AGENDA ATTACHMENTS

Strategic & General Services Committee

Wednesday, 10 October 2012, 6.00 pm

City of Fremantle

SGS1210-1 REQUEST BY TREVOR DUNCAN FOR EXEMPTION FROM CITY OF FREMANTLE PARKING LOCAL LAW 2006

ATTACHMENT 1

23.05.94

ENGINEERING SERVICES COMMITTEE

Minutes and Reports of the Ordinary Meeting of the Engineering Services Committee held in the Committee Room, Fremantle City Council on Wednesday 11 May, 1994 at 6.00 p.m.

TABLE OF CONTENTS

- 89 -

23.05.94

- 90 -

23.05.94

PRESENT

Cr D.H. Thompson	Chairperson
Cr M. Caputi	
Cr R. Corkhill	
Cr J. Franchina	
Cr A. Macri	
Cr A. Rimes	
Cr A. Sullivan	Observer
Cr H. Farrar	Observer
Cr S. Hoare	Observer
Mr P. de Villiers	City Manager
Mr E. Richardson	Director of Engineering Services
Mr G. Flood	Acting Assistant City Engineer
Mr A. Chai	Assistant Parking Manager
Mr C. Oughton	Parks and Recreation Manager
Mr S. McAll	Works and Services Manager
Mr A. Carmichael	Administration Officer - Engineering

CR D H THOMPSON MOVED THAT THE REPORT BE RECEIVED AND CONFIRMED AS THE MINUTES OF THE MEETING OF THE COMMITTEE. SECONDED BY CR A MACRI CARRIED

- 91 -

20 JUN 1994

ES4

23.05.94

Subject : Parking Scheme Amendment
File : 6.5.8
From : Director of Engineering Services

Purpose

To introduce "No Parking Anytime" restrictions on the North Western and South Eastern side of Letitia Road on the corner of Rule Street for a distance of approximately 20 metres to remove any existing parking at this corner.

Background

Letitia Road is very steep in its mid-section and less steep at the top and bottom where it joins Rule Street and Thompson Road respectively. There have been instances of run-away vehicles and at least one vehicle has run into the house at 44 Thompson Road opposite Letitia Road.

To alleviate this problem parking has been prohibited in the steep mid-section of the street. It is still permitted at both the top and the bottom of Letitia Road. A guard rail has also been constructed in front of the house at 44 Thompson Road.

Comment

It is considered that parking at the bottom (Thompson Road) end of Letitia Road can remain without causing any safety problem.

There are, however, some safety issues regarding parking at the Rule Street end of Letitia Road. It is possible for a vehicle, not properly parked along this section to run into the steep section of the street. This has the potential to cause severe damage or injury.

For the past few years a truck has been parked on the Rule Street end of Letitia Road. The driver lives at No. 6 Letitia Road. Officers of the Parking Department have examined the truck on numerous occasions and it has always been properly parked with the wheels turned into the kerb etc. Parking Officers point out that there is not really a suitable alternative area where the truck could park without causing convenience to other residents.

- 96 -

23.05.94

Desirably trucks of this size should be garaged overnight at a depot and not parked in residential areas. It is understood that the owner of the truck is a sub-contractor for Hindles. In the past it is understood, the owner of the truck has had some difficulty negotiating the parking of his truck at the company depot.

In instances such as this it is inevitable that the safety interests need to be balanced against those of convenience for residents. In this instance because of the potential for a serious accident I believe parking should be prohibited at the Rule Street end of Letitia Road. This would mean that the owner of the truck, Mr Duncan, would need to find a suitable alternative parking area for his truck. Desirably he will be able to negotiate with the trucking company to have the truck garaged at the depot.

Recommendation

(a) The Council's Parking Scheme be amended to introduce "No Parking Anytime" restrictions on both sides of Letitia Road from 6 metres West of Rule Street to the existing no parking prohibitions in Letitia Road.

(b) Mr Duncan be advised of the Council's decision and requested to negotiate with the trucking company to have his truck garaged at the depot.

CR D H THOMPSON MOVED THAT THE FOREGOING RECOMMENDATION NUMBERED ES4 BE ADOPTED. SECONDED BY CR R CORKHILL

CR A E FORMA MOVED THAT THE MATTER BE REFERRED BACK TO THE ENGINEERING SERVICES COMMITTEE FOR FURTHER CONSIDERATION AND REPORT

SECONDED BY CR A C SULLIVAN

THE MOTION WAS PUT AND CARRIED

- 97 -

SGS1210-2 TENDER FOR THE HIRE OF PLANT AND ROAD CONSTRUCTION MACHINERY FCC388/12

ATTACHMENT 1

ANNEXURE 1

NA Price Not Requested

Tenderer	Description	Dry Hire (Inc Gst)	Wet Hire (Inc Gst)	Travel/day $	Mobilise & Demobilise $	Minimum Hours (if applicable)
	TRUCKS					
COATES HIRE	6 - Wheel Tippers	442 RE-HIRE	NS			
	8 - Wheel Tippers	NA	NS			
	SKID STEER LOADERS					
	Rated load 680 - 850 kg with 4 in 1 bucket	NA	NS			
	ROLLERS					
	20 Tonne Self - propelled multiwheel	242	NS			DAY
	3 Tonne Self- propelled multiwheel	198	NS			DAY
	3 Tonne Twin drum	176	NA			DAY
	5 Tonne Twin drum	205	NA			DAY
	EARTH MOVERS					
	Excavators - 1.5 Tonne (including rock breaker)	225	NS			DAY
	Excavators - 4 Tonne	315	NS			DAY
	Excavators - 20 Tonne	495	NS			DAY
	Excavators - 30 Tonne	583	NS			DAY
	FRONT END LOADERS					
	2 – 2.5 Cubic Metre Front End Loader	1045	NS			DAY
Tenderer	**Description**	**Dry Hire (Inc Gst)**	**Wet Hire (Inc Gst)**	**Travel/day $**	**Mobilise & Demobilise $**	**Minimum Hours (if applicable)**
	TRUCKS					
EXECUTIVE HIRE	6 - Wheel Tippers	NA	93.5	93.5		4HRS MIN
	8 - Wheel Tippers	NA	104.5	104.5		4HRS MIN
	SKID STEER LOADERS					
	Rated load 680 - 850 kg with 4 in 1 bucket	NA	84.7	84.7		3HRS MIN
	ROLLERS					
	20 Tonne Self - propelled multiwheel	297	NS		148.50/HR	1DAY MIN
	3 Tonne Self- propelled multiwheel	242	NS		148.50/HR	1DAY MIN
	3 Tonne Twin drum	242	NA		110/HR	1DAY MIN
	5 Tonne Twin drum	275	NA		110/HR	1DAY MIN
	EARTH MOVERS					
	Excavators - 1.5 Tonne (including rock breaker)	NA	110	110		4HRS MIN
	Excavators - 4 Tonne	NA	102.3	102.3		4HRS MIN
	Excavators - 20 Tonne	NA	159.5		148.50/HR	8HRS MIN
	Excavators - 30 Tonne	NA	187		165.00/HR	8HRS MIN
* Extra Options Available	**FRONT END LOADERS**					
	2 – 2.5 Cubic Metre Front End Loader	495	148.5		148.50/HR	8HRS MIN
Tenderer	**Description**	**Dry Hire (Inc Gst)**	**Wet Hire (Inc Gst)**	**Travel/day $**	**Mobilise & Demobilise $**	**Minimum Hours (if applicable)**
	TRUCKS					
S & B SKIDSTEER SERVICES	6 - Wheel Tippers	NA				
	8 - Wheel Tippers	NA	110			4HRS MIN
	SKID STEER LOADERS					
	Rated load 680 - 850 kg with 4 in 1 bucket	NA	110			4HRS MIN
	ROLLERS					
	20 Tonne Self - propelled multiwheel					
	3 Tonne Self- propelled multiwheel					
	3 Tonne Twin drum		NA			
	5 Tonne Twin drum		NA			
	EARTH MOVERS					
	Excavators - 1.5 Tonne (including rock breaker)	NA				
	Excavators - 4 Tonne	NA				
	Excavators - 20 Tonne	NA				
	Excavators - 30 Tonne	NA				
	FRONT END LOADERS					
	2 – 2.5 Cubic Metre Front End Loader	NA				
Tenderer	**Description**	**Dry Hire (Inc Gst)**	**Wet Hire (Inc Gst)**	**Travel/day $**	**Mobilise & Demobilise $**	**Minimum Hours (if applicable)**
	TRUCKS					
ALLWEST PLANT HIRE	6 - Wheel Tippers	NA				
	8 - Wheel Tippers	NA				
	SKID STEER LOADERS					
	Rated load 680 - 850 kg with 4 in 1 bucket	NA				
	ROLLERS					
	20 Tonne Self - propelled multiwheel	330	120	120	425	8HRS MIN
	3 Tonne Self- propelled multiwheel					
	3 Tonne Twin drum	220	NA		380	8HRS MIN
	5 Tonne Twin drum		NA			
	EARTH MOVERS					
Excavator $98 no rock breaker	Excavators - 1.5 Tonne (including rock breaker)	NA	105	105	200	8HRS MIN
	Excavators - 4 Tonne	NA	115	115	425	8HRS MIN
	Excavators - 20 Tonne	NA	168	168	425	8HRS MIN
	Excavators - 30 Tonne	NA	190	190	425	8HRS MIN
	FRONT END LOADERS					
	2 – 2.5 Cubic Metre Front End Loader	NA	173	173	425	8HRS MIN

