889,455	685,463	645,393	659,038	679,506	478,022	515,171		514,695	599,517	685,855	7,784,972
Steam Rand	R 17,113.00	R 153,908.00	R 331,687.00	R 468,264.00	R 433,929.00	R 387,822.00	R 294,556.56	R 193,802.00	R 135,051.00	R 141,155.00	R 70,305.00		R 186,871.30	R 368,324.00	R 388,477.70	R 3,400,244.56
Steam Ton	157	1,412	3,043	4,296	3,981	3,558	2,487	1,778	1,239	1,295	645		1,714	3,379	3,564	30,979
Water m3	11,265	26,933	63,807	70,360	87,086	50,072	29,842	20,318	10,206	3,510	15,906		29,339	43,995	64,170	488,611
Effluent m3	8,172	9,905	33,486	35,687	22,592	25,459	20,297	12,830	8,125	6,307	10,142		14,762	16,338	38,148	244,173
Effluent %	72.54%	36.78%	52.48%	50.72%	25.94%	50.84%	68.01%	63.15%	79.61%	179.70%	63.76%		50.31%	37.14%	59.45%	
Wonderland	**Oct.**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total (year)**
Elec. Rand	R 44,366.00	R 53,209.62	R 38,165.28	R 45,234.62	R 50,258.00	R 46,209.69	R 40,028.29	R 46,334.48	R 47,894.82	R 50,452.48	R 50,880.10		R 36,948.96	R 69,404.66	R 53,786.50	R 575,598.08
Elec. KVA	410	419	416	400	432	448	288	403	400	410	416		432	432	480	4,956
Elec. KWH	141,120	199,680	94,400	151,360	173,440	137,920	161,920	158,080	170,240	184,320	184,640		73,600	43,593	166,080	1,699,593
Steam Rand	R 58,860.00	R 58,860.00	R 58,860.00	R 58,860.00	R 58,860.00	R 58,860.00	R 58,860.00	R 58,860.00	R 58,860.00	R 58,860.00	R 58,860.00		R 58,860.00	R 58,860.00	R 58,860.00	R 706,320.00
Steam Ton	540	540	540	540	540	540	540	540	540	540	540		540	540	540	6,480
Water m3	9,750	8,494	9,328	8,498	11,211	9,497	10,419	10,250	11,683	10,053	11,438		11,461	12,280	7,953	124,071
Effluent m3	7,072	3,675	4,896	5,068	4,432	5,680	8,337	7,615	9,301	18,066	7,293		5,959	4,560	4,711	85,917
Effluent %	72.53%	43.27%	52.49%	59.64%	39.53%	59.81%	80.02%	74.29%	79.61%	179.70%	63.76%		51.99%	37.13%	59.24%	
Dairy factory	**Oct.**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total (year)**
Elec. Rand	R 31,610.00	R 45,784.00	R 31,612.00	R 43,459.00	R 48,098.00	R 24,876.22	R 25,701.10	R 35,388.70	R 20,714.14	R 23,981.19	R 21,099.09		R 46,258.90	R 52,262.78	R 35,504.76	R 408,955.68
Elec. KVA	286	286	300	341	343	175	190	300	164	179	199		352	457	211	3,211
Elec. KWH	103,023	203,620	97,095	163,788	195,865	102,317	220,137	123,902	77,444	94,268	65,329		166,798	165,090	138,225	1,610,258
Steam Rand	R 20,710.00	R 20,710.00	R 20,710.00	R 20,710.00	R 20,710.00	R 20,710.00	R 20,710.00	R 20,710.00	R 20,710.00	R 20,710.00	R 20,710.00		R 20,710.00	R 20,710.00	R 20,710.00	R 248,520.00
Steam Ton	190	190	190	190	190	190	190	190	190	190	190		190	190	190	2,280
Water m3	2,665	3,344	3,964	3,344	2,782	2,245	2,613	2,463	2,539	2,386	2,968		3,054	4,107	4,549	37,014
Effluent m3	1,922	1,449	2,064	1,995	1,100	1,343	2,091	1,830	2,021	4,288	1,893		1,588	1,525	2,703	24,440
Effluent %	72.12%	43.33%	52.07%	59.67%	39.54%	59.82%	80.02%	74.29%	79.61%	179.70%	63.76%		51.99%	37.13%	59.42%	
Werda Cow Farm	**Oct.**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total (year)**
Elec. Rand	R 12,945.00	R 12,003.00	R 8,802.00	R 14,606.93	R 13,580.00	R 10,778.86	R 11,884.66	R 10,054.04	R 11,435.28	R 11,822.85	R 12,778.00		R 11,668.57	R 9,310.22	R 7,556.19	R 134,277.59
Water m3	9,481	9,196	9,368	9,852	9,145	3,171	3,532	3,062	3,247	3,673	3,531		3,836	6,670	3,015	62,102
Effluent m3	2,649	1,285	935	1,039	868	900	1,800	668	271	935	417		777	699	761	10,070
Effluent %	27.94%	13.97%	9.98%	10.55%	9.49%	28.38%	50.96%	21.82%	8.35%	25.46%	11.81%		20.26%	10.48%	25.24%	
Effluent plant	**Oct.**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total (year)**
Elec. Rand	R 8,404.00	R 8,702.00	R 10,011.88	R 6,703.52	R 6,519.36	R 6,331.91	R 6,449.13	R 6,425.41	R 11,436.28	R 11,822.85	R 12,778.02		R 11,668.57	R 9,233.73	R 9,931.68	R 112,084.98
Elec. KVA	64	69	67	12	10	8	9	8	8	11	10		8	72	73	41,996
Elec. KWH	32,634	32,407	42,720	42,427	41,977	41,758	41,280	42,209	42,637	42,623	42,657		42,403	32,622	36,843	492,093
Werda Piggery	**Oct.**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total (year)**
Water m3	4,652	5,066	6,527	9,349	8,101	6,005	6,637	12,751	5,969	5,192	5,767		6,143	6,714	8,315	95,314
Effluent m3	9,879	11,377	12,437	8,728	9,018	8,604	5,259	8,945	10,770	7,941	12,164		14,272	14,793	16,583	129,243
Effluent %	212.4%	224.6%	190.5%	93.4%	111.3%	143.3%	79.2%	70.2%	180.4%	152.9%	210.9%		232.3%	220.3%	199.4%	1904.7%

