Institute for Sustainable Futures

UTS UNIVERSITY OF TECHNOLOGY, SYDNEY

Australian Water Recycling Centre of Excellence

CUB YATALA BREWERY

The CUB Yatala Brewery water recycling scheme is located in outer northern area of Gold Coast City in Queensland. The plant commence operation in 2005.

CAPACITY

1.5-2 ML/d

CLASS OF WATER

A

TYPE

UASB, MBBR, RO

USAGE

Cooling towers, boiler feed, CIP systems, pasteurisation, pre-cleaning of vessels and pipes (not final rinses), floor washing, toilet flushing, and irrigation

Yatala Case Study

On-site industrial recycling improves water efficiency in beverage manufacturing

This case study is a financially, economically, environmentally, and socially successful industry example of in-house water recycling. Instead of the timing of brewery expansion plans being dictated by the local utility and its expansion of the regional wastewater treatment plant, CUB initiated on-site wastewater treatment and then on-site recycled water production, at a capital cost that was comparable to proposed headworks charges, and with significant recurrent savings through reduced water purchase, reduced trade waste discharge, and internal process savings because of higher quality water.

This study is funded by the Australian Water Recycling Centre of Excellence under the Commonwealth's Water for the Future Initiative

ABOUT THE PROJECT

This national collaborative research project entitled "Building industry capability to make recycled water investment decisions" sought to fill significant gaps in the Australian water sector's knowledge by investigating and reporting on actual costs, benefits and risks of water recycling **as they are experienced in practice.**

This project was undertaken with the support of the Australian Water Recycling Centre of Excellence by the Institute for Sustainable Futures (ISF) at the University of Technology Sydney (UTS), in collaboration with 12 partner organisations representing diverse interests, roles and responsibilities in water recycling. ISF is grateful for the generous cash and in-kind support from these partners: UTS, Sydney Water Corporation, Yarra Valley Water, Ku-ring-gai Council, NSW Office of Water, Lend Lease, Independent Pricing and Regulatory Tribunal (IPART), QLD Department Environment & Resource Management, Siemens, WJP Solutions, Sydney Coastal Councils Group, and Water Services Association of Australia (WSAA).

ISF also wishes to acknowledge the generous contributions of the project's research participants – approximately 80 key informants from our 12 project partners and 30 other participating organisations.

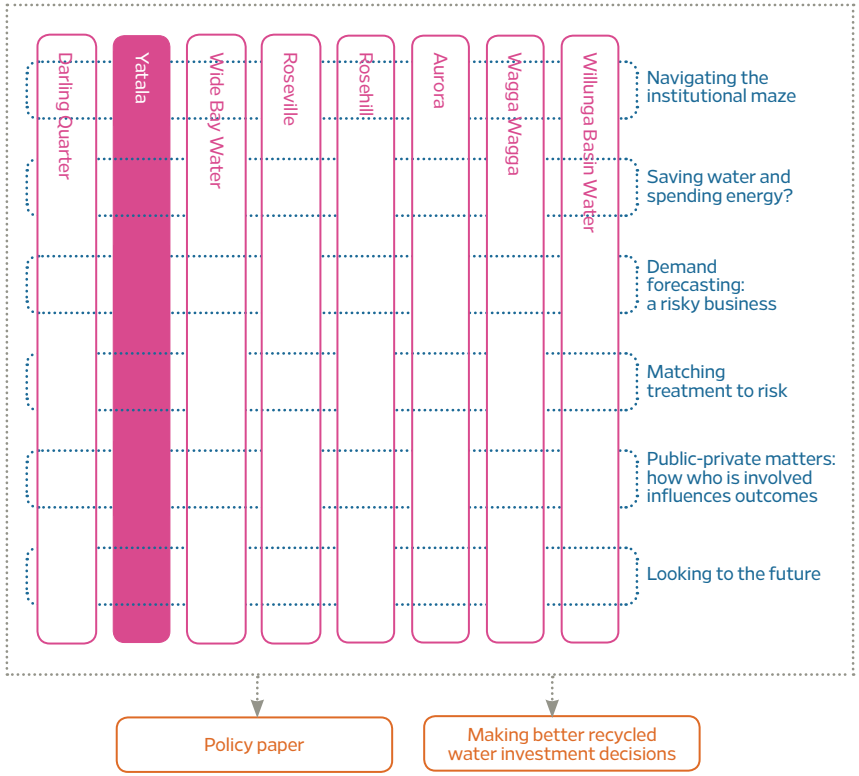
Eight diverse water recycling schemes from across Australia were selected for detailed investigation via a participatory process with project partners. The depth of the case studies is complemented by six papers exploring cross-cutting themes that emerged from the detailed case studies, complemented by insights from outside the water sector.