Tenderer	Description	Dry Hire (Inc Gst)	Wet Hire (Inc Gst)	Travel/day $	Mobilise & Demobilise $	Minimum Hours (if applicable)
	TRUCKS					
BREAK WEST HIRE PTY LTD	6 - Wheel Tippers	NA				
	8 - Wheel Tippers	NA				
	SKID STEER LOADERS					
	Rated load 680 - 850 kg with 4 in 1 bucket	NA				
	ROLLERS					
	20 Tonne Self - propelled multiwheel	330			370 EACH WAY	8HRS MIN
	3 Tonne Self- propelled multiwheel					
	3 Tonne Twin drum	181.5	NA		250 EACH WAY	8HRS MIN
	5 Tonne Twin drum	217.8	NA		250 EACH WAY	8HRS MIN
	EARTH MOVERS					
	Excavators - 1.5 Tonne (including rock breaker)	NA				
	Excavators - 4 Tonne	NA	88	55 EACH WAY	250 EACH WAY	8HRS MIN
	Excavators - 20 Tonne	NA	159.5	55 EACH WAY	370 EACH WAY	8HRS MIN
	Excavators - 30 Tonne	NA	192.5	55 EACH WAY	500 EACH WAY	8HRS MIN
	FRONT END LOADERS					
	2 – 2.5 Cubic Metre Front End Loader	NA	148.5	55 EACH WAY	370 EACH WAY	8HRS MIN
Tenderer	**Description**	**Dry Hire (Inc Gst)**	**Wet Hire (Inc Gst)**	**Travel/day $**	**Mobilise & Demobilise $**	**Minimum Hours (if applicable)**
	TRUCKS					
TRENCHBUSTERS PLANT HIRE	6 - Wheel Tippers	NA	90	135		4HRS MIN
	8 - Wheel Tippers	NA	100	150		4HRS MIN
	SKID STEER LOADERS					
	Rated load 680 - 850 kg with 4 in 1 bucket	NA	78	78		3HRS MIN
	ROLLERS					
	20 Tonne Self - propelled multiwheel					
	3 Tonne Self- propelled multiwheel					
	3 Tonne Twin drum	250	NA	78	156	8HRS MIN
	5 Tonne Twin drum		NA			
	EARTH MOVERS					
	Excavators - 1.5 Tonne (including rock breaker)	NA	111	76		3HRS MIN
	Excavators - 4 Tonne	NA	86	86		3HRS MIN
	Excavators - 20 Tonne	NA	125		500	8HRS MIN
	Excavators - 30 Tonne	NA				
	FRONT END LOADERS					
	2 – 2.5 Cubic Metre Front End Loader	NA	120	240		4HRS MIN
Tenderer	**Description**	**Dry Hire (Inc Gst)**	**Wet Hire (Inc Gst)**	**Travel/day $**	**Mobilise & Demobilise $**	**Minimum Hours (if applicable)**
	TRUCKS					
GROUND SUPPORT SYSTEMS	6 - Wheel Tippers	NA				
	8 - Wheel Tippers	NA				
	SKID STEER LOADERS					
	Rated load 680 - 850 kg with 4 in 1 bucket	NA	114.4		187	8HRS MIN
	ROLLERS					
	20 Tonne Self - propelled multiwheel	220	97.9		297	8HRS MIN
	3 Tonne Self- propelled multiwheel					
	3 Tonne Twin drum		NA			
	5 Tonne Twin drum		NA			
	EARTH MOVERS					
	Excavators - 1.5 Tonne (including rock breaker)	NA				
	Excavators - 4 Tonne	NA	108.9		187	8HRS MIN
	Excavators - 20 Tonne	NA	136.4		319	8HRS MIN
	Excavators - 30 Tonne	NA	150.15		341	8HRS MIN
	FRONT END LOADERS					
	2 – 2.5 Cubic Metre Front End Loader	NA	136.4		297	8HRS MIN
Tenderer	**Description**	**Dry Hire (Inc Gst)**	**Wet Hire (Inc Gst)**	**Travel/day $**	**Mobilise & Demobilise $**	**Minimum Hours (if applicable)**
	TRUCKS					
ABERCROMBIE EARTH MOVING	6 - Wheel Tippers	NA				
	8 - Wheel Tippers	NA				
	SKID STEER LOADERS					
	Rated load 680 - 850 kg with 4 in 1 bucket	NA				
	ROLLERS					
	20 Tonne Self - propelled multiwheel					
	3 Tonne Self- propelled multiwheel					
	3 Tonne Twin drum		NA			
	5 Tonne Twin drum		NA			
	EARTH MOVERS					
	Excavators - 1.5 Tonne (including rock breaker)	NA	85	85		4HRS MIN
Rocbreaker Attachement $143	Excavators - 4 Tonne	NA	99	99		4HRS MIN
	Excavators - 20 Tonne	NA				
	Excavators - 30 Tonne	NA				
	FRONT END LOADERS					
	2 – 2.5 Cubic Metre Front End Loader	NA				

Tenderer	Description	Dry Hire (Inc Gst)	Wet Hire (Inc Gst)	Travel/day $	Mobilise & Demobilise $	Minimum Hours (if applicable)
P & L RADONICH FAMILY TRUST	**TRUCKS**					
	6 - Wheel Tippers	NA	93.5	93.5		4HRS MIN
	8 - Wheel Tippers	NA	99	99		4HRS MIN
	SKID STEER LOADERS					
	Rated load 680 - 850 kg with 4 in 1 bucket	NA				
	ROLLERS					
	20 Tonne Self - propelled multiwheel					
	3 Tonne Self- propelled multiwheel					
	3 Tonne Twin drum		NA			
	5 Tonne Twin drum		NA			
	EARTH MOVERS					
	Excavators - 1.5 Tonne (including rock breaker)	NA				
	Excavators - 4 Tonne	NA				
	Excavators - 20 Tonne	NA				
	Excavators - 30 Tonne	NA				
	FRONT END LOADERS					
	2 – 2.5 Cubic Metre Front End Loader	NA				

SGS1210-3 RESIDENTIAL RECYCLING COLLECTION TENDER FCC346/12
ATTACHMENT 1

Quote/Tender Evaluation Form

1.0 Quote/Tender Number: WALGA TENDER
Project Name: RECYCABLE COLLECTION
Date: 17/09/2012

2.0 Quoter/Tenderer	Document Attached?	Details/Comments	Price Inc Gst
Perth Waste			$331,459.70
Cleanaway			375,139.60

Enter Lowest Price	$331,459.70
Enter highest price	375,139.60

3.0	Methodology	Experience	Resources	References	Price	Total Score
Quoter/Tenderer (Company Name)	15	15	15	15	40	100
Perth Waste	*15*	*15*	*15*	*15*	***40.0***	100.0
Cleanaway	*15*	*15*	*15*	*15*	***35.3***	95.3

Evaluation Panel

Lenny Covich Purchasing Officer
Stuart Edwards City Works Coordinator
Tracy Ellison Senior Admin Officer

SGS1210-4 REPORT FROM PARKING ACTION GROUP ON PROPOSED PARKING CHANGES

ATTACHMENT 1


FREMANTLE HARBOUR
Victoria Quay
Peter
Pl
Queen
Fremantle Train Station
VICTORIA QUAY
Ferry Terminal
B Shed
WA Maritime Museum
St
Fleet St
Cliff
Mouat
High
Little High Street
Phillimore St
Henry
Pakenham
Short St
Post Office
Leake St
Market
St
Pioneer Reserve
WEST END
Bannister St
CAPPUCCINO STRIP
Nairn St
Collie
Croke
St
Essex
Essex Lane
Norfolk
Norfolk Lane
South
Henderson
Esplanade Reserve
Mews
Boardwalk
Bathers Bay
FISHING BOAT HARBOUR
Challenger Harbour
Cape D'Orange Dr
Elder
Cantonment
Point
Woolstores Shopping Centre
Adelaide
CITY CENTRAL
High St Mall
William
Paddy Troy
Mall
Fremantle Markets
Parry
Princess May Park
Film & Television Institute
Adelaide St Plaza Shopping Centre
Queens Square
Ellen
Holdsworth
Fremantle Park
Police Station
Fairbairn St
The Terrace
Fremantle Prison
Fothergill
Fremantle Oval
Fremantle Football Club
Terrace
Fremantle Hospital
Suffolk
Arundel
Alma
Brennan St
Little Howard St
Wray
Howard
Russell
Grey
Marine Terrace
Rd
Price St
Douglas
South
Coral St
Wyola St
Gold
Silver
Louisa St
Rose St
Ada St
King
Key
Yellow 1 entry
Orange 2 entry
Pink 3 entry
Blue 4 entry
Green 5 entry

ATTACHMENT 2

SGS1210-5 UPDATED GRAFFITTI POLICY SG12

ATTACHMENT 1

ATTACHMENT 1

City of Fremantle / Notre Dame
Policy for the Management of Graffiti and Street Art within the City of Fremantle

Executive Summary

This agenda item reflects a co-operative project between the City of Fremantle and students at the University of Notre Dame. In recognition of the fact that the City's current graffiti policy is outdated and based on a WA Government initiative which no longer exists, the Mayor, Cr Rachel Pemberton and CEO Graham MacKenzie provided support and assistance to a group of public policy students at the University, who were charged with devising a new policy framework for the City to consider. If approved, the framework would then be sent out for consultation with a wide group of affected stakeholders before any decision would be made.
The new framework seeks to broaden public perceptions of uncommissioned artwork, with a view to preserving work which contributes to the culture and vibrancy of the City, whilst removing graffiti in a timely manner.

Background
The current Fremantle Graffiti Policy was endorsed in November 1999. It was based on the then State Government Graffiti Program (SGGP), a program which no longer exists. The policy is brief and focuses on collaboration and co-operation with this obsolete program. It focuses only on the removal of graffiti. There is no preventative plan in place to address the broader issue of the causes of illegal graffiti. The policy also states that removal on private property should take place with the consent of its "owners, occupiers and managers" (City of Fremantle Graffiti Policy 1999). This is not the case currently; there is no consent sought prior to removal.

The City's current graffiti policy also fails to distinguish between the graffiti and street art. This has meant that the City is obliged to remove all uncommissioned work which appears on buildings, whether it may have cultural value or not. This problem recently surfaced in the local media when a giant numbat mural was painted on Henderson St by renowned Belgian artist ROA. The words "The are less than 1000 numbats left in the wild" were inscribed on the mural and "save Warrup forest!". Whilst this contribution was removed soon afterwards (presumably by the same individual), the City would have no choice but to remove it under its current policy settings, regardless of whether or not members of the community valued it. This is but one well known example amongst a number of others in the Fremantle city's precinct. Given that the City is currently exploring methods of making the precinct more visually amenable, vibrant and lively, it would appear that the time has come to rethink our approach to uncommissioned artwork.