APPENDIX 4: PROCESS STEPS OF THE BEAN LINE

Process steps Bean line

	Estimation of potential				Potential available	Weighting "Expert opinion"	Total Points Process	Total Points Cost
Input	(Eco) toxic problem materials	◉ none	○ small quantities	○ large quantities	no	-	-	
Input	Raw, auxiliary and operating materials	◉ none	○ small quantities	○ large quantities	no	-	-	
Input	Energy consumption	○ low	○ moderate	◉ high	2	2	4	
Input	Costs (input materials and energy)	○ low	◉ moderate	○ high	1	2		2
Waste / wastewater / emissions	Solid waste	○ none	○ small quantities	◉ large quantities	2	2	4	
Waste / wastewater / emissions	Special- (or hazardous) waste (e.g. acc. to Basel Convention)	◉ none	○ small quantities	○ large quantities	no	-	-	
Waste / wastewater / emissions	Wastewater	○ none	○ small volumes	◉ large volumes	2	2	4	
Waste / wastewater / emissions	Problem wastewater components	○ none	◉ small quantities	○ large quantities	1	2	2	
Waste / wastewater / emissions	Airborne emissions (gases, VOC's, dust, waste heat)	◉ none	○ small quantities	○ large quantities	no	-	-	
Waste / wastewater / emissions	Disposal or preparation costs (internal / external)	○ low	◉ moderate	○ high	1	2		2
Technology	Technology status	○ appropriate	◉ suitable for optimisation	○ unsuitable	1	2	2	
Technology	Level of automation	◉ appropriate	○ suitable for optimisation	○ unsuitable	no	-	-	
Technology	Faulty batches, scrap	○ none	◉ small quantities	○ large quantities	1	2	2	
Technology	Maintenance, servicing, cleaning	○ appropriate	○ suitable for optimisation	◉ unsuitable	2	2	4	
Technology	Costs for maintenance, servicing, stoppages, scrap	○ low	◉ moderate	○ high	1	2		2
Level of optimisation of current process Expert opinion		○ high W = 0.0; ○ high / medium W = 0.5	○ medium W = 1.0; ○ medium/low W = 1.5	◉ low W = 2.0	Chosen Weighting = 2			

APPENDIX 5: THE MOST IMPORTANT PRODUCTS / SERVICES

Company: RFF Cannery **Created by:** SJ Oldham **Page:** 1 of 1

No.	Product or service / Intended use	Quantity (per year)	Measuring Unit
1	Fruit products (canned) - Peach	13,000	Ton
2	Fruit products (canned) - Apricot	5,000	Ton
3	Fruit products (canned) - Pear	2,500	Ton
4	Fruit products (canned) - Guava	600	Ton
5	Fruit products (canned) – Mixed Vegatables	10,000	Ton
6	Canned Jam (Mixed)	12,000,000	Cans