For each case study and theme, data collection included semi-structured interviews with representatives of all key parties (e.g., regulators, owners/investors, operators, customers, etc) and document review. These inputs were analysed and documented in a case study narrative. In accordance with UTS ethics processes, research participants agreed to participate, and provided feedback on drafts and permission to release outputs. The specific details of the case studies and themes were then integrated into two synthesis documents targeting two distinct groups: policy makers and investors/planners.

The outcomes of the project include this paper and are documented in a suite of practical, accessible resources:

- 8 Case Studies
- 6 Cross-cutting Themes
- Policy Paper, and
- Investment Guide.

For more information about the project, and to access the other resources visit www.waterrecyclinginvestment.com



ABOUT THE AUTHORS

The Institute for Sustainable Futures (ISF) is a flagship research institute at the University of Technology, Sydney. ISF's mission is to create change toward sustainable futures through independent, project-based research with government, industry and community. For further information visit www.isf.uts.edu.au

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Summary

With a beer production capacity of 450 ML/yr, Carlton United Breweries (CUB) at Yatala, south of Brisbane, is one of the largest breweries in the country. Using less than 2.5 L water/L beer, it is leading the way internationally in demonstrating world best practice water consumption. Historically this ratio was around 7-10L water/L beer, and internationally, the average is currently 3-6L water/L beer.

Water recycling at the brewery has happened in two stages. Bringing business risks under internal control without significant cost increases was a key driver in both stages. In 1993, CUB started treating its own industrial effluent on-site in order to avoid the charges it would have had to pay for the expansion of the local treatment plant, as the plant had no capacity to treat the brewery's effluent. In 2005, a doubling of the on-site effluent plant was needed to accommodate the brewery's plans to double production. However, this post-expansion effluent was once again in excess of what the local plant could cope with. By then the drought had started, so CUB was facing not only headwork charges but also escalating water and tradewaste discharge fees, leading the brewery to invest instead in a water recycling plant.

A decision to exclude the site's domestic sewage from the on-site recycling enabled the brewery to significantly reduce both regulatory compliance requirements and the risk of adverse public perceptions.

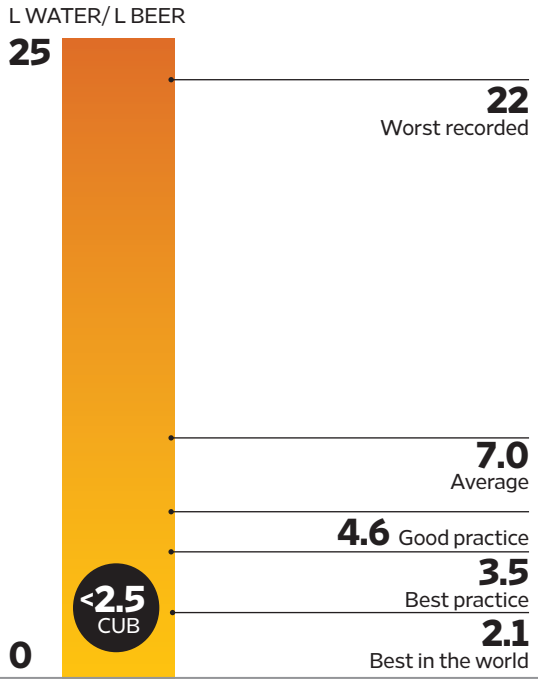
Keys to the successful implementation of the scheme included: CUB's willingness to take risks based on evidence, early ongoing engagement with Council, and collaboration with the research sector. The relationship with the research sector has evolved into a long-standing collaboration with mutual benefits.