At the beginning of 2012, University of Notre Dame Lecturer in Politics Dr Martin Drum approached Councillors at the City of Fremantle with the offer of having Public Policy students participate in the development of policy in the City. Cr Rachel Pemberton, in conjunction with Mayor Brad Pettit, consulted with officers at the City and advised that the City's Graffiti policy would be an appropriate one to revise given the above issues. During the course of their studies, students were advised by Mayor Pettit and Cr Pemberton, and further input was provided by senior officers at the City. A brief consultation session was held with a representative from a business, resident, and heritage organisation, and a draft of this agenda item was sent to a local street artist. These consultations by were no means intended as a substitute for a more extensive consultation process, but rather as a way of ascertaining what parameters were appropriate for inclusion or exclusion in this policy.

Detail

Definition
The new City's new Graffiti Policy needs to recognise the difference between graffiti and street art. This will enable it to promote a vibrant street art culture whilst continuing its approach to removing any undesirable forms of graffiti from public spaces and private property.

For this purposes of this policy graffiti should be considered as any act of

- Marking
- Painting
- Tagging
- Sketching

on personal or public property, which is considered destructive, offensive, or of no value to the community.

For this purposes of this policy street art should be considered as

- Authorised or unauthorised artwork which adds value to the culture or community of Fremantle.
- Material which does not compromise the visual aesthetics of specific precincts within Fremantle, such as buildings which have heritage value.

Implementation
All uncommissioned graffiti/street art will be assessed by the City of Fremantle Joint Graffiti Removal Team. Photographs will be taken of material prior to removal. This is established process even in those jurisdictions which take a hard line on graffiti, as it provides evidence for police to investigate. In this case such evidence will also be critical in evaluating the material quickly and effectively.

- Council officers should briefly examine all work prior to removal. Where possible, this should take place within 48 hours of the material being reported by the community or sighted by council officers.
- Work which is clearly defined as graffiti should be removed immediately. Priority should be given to the removal of material which is deemed offensive or obscene.
- All work deemed to have potential as street art should be referred to a select committee for determination. The membership of this committee should be determined through the policy's consultation process. Suggestions include one sitting member of council, one member who is a resident, one member who is a business owner, one member who is aged under 30, one member who is involved with or has connections to the street art community, and one member nominated by a heritage-based organisation. Final determination of the committee membership should be decided by Council.
- If the select committee recommends that the work should be considered street art, the City should not remove it, subject to the following:
    - Private property owners should be able to have any uncommissioned work on their property removed. A list of such properties should be established to facilitate this. This should also apply to State or Federal Government property.

- Uncommisioned artwork cannot be approved for retention without the consent of the owner.
- A decision to retain uncommissioned artwork should be reviewed after six months
- Where uncommissioned artwork is deemed to be street art and retained, members of the local community such as residents or businesses have a right to appeal. Upholding or dismissing such an appeal would be considered by an ordinary meeting of council.

Related initiatives

The City should establish a trial where a small precinct for street artists to produce their work in public is identified. This area would be on council property unless agreement is reached with a private owner. The City would permit work produced in such a location to stay for a nominated period of time, unless it were deemed offensive or obscene. Such a space could provide a clear pathway to encourage artists to contribute to the vibrancy of the community. The trial could initially be for a period of three months, to establish its efficacy. Input on the location should be sought from the community via the consultation process.

The City could consider making public canvasses available in selected areas, so that uncommissioned artwork could be developed and displayed for a defined period of time. If such canvasses were assessed as having a monetary value, they could be sold by council, with the proceeds going to charity. Potential artists would be made aware of this when the canvasses were set up.

The City has on occasion commissioned art for a number of public spaces around the City. Such policies should continue, and may encourage uncommissioned artists to develop material within the framework suggested above.

The City currently sponsors the Fremantle Street Arts Festival, in conjunction with local businesses. Such initiatives further legitimise the value of street art to the local community and complement the policy approach identified above. Further promotions could include hosting a street art exhibition, using a well known artist as its public face, or sponsoring workshops for those interested in the genre. It is anticipated that emphasising the value of street art might encourage those currently involved in graffiti to express themselves in an alternative fashion, which contributes to the community rather than defaces it.

Statutory and Policy Assessment

This proposal has been assessed against the Fremantle Graffiti Policy 1999, and against a range of State Government legislation. Criminal penalties for graffiti remain under the jurisdiction of the Western Australian government. The WA Police Act defines graffiti as a criminal offence, and the Criminal Code (WA) deals with criminal penalties. There are further provisions on graffiti in the Public Transport Authority Regulations Act 2003, the WA Planning and Development Regulations 2009, and the WA Rail Freight System (Corridor Land) Regulations 2000. None of these provisions impede the implementations of actions proposed in this policy. They do however, prohibit graffiti on state-owned property, which this policy needs to take into account.

Consultation

Business
All relevant business groups need to be consulted, including the Fremantle Chamber of Commerce and the Fremantle Business Association.

Community
Consultation should include residents, youth groups, the Street Artist community, Schools, the WA Police, and indigenous groups.

Heritage
The Fremantle Society should be afforded the opportunity to comment on any impact of this policy on the preservation of local heritage

Comment
Consultation methods need to be diverse to reach the identified groups listed above. It may appropriate for instance, to use online instruments such as blogs or social media, to connect with young people and the street artist community. Efforts should also be made to accommodate individuals who may not feel comfortable in contributing in traditional modes of consultation. Methods such as face-to-face meetings, or informal round-table discussions could be used. Other more traditional consultation methods might include public meetings, surveys, written submissions, and stakeholder meetings.
This policy has considerable potential to rejuvenate the urban heart of Fremantle and encourage greater community participation amongst local artists. It is hoped that the process can also help our local community identify those values which Fremantle wants to be known for.

Risk and other implications

Financial
The main aspects of the new Graffiti policy should not impose any significant impost upon the City. There are costs associated with some of the related initiatives, but these are easily quantifiable, such as commissioned artworks or public canvasses. The City has already committed to some of the related initiatives, including the Fremantle Street Arts Festival.

The State Government does offer a number of grants in the area of Crime Prevention which the City could apply for in implementing some of the related initiatives contained in the policy.

Legal
This proposal does not conflict with existing legislation, although it is proposed that consultation be conducted with the State Government to inform them of the proposed policy and seek their feedback. As stated above, all criminal penalties remain the domain of the State Government. Given that the policy advocates respecting the right of property owners to decide on the retention of material on their premises, it is not anticipated that businesses would take legal action over any of its provisions.

Operational
There will be some additional work for council officers in photographing material prior to removal, and in making preliminary determinations as to its content.

Organisational
It is recommended that this area of policy be transferred to the Community Development section of the City. This is so that the policy can be implemented in a holistic fashion, recognising the potential benefits to the City from encouraging street art, as well as the detrimental impact of graffiti.

Strategic and policy implications
This policy does constitute a change of policy in terms of assessing and removing graffiti, but it by no means contradicts previous policy decisions. Rather the policy should be seen as broadening the understanding and handling of the issue, and an attempt to mitigate its causes.
This policy should be seen as enhancing the City's efforts to make the business and urban precinct more vibrant. It is in line with the City's adoption of other initiatives such as the opening up of public space to residents and members of the Community.

Community Engagement
This policy gives street artists an opportunity to engage in their local community more fully. It constitutes an acceptance of their work and encourages them to contribute in a way which enhances the community's vitality.
This policy also offers the broader community the opportunity to decide what sort of material they would like to see more of in their public spaces, and what material is inappropriate.

Draft recommendations
That the City adopt this draft proposal as a starting point for a new policy on Graffiti and Street Art. That the City circulate this proposal to the Fremantle community with a view to incorporating feedback ahead of any formal adoption.

ATTACHMENT 2

SG12 GRAFFITI

Policy Type	Approved	Amended	Custodian
Strategic	22.11.99 (SDRCP87)		Physical Services Technical Assistant

Objective
To guide decision making regarding establishment of a one year Joint Agreement with the State Government Graffiti Program and to the removal of existing and new graffiti on both public and private property in Fremantle.

Higher Order Plan
Fremantle City Plan
- Aspirations For Council – Responsive to our Community
- Strategy 7 – Promote and further develop Fremantle as an attractive place for visitors and tourists:
- ❖ establishment of an Agreement with State Government Graffiti Program (SGGP) to control graffiti.
- ❖ establishment and operation of a Fremantle Graffiti Removal Team in conjunction with SGGP.
- ❖ increased management of graffiti issues and long term planning to reduce graffiti.
- ❖ in conjunction with SGGP - increased liaison with Police and Community on graffiti Reporting issues.

Legislative Framework
Local Government Act 1995
- Section 3.18 – The graffiti campaign is integrated fully with the State Government Graffiti Program, does not inappropriately duplicate work done by other bodies and will be efficiently and effectively managed with the support of the State Government Graffiti Program.
- Section 3.20 – Authorises the City to undertake works outside of Fremantle provided that it is done on behalf of the relevant local government or has the consent of the property owner, occupier or manager of the property.
- Section 9.29 – Authorises the CEO or the CEO's delegate to represent Council in court proceedings.

Police Act - Section 80 and 80 A
Civil Law suits against offenders.

Decision Maker
CEO

Delegation of Decision-Making
MANAGEMENT OF GRAFFITI ISSUES - REMOVAL OF GRAFFITI - FREMANTLE GRAFFITI CAMPAIGN

Delegation 3.61
Delegated by Council to: CEO
Delegated by CEO to: Manager Physical Services

Guidelines: Authority to decide on all issues relating to a Joint Agreement with the State Government and to the Fremantle Graffiti Campaign including its guidelines and information distribution.

Authority to decide on all issues relating to the establishment and operation of a "Joint Graffiti Removal Team.

Authority to decide on locations and methods for Graffiti removal.

Authority to under Local Government Act 1995 Section 9.29 to represent Council in court for recovery of costs.

Policy

There is a large quantity of existing graffiti in Fremantle at the time of policy development. Subject to agreement from private property owners/occupiers/managers existing graffiti should be removed within 9 months of the establishment of an operational graffiti removal team and new graffiti removed within 24 to 48 hours of reporting.