APPENDIX 6: THE MOST IMPORTANT TYPES OF WASTE AND EMISSIONS

Company: RFF Foods – Cannery **Created by:** SJ Oldham **Page:** 1 of 1

No.	Waste and/or liquid or gaseous emissions	Quantity per year	Measuring Unit	Purchase Costs	Disposal Costs	Total Costs
1	Effluent (Werda piggery have an agreement to put their effluent into the solid separators)	224,173	M^3	unknown	unknown	unknown
2	Irrigation (all effluent goes to irrigation)	224,173	M^3	unknown	unknown	unknown
3	Pips	unknown	unknown	unknown	unknown	unknown
4	Plastic	unknown	unknown	unknown	unknown	unknown
5	Tins	unknown	unknown	unknown	unknown	unknown
6	Cardboard	unknown	unknown	unknown	unknown	unknown
7	General waste	unknown	unknown	unknown	unknown	unknown
8	CO_2 from boilers	unknown	unknown	unknown	unknown	unknown

APPENDIX 7: THE MOST IMPORTANT RAW AND PROCESS MATERIALS

Company: RFF Foods – Cannery **Created by:** SJ Oldham **Page:** 1of 1

No.	Material	Quantity per year	Measuring unit	Unit costs	Total costs	Use	Percentage in the product
1	Water	488,611	M^3			Use in fruit processing, cooking, cleaning, transport	unknown
2	Caustic Soda	unknown	unknown	unknown	unknown	De-skinning fruit	unknown
3	Fruit	unknown	unknown	unknown	unknown	Raw material	unknown
4	Sugar	unknown	unknown	unknown	unknown	Raw material	unknown
5	Electricity (KVA)	16,184	KVA	unknown	R2 035 886	energy	unknown
6	Electricity (kWh)	7,784,972	kWh	unknown		energy	unknown
7	Juice	unknown	unknown	unknown	unknown	Used in	unknown
7	Tins	unknown	unknown	unknown	unknown	Storage for finished product	unknown
9	Steam (coal)	30,979	ton	unknown	R 3 400 244	pasteuriser	unknown
10	Cleaning materials	unknown	unknown	unknown	unknown	cleaning	unknown

APPENDIX 8: MAJOR TOXICOLOGICAL RAW AND PROCESS MATERIALS

Company: RFF Foods - Cannery Created by: SJ Oldham Page: 1 of 1

No.	Material	Quantity per year	Measuring unit	Unit cost	Total cost	Use	Percentage in the product
1	Effluent	244,173	M^3	unknown	Unknown	Waste water – used for irrigation after solids are removed	unknown
2	Solids (contractor compost)	unknown	unknown	unknown	unknown	Solids removed from effluent and from clean up are sold to a contractor for compost purposes. Data not available	unknown

APPENDIX 9: QUICK SCAN EVALUATION RESULTS

Department: RFF Cannery Process: Cannery Responsibilities: Engineering Manager Evaluation Result: significance red										
Activity Product	Aspect - normal - abnormal Operation	Environmental and Economical Impacts					overall significance traffic light			Action
		Nature	Human	Raw Material	Energy	Legal compliance				
Write the process step	**In normal use Accident or brake down**	**Impacts to flora, fauna ...**	**health and safety ...**	**Raw material and waste**	**Loss of heat, energy**	**Danger of non compliance**	**RED**	**ORANGE**	**GREEN**	**further assessment observation no action**
Water usage through process	**- wastage - cleaning mentality**	1	2	1	3	3		**X**		**Material Balance**
Steam usage	**- steam leaks - energy management**	3	3	1	1	3		**X**		**Energy Balance**
Energy consumption (storage)	**- energy saving**	3	3	1	1	3		**X**		**Energy Balance**
Note: Red is a significant process |Orange: process needs to be observed |Green: Process need to be further investigated Impacts: 1 is significant - 2 is minor significant – 3 not significant										

APPENDIX 10: CP FOCUS OPTIONS

In the table below the areas initially identified as having opportunities for implementation of CP within the production process concerned can be given. In the second column ('CP Focus') the specific part(s) on which the CP audit should concentrate should be indicated. Finally, the implementation priority and remarks about the prioritization can be stipulated.