The decisions to operate the scheme internally and not to use it as a marketing instrument to the product consumers were also important to reduce certain risks.

In operation since 2005, the plant has been running smoothly with just a few small hiccups.

In 2006 the brewery won the inaugural QLD EPA Sustainable Industries Award for Industrial Eco-efficiency, and a UN environmental award.

International benchmark of water usage rations in the brewing industry*



*Source: Donnelly, D., Fitzgerald, D., Molamphy, C., Spitere, M. 2013, 'Minimisation of water use in the brewery - the importance of water conservation', *Brewer & Distiller International*, January 2013, pp. 17-22

CUB stages

1993
1ST STAGE: On-site effluent treatment (UASB)
Production: 140 ML/yr beer
Aust. market share: 5%
Water to beer ratio: 5.5 L/L

2005
2ND STAGE: 2 x UASB and RW plant
Production: 230 ML/yr beer
Aust. market share: 10%
Water to beer ratio: 2.5L/L

2011
CURRENT
Production: 330 ML/yr beer
Aust. market share: 21%
Water to beer ratio: 2.3L/L

The Scheme

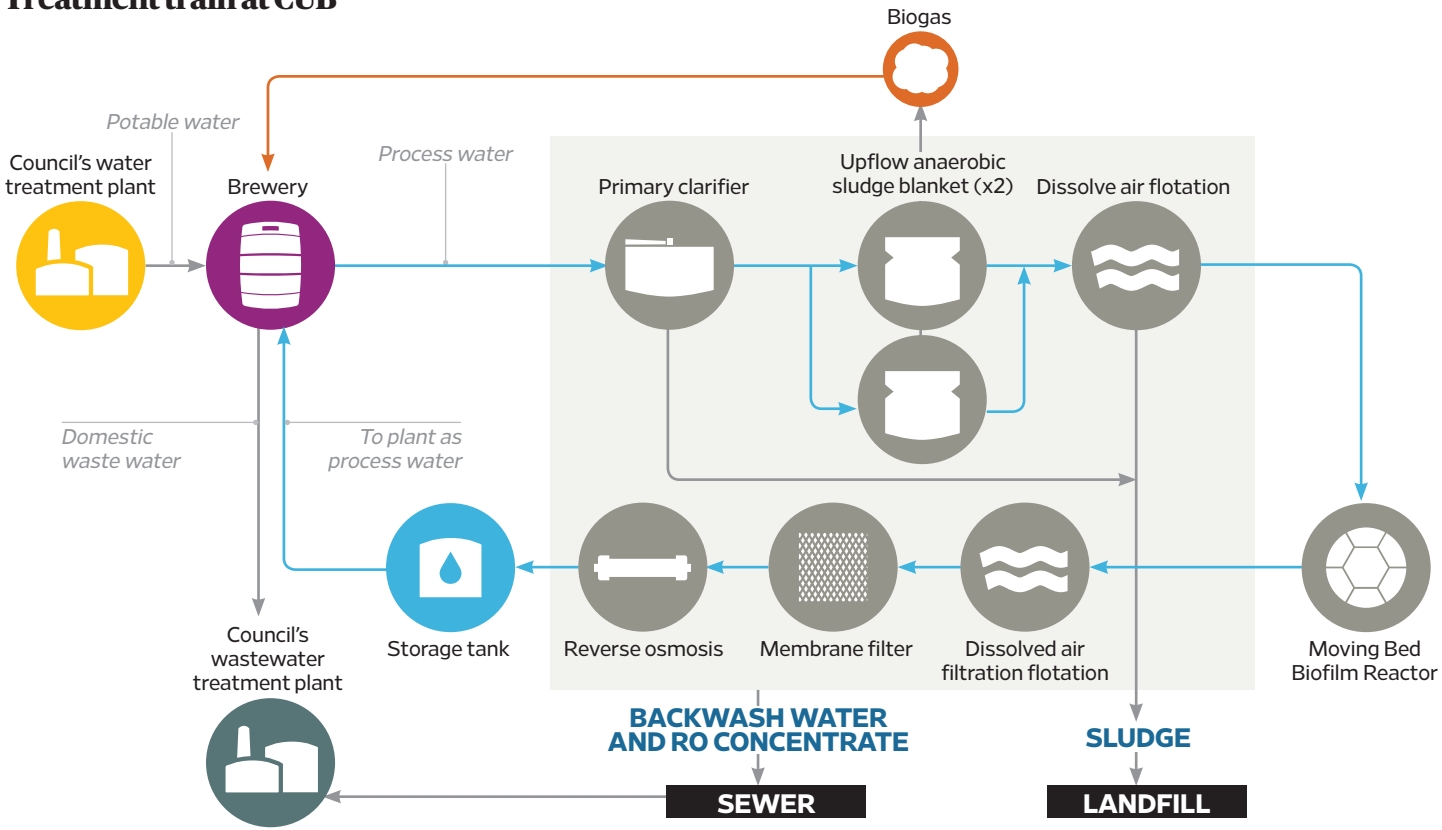
The scheme is located at CUB's Yatala site south of Brisbane. The brewery process produces 3.4 - 4.3 ML/d of liquid trade waste, of which approximately 65% is treated and reused as process water. Recycled water is produced at an average rate of 1.5-2ML/d. End-uses include cooling towers, boiler feed, cleaning in place (CIP) systems, pasteurisation, pre-cleaning of vessels and pipes (not final rinses), floor washing, toilet flushing and irrigation.