Priorities for graffiti removal will be based initially on cleaning in the City Centre then move on to major arterial roads, parks, schools and public open space. Removing obscene or offensive graffiti is a first priority. New graffiti will take precedence over old since a key element in the Campaign is to get new tags down in 24-48 hours. Removing graffiti from Council facilities will also have a high priority.

The City of Fremantle is keen to establish an agreement with the State Government Graffiti Program to implement an integrated Fremantle Graffiti Campaign in accordance with the attached State Government Graffiti Program Resources or Input flowchart *(refer to Policy Manual attachments)*.

This policy authorises the undertaking of graffiti removal from private property subject to agreement by owners, occupiers and managers of private property and their indemnification of the City against any claims for damage to the vandalised surface caused by the City's graffiti removal treatment.

This policy authorises the use of the City's Graffiti Removal Team and its equipment by the State Government Graffiti Program in other municipalities on a direct cost recovery basis.

National Competition Policy Implications

Principal LR. 1 of the Clause 7 Competition Policy Statement specifies that:

> "Legislation should not restrict competition unless it can be demonstrated that:
> (a) the benefits of the restriction to the community as whole outweigh the costs: and
> (b) the objectives of Local laws can only be achieved by restricting competition."

Principal LR1 also applies to Council policies.

The purpose of this policy is to establish a graffiti removal and management agreement between Council and a division of the State Government. The agreement brings Fremantle into line with a number of other Councils who have similar agreements and utilise the State Government Graffiti Program to obtain specialised graffiti services including a telephone hotline, electronic graffiti reporting to the WA Police and provision of records, statistics, and financial or other detailed reports from electronic databases to allow for policing and effective removal of graffiti or its management.

The graffiti removal service has the potential to impact on other private organisations currently involved in removal of graffiti from private premises in Fremantle on a commercial basis. Nevertheless, the high incidence of new graffiti in Fremantle, together with the large volume of graffiti already existing, suggests that the private approach to graffiti removal has not been a success.

The public interest benefits to the community of introducing the Fremantle Graffiti Campaign are therefore considered to outweigh the costs to any private organisations that may be affected.

Policy Implementation Steps
The Policy involves delegation of decision making to the CEO.
Implementation will involve:

- the setting of service specification to achieve a valued community service.
- Establishing and following Campaign guidelines and SGGP requirements.
- ensuring safe and efficient operation of graffiti removal.
- performance to predetermined budgetary requirements.

Reporting Arrangements on Decision-Making under this Policy
Reports to the Manager of Physical Services Development will be prepared on a regular basis to monitor achievement of the above implementation steps. Such reports will list main activities undertaken, major expenditure and detail all initiatives undertaken.

Policy Review Date
September 2000.

ATTACHMENT 3

City of Fremantle

Policy

Updated Graffiti Policy SG12

Type:	Strategic
Legislation:	"<Legislation or NA>"
Procedure:	"<Insert hyperlink or NA>"
Delegation:	"<Delegation or NA>"
Other related document:	Graffitti removal procedures.

Objective

To determine decision making regarding the management of graffiti and unauthorised street art across the City of Fremantle on both public and private property.

Policy

Graffiti or graffiti vandalism refers to the illegal activity of defacing private and/or public property without the consent of the property owner. *Urban art* refers to legal work, where permission to mark a surface has been granted by the owner of the property.

Graffiti is words or drawings on walls without permission. There are four main types of Graffiti:

- Tags which are written or etched on any surface using pens, paint, spray cans and if the most common form of graffiti.
- Pieces which are large or small mural style works that may incorporate a signature and may have artistic merit.
- Slogans which are words about an issue, idea or thought, could be applied with paint or on stickers, paste ups or etched into the surface.
- Stencils where a template has been used to create a design and spray painted onto a surface.

All graffiti will be assessed by the City's graffiti removal team and be removed within 24-48 hours of reporting. Priority is given to removing offensive or obscene graffiti. It is important that the City continue to be able to provide a swift response to all graffiti removal. All graffiti on heritage places will be removed under the guidance of heritage advice.

Graffiti that falls into the category *of pieces, slogans* or *stencils* and may have cultural or artistic merit and considered to be "unauthorised street art" and will be photographed and referred to the Director Community Development for a decision about its removal or retention. The Director will liaise with the City's public art officer as required to make a determination, and instructions will be relayed to the graffiti removal team in relation to the retention or removal of the graffiti.

Unauthorised street art on private property that is deemed to have cultural or artistic merit will be left in place unless there is a request to have it removed made by the property owner A register of retained street art will be kept.

The City will continue to work with the state government and young people to develop graffiti reduction programs and the youth urban art program to promote responsible street art and reduce graffiti hotspots.

Responsible directorate:	Community development
Reviewing officer:	Director Community Development
Decision making authority:	Council
Council item number:	<Type Number press Tab>
Policy adopted:	Click here to enter a date. "<Council number>"
Policy amended:	Click here to enter a date.. "<Council number>"
Next review date:	2015

SGS1210-6 FREMANTLE LEISURE CENTRE POOL HEATING OPTIONS
ATTACHMENT 1

EMC
ENERGY MADE CLEAN

Renewable and Low Carbon Solutions for Fremantle Leisure Centre

FINAL

Updated January 23, 2012

Prepared for Alex Hyndman, Sustainability Officer

EMC DOCUMENT: FLC-PHO-R-001-B

www.energymadecleanEMC.com Offices in Perth, Melbourne, and Kalgoorlie.

Executive Summary

The Fremantle City Council is examining the available options to reduce the greenhouse gas emissions from the Fremantle Leisure Centre (FLC). The energy used to heat the pools at the FLC is the source of a significant component of the City of Fremantle's annual emissions inventory.

EMC has developed a model which incorporates the electricity and gas consumption data from the FLC to determine the thermal and electrical loads that need to be taken into account when examining alternative energy technology.

A total of 25 different technology configuration scenarios were evaluated to determine the energy and cost performance of the technology options. The technologies examined in the scenarios included cogeneration plants, air-source heat pumps, ground-source heat pumps, deep geothermal and the extraction of shallow aquifer water as a heat source for heat pumps.

The scenario analysis revealed several key insights into the relationship between technology options, capital and operating costs, and emissions abatement. The scenario which resulted in the shortest payback period (125kWe cogeneration plant with 1x air source heat pump, 3.5 years payback period) also delivered the smallest emissions abatement (117.8 tCO_2e per annum). In contrast, the most expensive scenario (deep geothermal, 14.6 year payback period) delivered the highest emissions abatement (520 tCO_2e per annum).

The modelling indicates that the best result which optimises the balance between cost and emissions abatement is a 125kWe combined heat and power (CHP) or cogeneration unit coupled with heat pumps supplied with water from a shallow aquifer beneath the FLC. The key financial and environmental results are shown in the table below.

Scenario	Total Gas Cost ($)	Gas Savings ($)	Total Electricity Cost ($)	Total Peak Elect Sourced (kWh)	Gas GHG (t CO2-e/year)	Electicity GHG (t CO2-e/year)	GHG Savings (t CO2-e/year)	Capital Cost ($)	Simple PbP	NPV 6%	NPV per tonne CO2 abated
Baseline	$183,654	-	$103,856	255,669	639.3	470.8	-	-	-	-	-
125kW Cogen, 3x100kW HP, Thermal	$136,250	47,404	$52,837	138,882	463.8	220.1	426.2	$711,951	7.2	404,705	47

In general terms, our analysis has shown that the optimal environmental and financial benefit is achieved through a combination of different technologies and operating principles. The model that was developed enables the City to evaluate these technology mixes. The modelling also shows that by operating the cogeneration system to meet thermal demand results in maximised greenhouse gas savings.

There are risks in implementation and operations of the shallow geothermal option. Direct exchange GSHP can provide similar, but poorer results to shallow geothermal, but the technical risk is likely to be lower.

Contents

1 Introduction

The Fremantle City Council is examining the available options to reduce the greenhouse gas emissions from the Fremantle Leisure Centre (FLC). The energy used to heat the pools at the FLC is the source of a significant component of the City of Fremantle's annual emissions inventory. FLC also uses a substantial amount of electricity and these indirect emissions are also taken into account in this work.

The pool is currently heated by a natural gas-fired boiler. This provides an inexpensive and convenient option for pool heating, however there are still substantial carbon emissions associated with gas combustion and the price of natural gas is predicted to increase.

The City has investigated various options for replacement of the gas-fired heating system but has not been able to settle on an acceptable solution. This project will perform a comparison between four technologies (cogeneration with natural gas, air-source heat pumps, direct exchange ground-source heat pumps and shallow geothermal coupled with heat pumps) to present an unbiased account of the advantages and disadvantages of these individual technologies, and combinations of these technologies. The first three of the options have been evaluated separately from the shallow geothermal option.

2 Reference information

Several documents were provided by the City of Fremantle:

1. April 2011: Urban Energy Australasia, *Co-generation quotation Combined Heat and Power.* (unsolicited proposal).
2. May 2010: GHD, *Water Heating Options at Fremantle Leisure Centres, Geothermal vs. Solar.*
3. July 2004: Rockwater, *Feasibility of Obtaining Geothermal Groundwater for Fremantle Aquatic Centre.*
4. April 2004: Lincolne Scott, *Fremantle Leisure Centre Alternative Energy Study.*
5. Novermber 2011: Rockwater, *Preliminary Desktop Study to Heat Pools using Low Temperature Geothermal Resources*

In addition to the above documents, the City of Fremantle also provided intraday electricity and gas consumption data which was sourced from the utility providers. EMC conducted site visits and interviews with key personnel to gain an understanding of current practices and operational requirements of the FLC. EMC also visited several other aquatic centres during the course of the project.

3 Scope and methodology

EMC has developed a model which incorporates the electricity and gas consumption data from the FLC to determine the thermal and electrical loads that need to be taken into account when examining alternative energy technology. The reports previously commissioned by The City, and proposals provided by vendors, were based on annual and seasonal characteristics which did not account for intraday performance requirements at the FLC. Based on EMC's prior experience, the use of hourly data for this type of study can yield very different findings than a seasonal or annual analysis. A key feature of EMC's model is that it is based on the hourly thermal and electrical data obtained from FLC, resulting in a comprehensive and accurate understanding of energy system performance.