Identified (sub-)processes with CP opportunities		CP Focus		Priority	Remarks
1.	Water usage for cleaning	Reduce water usage	(F1)	med	Will take staff awareness and training – slight input for BAT cleaning aids
2.	Steam usage in the cannery	Reduce and repair steam leaks	(F2)	med	Steam audit and maintenance
3.	Steam usage in the cannery	Steam audit	(F3)	hi	Must be done before decision can be made on steam line
4.	Electricity consumption – refrigeration storage	Repair faulty doors on refrigeration storage units	(F4)	hi	Cost involved, but must be completed to reduce energy lost through refrigeration areas
5.	Staff awareness	With regards to water consumption and cleaning	(F5)	hi	No cost
6.	Staff awareness	With regards to entering and exit refrigeration storage units	(F6)	hi	No cost
7.	Solid waste spillage on floor	Reduce water usage & reduce COD in effluent	(F7)	med	Staff awareness and training
8.	Compressed Air	Reduce energy consumption	(F8)	Lo	Conduct compressed air audit and repair findings.

APPENDIX 11: MASS AND ENERGY BALANCES FOR OPTION FINDING

Benchmarks: Process: Cannery							
Input		Source of information	Output			Source of information	
Name:	Quantity	Value		Quantity	Balance	Value	Loss
raw material 1:			product 1:				
raw material 2:			product 2:				
raw material 3:			product 3:				
water:	488,611 m^3/yr	Water meters	non-product 1:				
Energy KVA:	16,164	Invoice	non-product 2:				
Energy kWh	7,784,972	invoice	non-product 3:				
steam	30,979	calculation	waste water:	244,173 m^3		unknown	
others 3:			energy loss:			unknown	

APPENDIX 12: CP OPTIONS GENERATED PER IDENTIFIED FOCUS OF AUDIT

Per CP Focus give the CP Options according to the table below. The number in the upper left corner of the table corresponds with the selected CP Focus (see 5, 'Selection of audit focus').

Description of CP Option		Directly Implemented[2]	Technical Feasibility	Economic Viability	Environmental Evaluation	Implementation Decision	Investment (€)	Savings (€)
1	Detailed Monitoring and Benchmarking	pos	pos	pos	pos		med	medium
2	Waste Product Recovery	pos	neu	pos	pos		low	
3	Pips for oil	pos	pos	neu	pos		unknown	Recycle used pips for oil
4	Recycle packaging	pos	pos	pos	pos		low	Income from packaging instead of going to landfill
5	Cooling system control	pos	neu	pos	pos		med	medium
6	Cascade rinsing	pos	neu	pos	pos		med	Water consumption and effluent
7	Magnuson Rinse optimisation	pos	neu	pos	pos		med	Water consumption and effluent
8	Review energy management policy	pos	pos	pos	pos		med	Boilers and steam generation
9	Tariff Management, load profile and peak demand	pos	neu	pos	pos		low	high
10	Steam balance and boiler efficiency	pos	pos	pos	pos		Hi	
11	Use waste biomass for boiler fuel	pos	neu	pos	pos			
12	Repair compressor leaks	pos	pos	pos	pos		low	
13	Draw air from boiler ceiling	pos	pos	pos	pos		low	
14	Exhaust gas from boiler stack used to pre-heat boiler feed water	pos	pos	neu	pos		med	Increase in air temp reduced energy consumption
15	General insulation of piping	pos	pos	neu	pos		med	Reduce energy loss through

Description of CP Option		Directly Implemented[2]	Technical Feasibility	Economic Viability	Environmental Evaluation	Implementation Decision	Investment (€)	Savings (€)
								radiation
16	Variable speed drives	pos	pos	neu	pos		high	Change all fixed speed motors to variable speed motors
17	Optimise cooling towers	pos	Pos	Pos	pos		high	
18	Energy efficient motors	pos	Pos	Pos	pos		high	
19	Environmental management system	pos	Pos	neu	pos		high	Update and maintain current EMS
20	Pre heat feed water for steam supply	pos	pos	neu	pos		med	Preheated water for steam feed supply reduces energy consumption
21	Floor cleaning	pos	pos	pos	pos		low	50% water used for cleaning
22	Closing doors to refrigeration storerooms after entering of exiting.	pos	pos	neu	pos		low	25% saving on energy going into cooling the stores
23	Repairing main insulated doors to refrigerated storerooms	pos	pos	neu	pos		low	Reduce energy lost through heat transfer
24	Repair windows in cold storage rooms	pos	pos	pos	pos		low	Reduce energy lost through heat transfer
25	Replace all lighting with energy efficient bulbs throughout plant	pos	pos	neu	pos		med	Reduce energy consumption through efficient bulbs.
26	Turn off lighting when not in use	pos	pos	pos	pos		low	
27	Replacing retort on main vegetable line	neg	neg	neg	pos		high	Reduce steam and water loss