Only effluent from the brewery process is recycled. Human effluent is directed to the standard sewer line.

The treatment system is multi-barrier and includes an Upflow Anaerobic Sludge Blanket (UASB) system which allows the recovery of approximately 90% of the energy contained in the wastewater and reverse osmosis (RO) to remove salts. Captured biogas is used to gas-fire the boiler.

Most of the solid streams are dewatered and disposed to landfill, and the RO concentrate, some backwash water, and other solid streams are discharged to the sewer line.

Treatment train at CUB



On-site water recycling ticked all the right boxes

Moving operations to a rural area meant that either the town or the brewery needed to build new treatment facilities.

In 1993 CUB shifted its operation to their current site at Yatala. The location and size of its previous plant in Brisbane CBD offered limited opportunities to expand production. The then semi-rural location of the site at Yatala, which was previously owned and established by a small independent brewery, Power Brewing, was suitable for CUB's expansion plans.

However, the local wastewater treatment plant at Eagleby was set up for residential wastewater and had limited capacity to treat the brewery's trade waste. The plant was designed for a load of 30-40,000 equivalent population, and the brewery's post-expansion wastewater was approximately equivalent to the biological load of around 60,000 more people. For the brewery to expand, either the public sewage treatment plant would have to triple its size, or the brewery would have to treat its effluent on-site.

Whilst being supportive of attracting industry into the area, as a rural council, it had no experience in treating high strength industrial trade waste. In the context of the region, the brewery's trade waste volume was also significant, and any expansion of the local WWTP would be designed to serve the area's rapidly growing population, limiting the capacity to receive the brewery's trade waste.

Substantial headwork charges plus uncertainty about when the local treatment facilities would be extended triggered action to treat effluent onsite.

The headwork charges regime at the time required significant industry contributions towards the cost of new infrastructure. This meant that CUB would have had to pay a large percentage of the treatment plant's upgrade. The timing of the upgrade was uncertain and a wait of at least five years was anticipated, which put the brewery's expansion plans on an uncertain footing. To manage this uncertainty, the company decided to build its own on-site wastewater treatment at a cost that was similar to the contribution it would have had to pay towards the municipal plant expansion ($3 - 4m in 1993 dollars).