A customised version of EMC's pool energy system model has been delivered along with this report.

3.1 Energy system modelling

The model developed by EMC is an MS Excel macro-enabled spreadsheet. The key inputs are the thermal and electrical data for the FLC, and parameters such as the greenhouse gas emissions intensity of grid electricity and natural gas. The model can derive the energy system performance for any combination of natural gas fired cogeneration (or CHP, Combined Heat and Power), heat pumps (ground and air sourced), solar thermal and solar photovoltaic (PV) systems. The model accounts for the performance of the existing natural gas boiler, should it be required. A number of different scenarios can be investigated by altering the number and type of various pieces of equipment.

Another important input is the operating mode for the cogeneration system, which will be described in detail further in the report.

The model can also account for:

- A feed-in-tariff
- Renewable Energy Certificates
- Demand charges
- Power factor levy

The results of each system scenario are then compared with each other, and with the baseline energy usage and greenhouse gas emissions of the existing gas-fired system at the FLC.

3.2 Financial Impacts

The financial impacts are calculated and compared to the baseline financial performance of the current system. The model accounts for capital costs, operating costs and maintenance costs.

The electricity costs account for peak, off-peak, demand and reactive power correction costs. The electricity consumption of the heat pumps is taken into account when calculating electricity costs. The cost of gas is calculated for the gas-fired cogeneration plant and for scenarios where the existing gas boiler is still required to meet the overall energy demand. The overall benefit is then calculated against the baseline case and this is used in the calculation of the NPV (Net Present Value).

3.3 Greenhouse Gas Impacts

The greenhouse gas impacts are taken into account by calculating the electricity usage and gas usage for each scenario. These are compared to the baseline greenhouse gas emissions of the existing system to determine the emissions abatement achieved by each scenario.

4 Technology descriptions

4.1 Combined heat and power (cogeneration)

Also known as cogeneration, this technology uses a reciprocating engine fuelled by natural gas. The engine is connected to a generator which can supply electricity to the site, or export electricity to the grid. Typically about 38% of the energy supplied as fuel to the engine is converted to electrical energy. The rest of the energy leaves the engine in the form of heat via the hot exhaust gases, the coolant system and the oil system. A large amount of the waste heat can be recovered through heat exchangers and can be used to heat the pool water. The use of a heat recovery system can increase the efficiency to around 80-90%, depending on the temperatures and complexity of the heat recovery application. A schematic of a typical CHP system is presented in Figure 1.

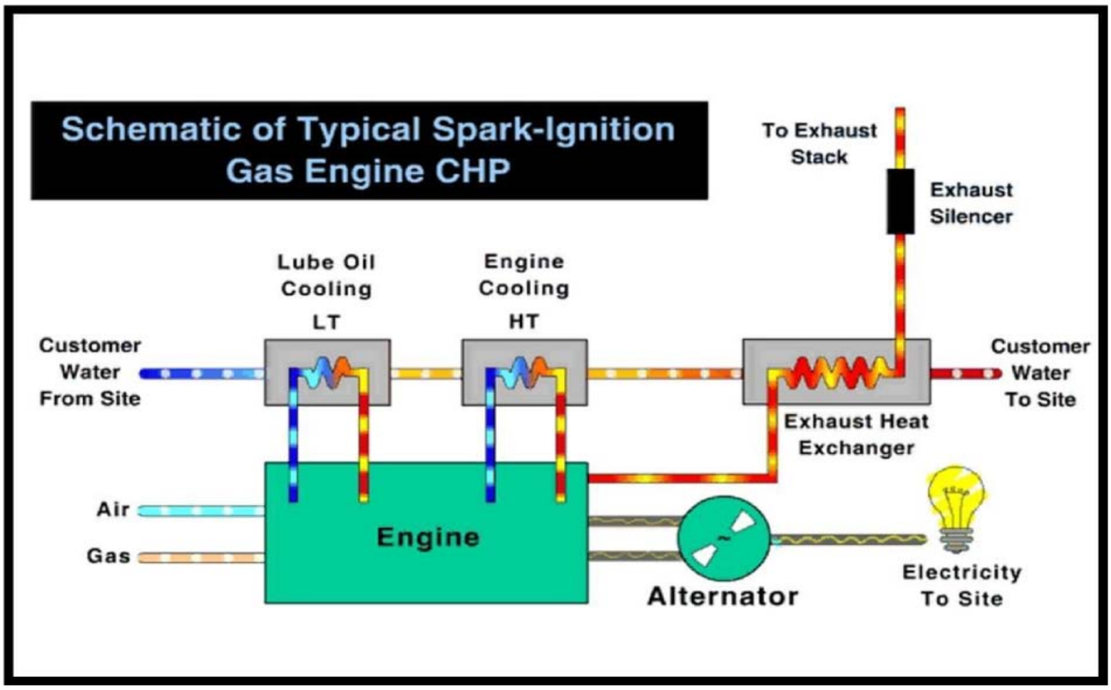


Figure 1: Schematic of Combined Heat and Power system[1]

4.2 Air-Source Heat Pumps

A heat pump is a device which uses a thermodynamic cycle to move energy from a heat source to a heat sink. In the case of an air-source heat pump (ASHP) for pool heating, the heat pump uses electricity to move energy from the air into the pool water. An air source heat pump can typically move 3 units of heat for every 1 unit of electrical energy needed to run the system. They are therefore an energy efficient means of heating. A good example of air-source heat pumps is the common air conditioning unit. A schematic illustrating an air-source heat pump to heat pool water is presented in Figure 2.

[1] http://qandras.net/lang/en/2009/06/.

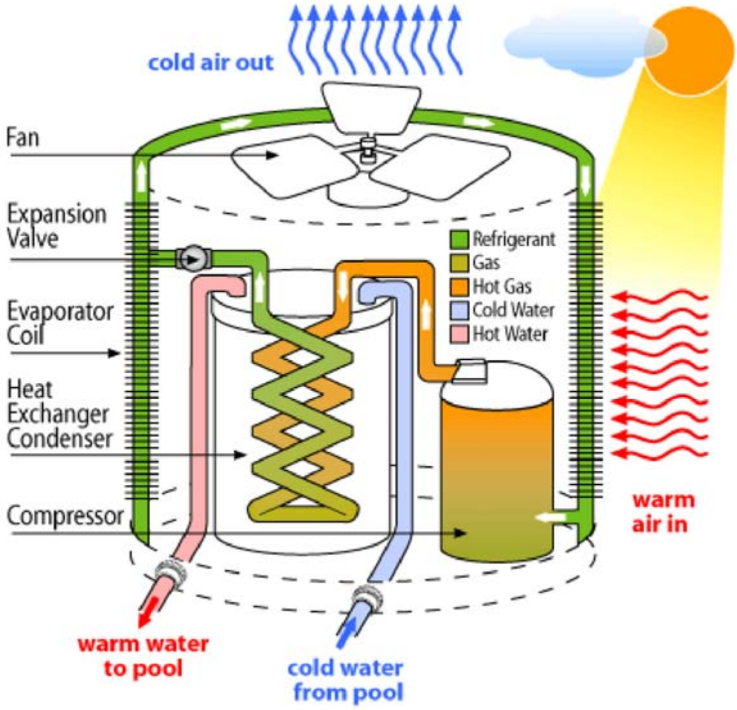


Figure 2: Schematic of an air source heat pump for pool heating[2]

4.3 Ground-source heat pumps

The thermodynamics of a ground-source heat pump (GSHP) are similar to that of an air-source heat pump. The key difference is that instead of the evaporator exchanging heat with the air, the heat is exchanged with the ground via a closed-loop tubing system. GSHPs are more costly to install than ASHPs. However, a GSHP operates at a much higher efficiency and the ground source temperatures are more consistent throughout the year. The typical layout of a GSHP is presented in Figure 3.

[2] http://www.hitemp.co.za.

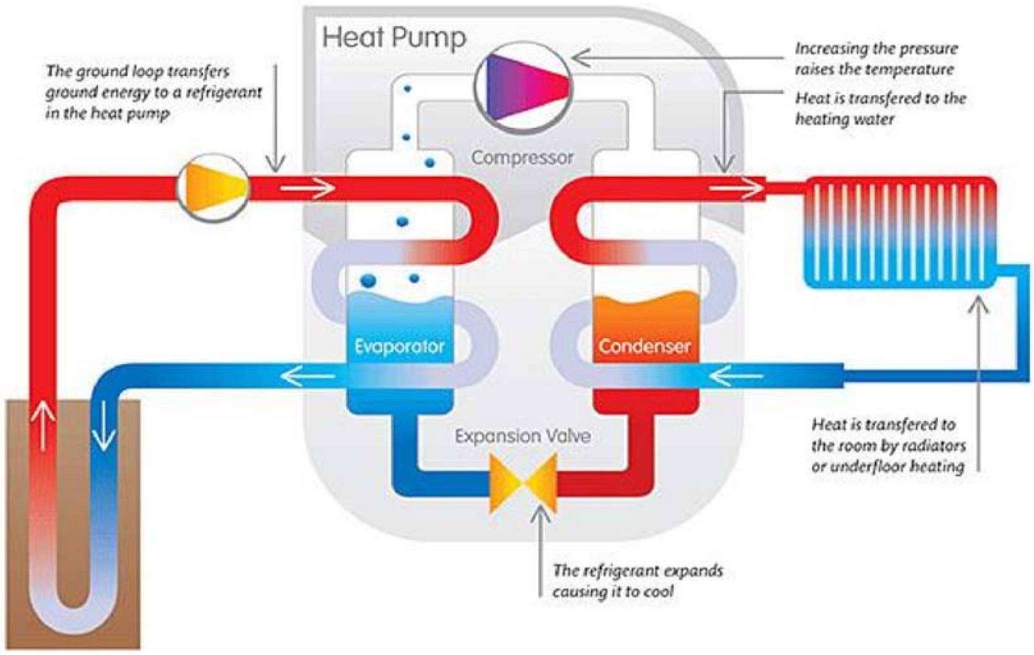


Figure 3: Ground source heat pump installation[3]

4.4 Geothermal heating

Underground aquifers under Fremantle contain water at about 43°C at a depth of around 900 meters below ground level. This water can be extracted from the ground, used to heat the swimming pool and then re-injected back into the ground at a cooler temperature. A similar system has been used to heat the Claremont Pool since 2003.