> "[...]we were facing, one way or another, very significant costs, either to pay the municipality to build the big effluent treatment plant for us or to install our own effluent treatment plant. Installing our own meant that we could control the timing rather than being reliant on a government decision around when they thought it was appropriate to expand[...]"

In the midst of drought, water recycling was a financial imperative.

Later on, in the early 2000s, with the pending closure of its Kent Brewery in Sydney and plans to shift production to Yatala, CUB was once again facing the issue of what to do with increased amounts of trade waste. This meant a doubling of its trade waste volume and as before, the local WWTP at Eagleby would have required significant expansion in order to cope with this increase in high strength effluent. The alternative was for CUB to simply double the capacity of their Upflow UASB treatment system. However, the region was experiencing a severe drought, with dam levels at less than 15 per cent at one stage. The state government was investing significantly in drought proofing infrastructure. This would ultimately lead to an increase in the future price of water and possibly of trade waste charges as well. The impact of this on the Brewery's post-expansion running costs, combined with the strong possibility of water restrictions, acted as key drivers for CUB to consider on-site water recycling.

In addition, once CUB proposed on-site water recycling, the utility offered to waive the remaining headworks charges in return for reducing the water demand by more than 1ML/d and reducing the wastewater treatment volumes by around 1.5ML/d.

It was anticipated that the avoided headworks charges, combined with the avoided potable water and trade waste periodic charges, would offset the cost of installing a purified recycled water plant for on-site use. In addition, halving the additional water demand alleviated both the risk of not being able to negotiate expansion of the production facility with Council due to general water restrictions, and the risk of being subject to restrictions.

Water recycling ticked another important box too.
A doubling of production meant a doubling of water usage, which would represent a significant portion of the city's water supply. In the context of severe water restrictions for the whole of Southeast Queensland at the time, this was politically sensitive. Water recycling would not only avoid such issues but also give the brewery a good story of corporate social responsibility to tell from the public relations perspective, which aligned with CUB's overall policies and corporate values.

> "Politically there's an issue if ordinary rate payers are being hit with tougher and tougher restrictions [...] and here is a major brewery doubling the uptake of water. It's not necessarily a good look [...] the drivers were such that we had no option but to install it [...] but when we did it, it was for all those right reasons."

Multiple internal and external enablers contributed to the success of the plant

The investment was financially risky but there was internal space for innovation.
Going down the path of water recycling had its risks. Waste water treatment was not part of CUB's core business expertise, and there was uncertainty around the technologies involved. Whilst there were a lot of benefits anticipated and certainty that some of these would eventuate, there was also a lot of uncertainty around the magnitude of these, as well as the magnitude of the costs.

Despite this, there was the space and mindset internally to embrace these uncertainties and take a calculated risk based on evidence. Multiple factors contributed to this.

A champion backed up by top management was instrumental.
The idea of water recycling as an alternative to upgrading the local trade waste plant was instigated and championed by the operations support manager at the time, who had a genuine interest in process improvement in general within the brewery and in water recycling in particular. He was instrumental in building the case internally, making sure it was a sound financial investment and taking the initiative of approaching the research sector, as well as being perseverant in overcoming technological obstacles.

Also essential was the willingness of the company's top management to consider the idea, and to support and finance the generation of evidence on which to base decision-making.

A history of sustainable management policies and CUB's existing industrial skill set also helped.
CUB is committed to sustainable management and cleaner production practices. Its well-resourced process engineering department already had a decade of experience in environmental improvement aligned with cost reduction, with a particular focus in reducing water usage.

> "Being an Australian brewery, we're always conscious of water use, so we already had a focus in that area and [...] a large database of existing information and knowledge of options which in the end gave us the ability to be much more confident in our decision making."

Therefore introducing water recycling was consistent with CUB's approach to process improvement, and did not require major internal shifts or restructuring of resources.

In addition, given the biological nature of the brewery business and CUB's existing industrial skill set, there was the internal capability to accommodate the new technologies and processes to operate and manage the scheme.

Approaches to gathering evidence to build the case for on-site trade waste treatment and water recycling proved effective in obtaining organisational buy-in. In each stage, first with the onsite trade waste treatment plant and later with the water recycling plant, there were two main concerns at the centre of decision-making: economic viability and the reliability of the technologies. If the effluent treatment fails, production stops, with significant implications.

> "[...] if you're an industrial plant and the treatment plant at the tail end of it stops working, you have to stop your industrial plant. The cost of that would have been immense. So we had to have a very, very high reliability factor for this effluent treatment plant to ensure it didn't stop the brewery."

Building the case for the UASB technology for on-site trade waste treatment involved visits to breweries in the Netherlands and Bangkok that used the same technology from the same provider, Parques. There was an interest in how the technology performed in Bangkok in particular because of the climate similarity to Australia. Records of this plant showing it was very stable and robust, combined with Parques' substantial expertise in South-East Asia, gave CUB the confidence to invest in the technology.

Later, the process of building the case for the recycled water plant involved running a pilot plant for eight months. This demonstrated the viability of the overall process and made it possible to experiment with different things within the plant (e.g. different approaches to filtration, and disinfection), and allowed staff to become familiar with the technology and gain understanding of the process.

Good early liaison with Council paid off. CUB recognised from the start that keeping close contact with Council was essential to avoid regulatory risks and ensure smooth management of public relations. This proved to be effective in getting support and assistance from Council, particularly when the brewery faced technical problems in implementing its trade waste treatment plant.

> "We held a lot of discussions with council and they were very helpful about [...] how we'd work constructively with them, so we didn't do anything that would upset their plans. I think that meant that when we had occasional glitches[...] they assisted us by coping with that higher flow [...] [by] modifying their plant to deal with that[...]"

CUB's liaison with Council was also critical during the transition to water recycling, as the brewery gradually withdrew from discharging trade waste effluent to the local WWTP. The high sugar content of the brewery's pre-treated trade waste assisted in the breakdown of the Council's wastewater so the withdrawal of this flow of sugars affected the performance of the Council's plant. It was important that the Brewery liaised with Council on the timing and speed of the phasing out period.

Collaboration with the research sector has evolved to a symbiotic relationship with mutual benefits.
Faced with difficulties with their UASB system, CUB approached the University of Queensland Advanced Water Management Centre (UQ AWMC) for advice. UQ AWMC is a world class research group specialising in innovative wastewater treatment, and it helped by identifying that the system was deficient in certain nutrients.

That was the start of a long-standing informal collaboration. The research centre has continued to provide troubleshooting support and a technical sounding board for decisions around technology options, and it assisted CUB in installing and running the water recycling technology pilot plant.

For the UQ AWMC, the benefits of this collaboration have been equally significant. It has not only helped the Centre to gain a better understanding of the process industry, the end users of the technologies they develop, but also of what works and what doesn't in practice. The Centre has been able to access sludge from the brewery's digesters to test technologies in development, as well as run pilots of new technology at the brewery. This is immensely beneficial to the research sector because it reveals larger scale issues that are not encountered in small laboratory reactors.

For example, in 2008, the UQ AWMC piloted a Microbial Fuel Cell (MFC) at the brewery. This technology has the potential to reduce energy usage and GHG emissions of waste water treatment processes. Although MFC is unlikely to replace the UASB system at Yatala, the new technology may have other applications in smaller operations, such as wineries and small boutique breweries.

The UQ AWMC is also able to access Yatala to run study tours for students, and uses it as a case study to demonstrate the feasibility of certain technologies.

Enablers that contributed to the success of the scheme

Some decisions were key in reducing certain risks

Domestic sewerage proportion of the waste stream not worth the hurdle to recycle it.
On this site, human sewage is a very small waste stream compared to that from beer production. Although the plant had enough capacity to cope with the sewage, it was not worth the hurdles of regulatory compliance and the public perception risk. Thus a decision was made not to include this stream in the water recycling treatment. For this reason, the plant is considered low risk, which simplified regulatory compliance significantly.