A geothermal heating system for the FLC would consist of a submersible pump to extract the hot water, a heat exchanger to transfer heat to the pool water, and re-injection to the top of the aquifer through a shallower bore at approximately 650 metres depth.

Deep geothermal heating is a very efficient and low carbon means of heating the pools. However, there are significant capital costs and risks associated with the drilling and maintenance of the boreholes.

4.5 Shallow aquifer geothermal heating

An alternative strategy has come under consideration since the report was first developed. That is to use shallow aquifers as a supply of ground water at a temperature of 20-28°C as

[3] http://www.energygroove.net/heatpumps.php.

the heat source for the electric heat pumps. Water would be extracted from shallow bores, passed through the heat pumps above ground and then re-injected into the aquifer. This method has the advantage of requiring far less drilling and far shallower drilling which drastically reduces installation costs. Figure 4 below illustrates the concept.

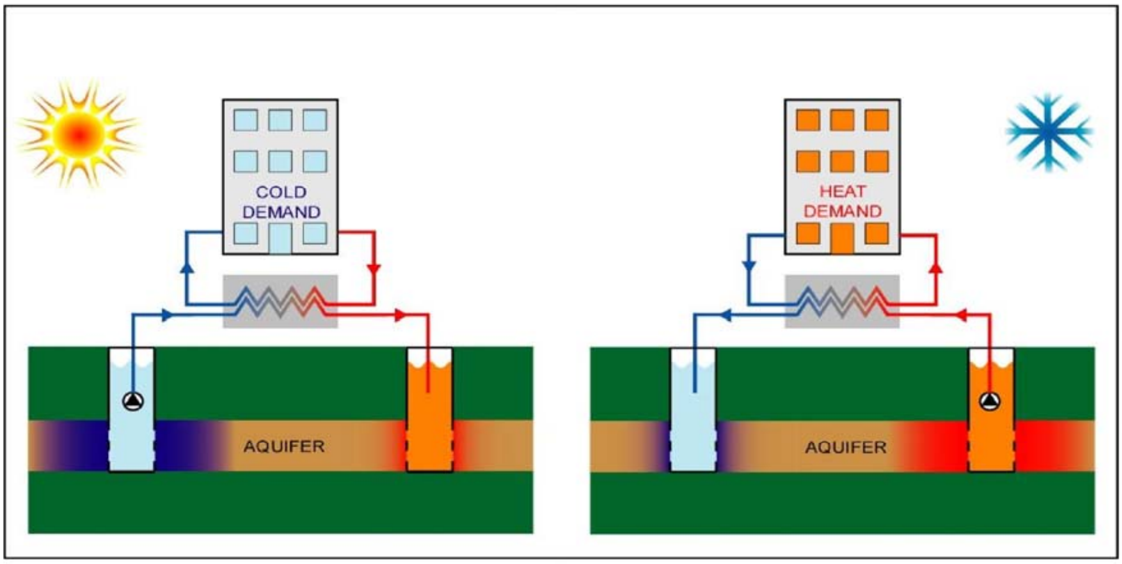


Figure 4: Schematic of shallow aquifer water extraction and heat pump systems[4]

5 Energy system modelling

5.1 General observations on current system performance

A number of important observations were made when analysing the electricity and gas consumption data for the FLC. The gas data in particular was showing an unusually large variation in usage. The graph presented in Figure 5 illustrates the daily average gas usage during the 2010 calendar year, with the daily variation presented using candlestick diagrams. Each candlestick illustrates the gas usage for a particular month. The body of the candlestick illustrates the average daily maximum (daily high), the average daily minimum (daily low), and mean usage for the month. The upper and lower tails of the candlestick (max and min) illustrate the hourly maximum and minimum demand during the month.

[4] http://www.sonicsampdrill.com/products.asp?uid=143

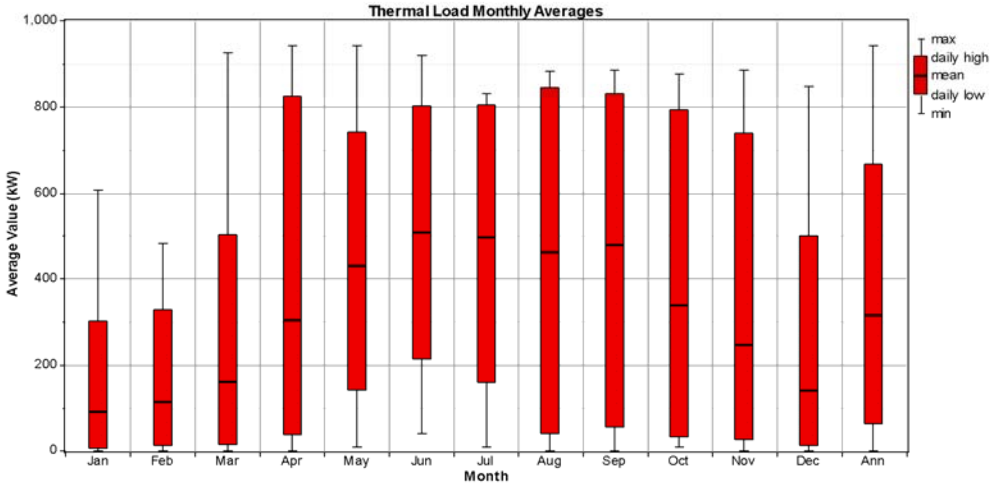


Figure 5: FLC gas consumption candlestick diagram

For purposes of comparison, EMC has referenced a data set from another leisure centre with similarly sized swimming pools in WA. The diagram presented in Figure 6 presents the energy consumption of the leisure centre in a candlestick format, which illustrates that the reference pool in Figure 6 experiences much less daily variation in energy consumption. The pool below is in an indoor facility.

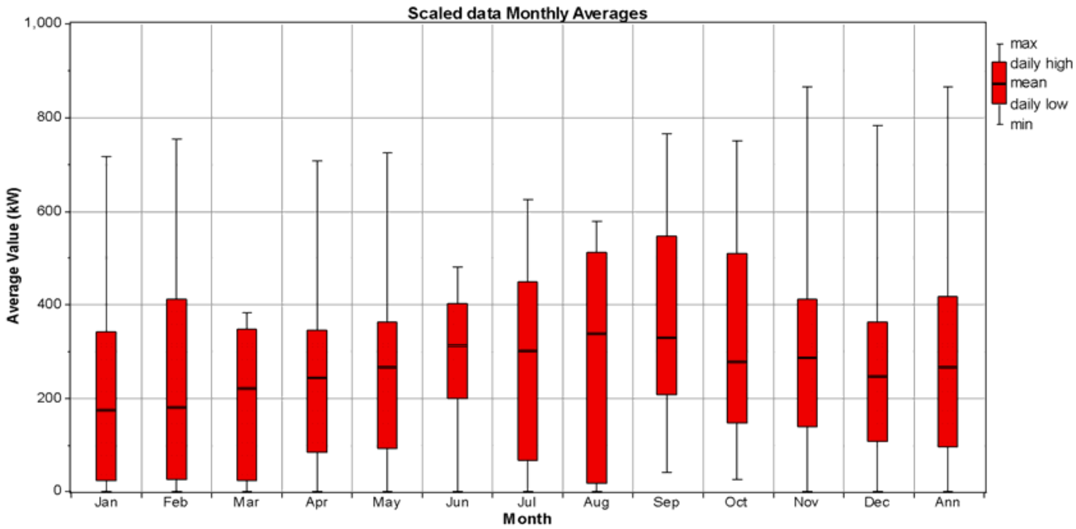


Figure 6: Gas consumption of a similarly-sized leisure centre in WA

The leisure centre illustrated in Figure 6 uses an automatic temperature control system, while the FLC uses a manual temperature control system. EMC suspects that the large variation in daily energy consumption at FLC is partly due to the manual control system.

Staff open the heating loop manually, whilst a thermostat turns the heating system off, based on the pool temperature, which may result in larger variations in water temperature and energy consumption than would otherwise be achieved through automated control. Both pools at FLC are essentially outdoors (the smaller pool is covered, but not indoors) which means that there is no space heating systems. The reference centre mentioned does have gas fired space heating.

The daily thermal load of the FLC is calculated from the energy consumption data, and the wide daily variation is therefore included in the analysis. If FLC implemented one of the technology upgrades under consideration in this report, and an automatic control system were included in the retrofit, this could alter the behaviour of the system, ultimately resulting in a more energy efficient operating regime.

The diagram in Figure 7 illustrates the daily electricity demand for the FLC over the 2010 calendar year. Demand appears to be reasonably constant with the exception of a reduction in usage through the end of winter and into the start of spring.

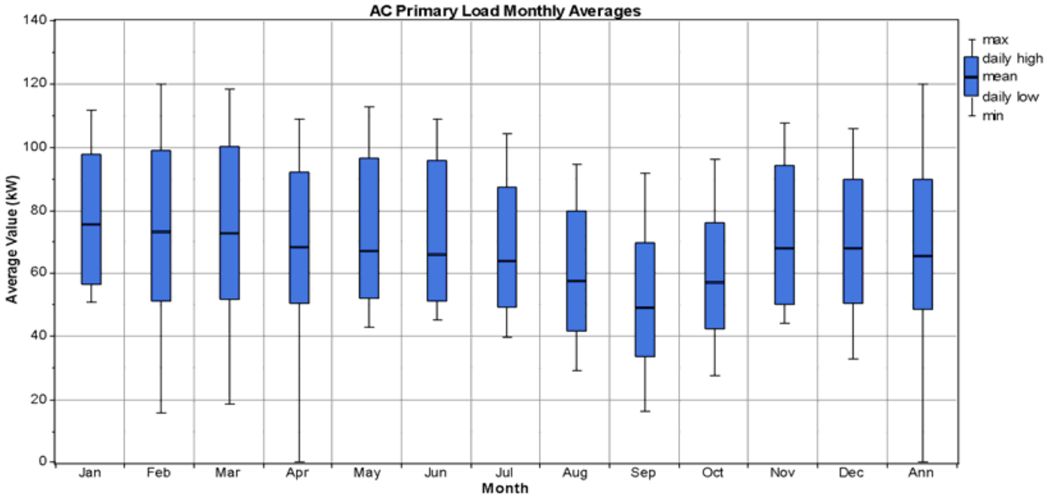


Figure 7: Daily heat load on the pools

5.2 Daily Profile

The graph in Figure 8 presents the daily profile in March for thermal energy and electricity (averaged for every Wednesday in month of March). It can be observed that the thermal peak occurs at around 8:00am with a second peak in the evening. It is expected that with an automatic control system, the thermal peak loads will be distributed over a larger timeframe. The electrical load throughout the day is relatively constant, which is as expected with the swimming pool pumps being the largest consumer of electricity.