Internal operation and maintenance of the plant promotes ownership of problems and has proved effective in troubleshooting.
CUB's previous bad experience with outsourcing operation and maintenance (O&M) to a third party at a similar plant in WA led it to decide to run the scheme internally. This meant that in-house expertise had to be developed but the advantage has been that problems are owned internally. This has led to less 'finger pointing and blaming' when something goes wrong, and more efficient and effective problem solving.

> "[...] we own it, we run it, we are responsible for it [...] So as a consequence the rest of the plant is involved in it going [performing well]. So if they play up, I can come back and down and I can stop the bloke who did the problem and he understands that it's our problem."

Another advantage is the opportunity to identify opportunities for further cost savings through having access to and interest in effluent quality data. For example, an interest in reducing the impacts of pH and salt concentrations on the trade waste treatment process led process engineers to identify an opportunity to drastically reduce caustic soda use for cleaning, which improved wastewater treatment performance, reduced production costs, and improved environmental outcomes, all at the same time.

Approach to manage public relations was to be transparent upfront but not to market the scheme directly to product consumers.
CUB's major concern in publicising the RW plant was how it would be portrayed by the media and that it could be falsely perceived as a public health risk. The brewery was aware that too much secrecy could lead to unfounded sensationalism by the media. Therefore, CUB opted to publicise the RW plant openly, and market it as a good story of sustainability upfront, emphasising in every communication that RW was not being used for beer.

However, although CUB publicised its RW scheme openly, it did not use it as a marketing instrument to general consumers. This decision was made on the basis that consumers with an interest in green production processes represented a very small niche market, and therefore there was general low demand for such products.

> "Our marketing people didn't think the public were engageable for a green beer. There were a few small niche [brewers] who were talking about what good guys they were and using organic mal and so on. But across the broad spectrum globally no breweries were trying to market to consumers on the basis of their green credentials. It was too complex."

The future is looking promising under new ownership

The strong culture of corporate sustainability of SABMiller, who took over ownership of CUB in 2011, is providing the brewery with the incentive to further improve its overall sustainability performance, particularly in other areas of sustainability where other SABMiller breweries are performing better.

Being one of the biggest producers of beer in the world, SABMiller takes part in corporate social responsibility indices such as the Dow Jones Sustainability Index. Such indices are increasingly important as benchmarks for best practice, particularly as investors pay more attention to performance in these realms.

SABMiller monitors and periodically evaluates and internally benchmarks the performance of its breweries around the world on different areas of sustainability, reporting on progress towards international benchmarks following the Global Reporting Initiative international standards. These monitoring, evaluation, and benchmarking processes also encourage the exchange of good practices and effective troubleshooting to find solutions.

CUB's water recycling experience and high performance in water conservation is a benefit for SABMiller as it is able to apply the scheme's expertise to its other breweries.

Costs and Benefits

CUB's decision to treat its effluent on-site in 1993 led to significant advantages. The capital cost of the UASB plant was around $4.3m (in 1993 dollars), comparable to the combination of the $3-4m (in 1993 dollars) of avoided headwork charges, and trade waste discharge fees. In addition, the brewery gained independence from government decisions regarding the timing of their expansion.

2nd stage cost considerations*

ORIGINAL (BEFORE 2ND STAGE)		2ND STAGE OPTIONS					
		DOUBLING OF UASB PLANT BUT NO RECYCLING		DOUBLING OF UASB PLANT AND RECYCLING		SAVINGS TO	
						CUB	COMMUNITY
Headwork charges	–	~$5.7m		~$1.3 m (waived in return for water consumption being limited to an increase of 32% and greater capacity being made at the local WTP through a reduction of 30% in wastewater discharge)		~$5.7m of avoided headwork charges	$16.8m (delayed cost of upgrading local WWTP)
Water consumption	1.9 ML/d	3.6 ML/d (increase of 90%)	$1.2m pa	2.5 ML/d (increase of 32%)	$867,000 p.a	$333,000 p.a	1.1 ML/d of potable water
Water charges		~$ 0.95/kL		~$ 0.95/kL			
Wastewater discharge	1.3 ML/d	2.4 ML/d (increase of 85%)	$1.9m p.a	0.93 ML/d (reduction of 30%)	$740,000 p.a	$1.16m p.a	1.5 ML/d of tradewaste discharge
Wastewater charges		$2.18/kL		$2.18/kL (assumed high end)			

* analysis done in 2004 dollars

Later on in 2005, the option of water recycling offered significant benefits when compared to the option of simply doubling the capacity of their UASB system. The investment was significant, with the water recycling plant costing $6.5m (in 2004 dollars), but it avoided headwork charges of approximately $5.7m (in 2004 dollars) and the risk of being subject to water restrictions and escalating water and trade waste prices. The estimated operating costs for the entire water recycling plant are around $0.85/kL (2007 dollars), a relatively small cost when compared to the potable water and trade waste charges of $0.95/kL (2004 dollars) and $2.18/kL (2004 dollars) respectively. Considering the plant's biogas production provides energy savings of $500,000 p.a (2007 dollars), this meant that at the time the decision was made to recycle water on-site, the brewery was looking at around $2m p.a (2004 dollars) in operating cost savings.

Other non-monetised benefits to the brewery include:

- Independence from government decisions regarding the timing of their expansion
- Reduced greenhouse gas emissions
- Benefits from higher quality water, including reduced scaling potential, lower chemical consumption, more effective cleaning action, and lower bleeding rates
- Environmental credentials recognised by industry and government
- Employee pride
- Attracts best young engineers
- High quality sludge.

"[...] it was a very good engagement tool for employees to know that [...] the guys at Yatala were running the most water efficient brewery in the world. Which gave them pride in their plant."

"Anybody else who wants to start a trade waste plant in Australia at the moment, wants the sludge from our trade waste plant. Because we've got the best sludge there is."

For Council, the option of CUB becoming independent from the local sewage network provided the benefit of delaying the need for an expansion of the local WWTP and the costs to the community associated it, which were estimated at $16.8m (in 2004 dollars).

Further, in the context of drought, Council had an interest in maximising water sustainability outcomes for businesses and CUB's water recycling initiative provided an example to other businesses in the same industry.

Additional realised benefits include:

- Transport and energy savings and reduced GHG emissions: the brewery uses less energy to treat its effluent to potable standard than the council would have used to transport and treat the effluent to the sewerage system standard
- No increase in salts discharge despite the brewery's doubling of production.

Reflections

Headwork charges regime can be effective as an incentive to encourage industry to take leadership.
For CUB, the headwork charges regime at the time meant that whether it introduced water recycling, or contributed to the upgrade the local WWTP, it faced substantial costs. This provided the brewery with the incentive to engage in some careful thinking around the benefits and risks of each option besides the cost.

Benefits of collaborating with the research sector may repay the effort involved.
In the water sector industry-research collaboration is essential to enable certain technologies to be tested under real world conditions which are impossible to mimic in small-scale laboratory reactors. This often involves some effort and commitment on the side of the industry partner to facilitate processes internally to accommodate requirements to test new technologies.

In the case of CUB, the presence of a champion who was proactive in ensuring the scheme went ahead made the difference and the tradeoff has been worth it. Access to technical support from the UQ AWMC has been a significant factor to the success of the recycling water plant and to continuous improvement in the brewery's broader operational/technological performance.

Outsourcing is not always the best solution.
There are significant benefits in opting for internal O&M of water recycling schemes. In the case of CUB's brewery at Yatala, this has meant less finger pointing and blaming when problems emerge, and more efficient and effective problem solving than at a similar plant where CUB had outsourced O&M to a third party. With in-house expertise to run the scheme, and ownership of its O&M, the brewery is able to more easily manage the impact of production decisions on the effluent treatment plant, including making production improvements that are also good for the efficiency of the plant and good for the environment.