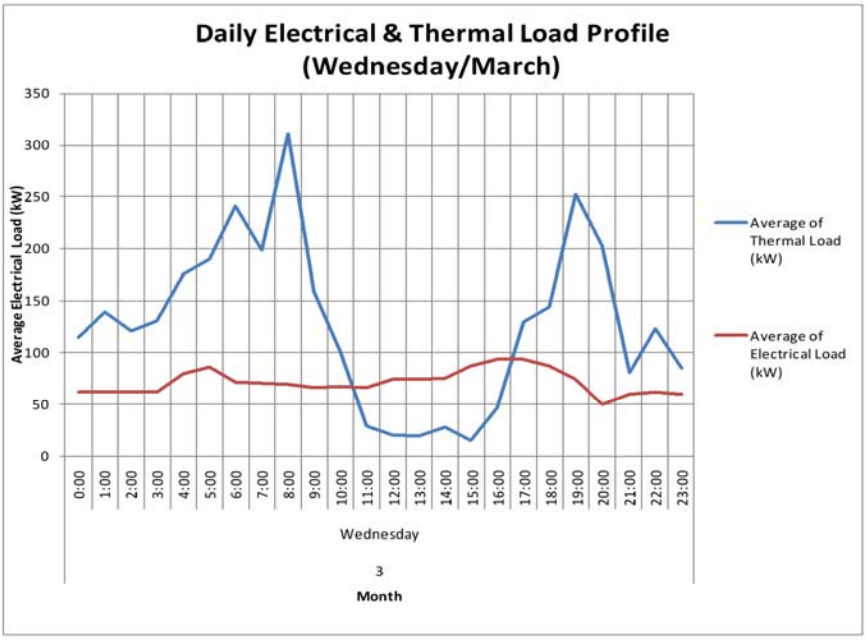


Figure 8: Intraday gas and electricity consumption at FLC

5.3 Scenario development

With a validated model of energy use at FLC, scenario analysis was undertaken to examine several different technology configurations. A total of 17 different technology configuration scenarios were evaluated to determine the energy and cost performance of the technology options, and to find an optimal configuration. The shallow geothermal options are analysed separately in section 7 of this report.

One basis for the scenario design was the quotation that was received by FLC for a CHP and air source heat pump system consisting of a 125kWe gas engine and 2x210kWth air source heat pumps. This system was compared to systems containing 21kWth ground source heat pumps and also a smaller 75kWe gas engine. Eight scenarios were examined for cogeneration and heat pumps, and two different operating regimes were also modelled. This resulted in a total of 16 cogeneration and heat pump scenarios.

The two operating regimes considered are a 'peak load' regime and a 'thermal' regime. The peak load operating regime implies that the gas engine will only run during the peak electricity tariff period (8am to 10pm weekdays). This means that the electricity produced by the system during these hours has peak value. By reducing the peak demand, electricity costs are reduced substantially.

The thermal load operating regime follows the demand for heat from the swimming pools. This means that the gas engine operates substantially during off peak periods and periods of lower electrical demand. The overall savings are lower, but utilisation rate of the cogeneration plant is higher.

Table 1 below presents the technology combinations for each scenario. Each of these combinations was calculated for the two operational regimes described above.

A deep geothermal scenario was also considered. The economics of deep geothermal improve with scale because the fixed capital cost of drilling and establishing the balance of plant are amortised over the total energy production of the system. It was determined that the only relevant scenario is one where deep geothermal is deployed at a scale that would completely displace gas usage at the FLC.

Scenario	Cogen	Heat pumps
1	125kWe, 166kWth	2x210kWth Air source
2	125kWe, 166kWth	1x210kWth Air source
3	125kWe, 166kWth	10x21kWth Ground Source
4	125kWe, 166kWth	20x21kWth Ground Source
5	75kWe, 132kWth	1x210kWth Air source
6	75kWe, 132kWth	2x210kWth Air source
7	75kWe, 132kWth	10x21kWth Ground source
8	75kWe, 132kWth	20x21kWth Ground source

Table 1: Cogeneration and heat pump scenarios investigated

5.3.1 Scenarios not included in this report

Scenarios for a single cogeneration plant, or a single type of heat pump, were not included in the detailed study because they are not competitive on a cost or greenhouse abatement basis with the technology combinations detailed in Table 1. For example, if a 75kWe cogeneration system were installed, the annual utility savings would only be $40,000. For an upgrade consisting only of ASHPs the greenhouse gas emissions would increase, and for an upgrade consisting only of GSHPs the payback is almost 18 years.

The model supplied by EMC, which accompanies this report, can be used to explore the economics and greenhouse gas emissions of scenarios which are not discussed here.

5.4 Financial assumptions

5.4.1 Cogeneration

The pricing assumptions for cogeneration were taken from the quotation supplied to FLC from Urban Energy Australia in May 2011. This quotation was for a 125kWe unit. For the 75kWe unit a scaling factor was applied and the technical information for a ThermoGen unit used because this unit supplied a greater proportion of thermal heat (i.e. less electrically efficient). EMC corresponded with cogeneration system suppliers to confirm cost estimates. The installed costs include the costs of associated plant and equipment.

Table 2: Financial assumptions for cogeneration plant

Item	Budgeted cost	Total installed
125kWe Tedom Cogeneration unit	$157,574	$204,701
75kWe ThermoGen Unit	$113,114	$160,281

5.4.2 Air Source Heat Pumps

The Air Source Heat Pumps were priced on the basis of the Urban Energy Australia quotation.

Table 3: Financial assumptions for ASHPs

Item	Budgeted cost	Total installed
AstralPool AHPBU500 (210kWth)	$48,708	$84,708

5.4.3 Ground Source Heat Pumps

Ground Source Heat Pumps were costed based on an estimate from GT Power, the agents for the Direct Geo-Exchange GSHP systems.

Table 4: Financial assumptions for GSHPs

Item	Budgeted cost	Other Installation costs
EarthLink DX (21kWth)	$38,275 per heat pump	$78,000(whole installation)

Other installation costs include the costs of integrating all the heat pump units. The cost for each heat pump includes the costs of drilling and installing the copper ground loops. These costs are for pool heating only. There may be a business case for including domestic hot water, but as this is a relatively small energy consumer, it has not been included in this analysis.

5.4.4 Geothermal

Estimates for geothermal costs were taken from previous reports for FLC. EMC commissioned the Geothermal Centre of Excellence at the University of Western Australia to undertake a review of geothermal energy for the FLC. The review found that the temperatures and depths which were projected by Rockwater in their 2004 report were conservative, meaning that higher temperatures are available than originally anticipated. Capital costs, however, have increased by approximately 2.5 times since the 2004 report. The analysis conducted by the Geothermal CoE is included as an appendix to this report. The costs in Table 5 include the associated piping and installation costs.

Personal conversation with the manager at Claremont Pool was used as the basis to estimate bore maintenance costs which have actually been incurred at Claremont.

Table 5: Financial assumptions for geothermal

Item	Total installed
Hole Boring	$1,750,000

5.5 Results of Scenario analysis

The financial and greenhouse gas results from the scenario assessment are presented in Table 6. This table was derived by sequentially modelling each scenario in the Excel model using the current gas and electricity tariffs. The key financial parameters which are calculated are the Simple Payback, the NPV and the annual utility savings. The annual utility savings are based on the current tariff, however an escalation in tariffs has been taken into account in the NPV calculation. The capital costs are based on the most recent estimates for the technology.

The first ranking is by greenhouse gas savings. The last two columns represent the savings or extra cost of carbon offsets ($8 per tonne CO_2) and GreenPower ($0.05/kWh) against the current base case.

Scenario	Total Gas Cost ($)	Gas Savings ($)	Total Electricity Cost ($)	Total Electricity Sourced (kWh)	Savings Electricity ($)	Utility Savings	GHG Savings (t CO2-e/year)	Capital Cost ($)	SimplePbP	NPV 6%	Offset savings	Greenpower savings
Deep Geothermal	-	$183,654	$118,856	589,090	-$15,000	$168,654	520.0	$1,750,000	12.2	420,964	$5,083	-$8,322
125kW Cogen, 20x GSHP, Thermal	$137,266	46,389	$53,946	274,118	$49,910	$96,298	417.8	$1,009,641	10.5	146,171	$1,371	$14,977
75kW Cogen, 20x GSHP, Thermal	$117,334	66,320	$85,220	430,741	$18,636	$84,956	363.2	$965,221	11.4	105,811	$1,960	$7,163
125kW Cogen, 10x GSHP, Thermal	$169,073	14,581	$42,598	219,420	$61,257	$75,838	344.8	$627,171	8.3	204,557	$431	$17,690
75kW Cogen, 10x GSHP, Thermal	$150,811	32,843	$62,891	317,017	$40,965	$73,809	332.4	$582,751	7.9	311,710	$971	$12,848
125kW Cogen, 1x ASHP, Thermal	$169,073	14,581	$50,827	259,751	$53,029	$67,610	311.8	$289,409	4.3	411,986	$431	$15,691
125kW Cogen, 2x ASHP, Thermal	$137,266	46,389	$84,007	427,106	$19,849	$66,238	292.3	$338,117	5.1	341,538	$1,371	$7,334
125kW Cogen, 20x GSHP, Peak	$109,130	74,524	$56,094	592,579	$47,761	$122,286	260.8	$1,009,641	8.3	557,808	$2,202	-$965
75kW Cogen, 1x ASHP, Thermal	$150,811	32,843	$83,645	430,248	$20,211	$53,054	239.6	$244,989	4.6	320,720	$971	$7,189
75kW Cogen, 20x GSHP, Peak	$93,935	89,719	$86,626	693,146	$17,229	$106,949	234.6	$965,221	9.0	454,174	$2,651	-$5,966
75kW Cogen, 2x ASHP, Thermal	$117,334	66,320	$120,153	615,952	-$16,297	$50,023	211.3	$293,697	5.9	224,009	$1,960	-$2,096
125kW Cogen, 10x GSHP, Peak	$148,759	34,896	$40,212	482,842	$63,644	$98,539	204.1	$627,171	6.4	564,141	$1,031	$4,507
75kW Cogen, 10x GSHP, Peak	$134,307	49,347	$62,346	555,749	$41,509	$90,857	197.8	$582,751	6.4	581,750	$1,458	$903
125kW Cogen, 1x ASHP, Peak	$148,759	34,896	$52,760	587,166	$51,096	$85,992	118.5	$289,409	3.4	703,152	$1,031	-$697
125kW Cogen, 2x ASHP, Peak	$109,130	74,524	$89,806	801,453	$14,049	$88,574	89.6	$338,117	3.8	695,339	$2,202	-$11,405
75kW Cogen, 1x ASHP, Peak	$134,307	49,347	$84,108	690,423	$19,748	$69,095	87.4	$244,989	3.5	574,808	$1,458	-$5,829
75kW Cogen, 2x ASHP, Peak	$93,935	89,719	$123,647	912,916	-$19,791	$69,928	54.4	$293,697	4.2	539,304	$2,651	-$16,954

Table 6: Table of results ranked for greenhouse gas savings

The geothermal option provides the greatest greenhouse gas savings because it completely displaces natural gas usage. However, the pumps which extract and re-inject the water from the bore use electrical energy. That amount has been estimated and taken into account above. Overall, the geothermal option is still financially attractive as it has a reasonably large NPV. The next most effective option for reducing greenhouse gases is Scenario 4 using the thermal load regime. This option uses 20 GSHPs and the 125kWe cogeneration unit. Financially, this option has a positive NPV and will achieve around 80% of the GHG savings that geothermal could achieve.

The key trend to note with regards to greenhouse gas savings is that the thermal load-following regime provides the highest savings. This is because the CHP unit achieves a greater utilisation rate than it would under the peak operating regime. This increase greatly reduces the greenhouse gas emissions from the facility, mainly because of the displacement of "dirtier" electricity.

Table 7 presents the scenarios ranked by their NPV at a 6% discount rate over 20 years. Cogeneration with heat pumps running under the peak regime delivers the highest NPV. This is because the cogeneration plant is displacing expensive peak electricity. The most NPV-positive project uses only 1 ASHP which means that the capital cost of this option is low. This is the key reason for the high positive NPV. The important aspect to note is that the greenhouse gas savings from this option are only 20% of what could be achieved with the most expensive option (the geothermal option).

Scenario	Total Gas Cost ($)	Gas Savings ($)	Total Electricity Cost ($)	Total Electricity Sourced (kWh)	Savings Electricity ($)	Utility Savings	GHG Savings (t CO2-e/year)	Capital Cost ($)	SimplePbP	NPV 6%	Offset savings	Greenpower savings
125kW Cogen, 1x ASHP, Peak	$148,759	34,896	$52,760	587,166	$51,096	$85,992	118.5	$289,409	3.4	703,152	$1,031	-$697
125kW Cogen, 2x ASHP, Peak	$109,130	74,524	$89,806	801,453	$14,049	$88,574	89.6	$338,117	3.8	695,339	$2,202	-$11,405
75kW Cogen, 10x GSHP, Peak	$134,307	49,347	$62,346	555,749	$41,509	$90,857	197.8	$582,751	6.4	581,750	$1,458	$903
75kW Cogen, 1x ASHP, Peak	$134,307	49,347	$84,108	690,423	$19,748	$69,095	87.4	$244,989	3.5	574,808	$1,458	-$5,829
125kW Cogen, 10x GSHP, Peak	$148,759	34,896	$40,212	482,842	$63,644	$98,539	204.1	$627,171	6.4	564,141	$1,031	$4,507
125kW Cogen, 20x GSHP, Peak	$109,130	74,524	$56,094	592,579	$47,761	$122,286	260.8	$1,009,641	8.3	557,808	$2,202	-$965
75kW Cogen, 2x ASHP, Peak	$93,935	89,719	$123,647	912,916	-$19,791	$69,928	54.4	$293,697	4.2	539,304	$2,651	-$16,954
75kW Cogen, 20x GSHP, Peak	$93,935	89,719	$86,626	693,146	$17,229	$106,949	234.6	$965,221	9.0	454,174	$2,651	-$5,966
Deep Geothermal	-	$183,654	$118,856	589,090	-$15,000	$168,654	520.0	$1,750,000	12.2	420,964	$5,083	-$8,322
125kW Cogen, 1x ASHP, Thermal	$169,073	14,581	$50,827	259,751	$53,029	$67,610	311.8	$289,409	4.3	411,986	$431	$15,691
125kW Cogen, 2x ASHP, Thermal	$137,266	46,389	$84,007	427,106	$19,849	$66,238	292.3	$338,117	5.1	341,538	$1,371	$7,334
75kW Cogen, 1x ASHP, Thermal	$150,811	32,843	$83,645	430,248	$20,211	$53,054	239.6	$244,989	4.6	320,720	$971	$7,189
75kW Cogen, 10x GSHP, Thermal	$150,811	32,843	$62,891	317,017	$40,965	$73,809	332.4	$582,751	7.9	311,710	$971	$12,848
75kW Cogen, 2x ASHP, Thermal	$117,334	66,320	$120,153	615,952	-$16,297	$50,023	211.3	$293,697	5.9	224,009	$1,960	-$2,096
125kW Cogen, 10x GSHP, Thermal	$169,073	14,581	$42,598	219,420	$61,257	$75,838	344.8	$627,171	8.3	204,557	$431	$17,690
125kW Cogen, 20x GSHP, Thermal	$137,266	46,389	$53,946	274,118	$49,910	$96,298	417.8	$1,009,641	10.5	146,171	$1,371	$14,977
75kW Cogen, 20x GSHP, Thermal	$117,334	66,320	$85,220	430,741	$18,636	$84,956	363.2	$965,221	11.4	105,811	$1,960	$7,163

Table 7: Table of results ranked for NPV

The data in the tables above has been graphed in Figure 9 to illustrate which options provide the optimal cost abatement.

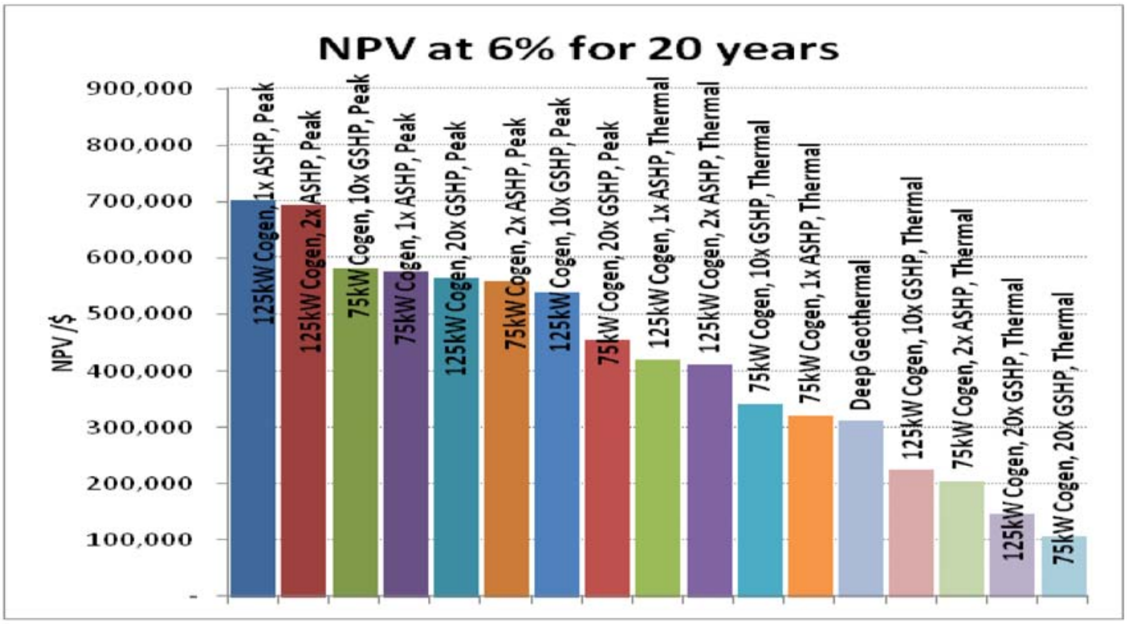


Figure 9: NPV for the 17 scenarios studied

6 Technical solutions

6.1 Cogeneration with ASHP

Air source heat pumps use energy from the air to heat the water from the pool. This means that for every unit of electrical power supplied to the heat pump, between two and four units of heat energy can be supplied to the pool. The ASHPs are however, less efficient during winter, when the demand for heat from the pool is highest. This means that more electricity will be required for heating in winter than in summer, which reduces the greenhouse gas abatement benefits from these systems. ASHPs are relatively inexpensive to install and maintain, so the paybacks for these systems are relatively low.

The two operating regimes studied also dramatically affect the performance of the cogeneration system and the ASHP. In the peak regime, cost savings are maximised at the expense of greenhouse gas abatement. In the thermal regime, greenhouse gas abatement is maximised at the expense of reduced cost benefit, extending payback and reducing NPV.

Installation of the cogeneration with ASHP is also a relatively simple technical change.

The performance of the cogeneration system following thermal load with the ASHPs is demonstrated in Figure 10, Figure 11 and Figure 12. The example used is Scenario 1T (Table 1) (125kWe CHP with 2x10kWth ASHP). The graphs presented below can be developed for any scenario using the model that was developed as part of this project.

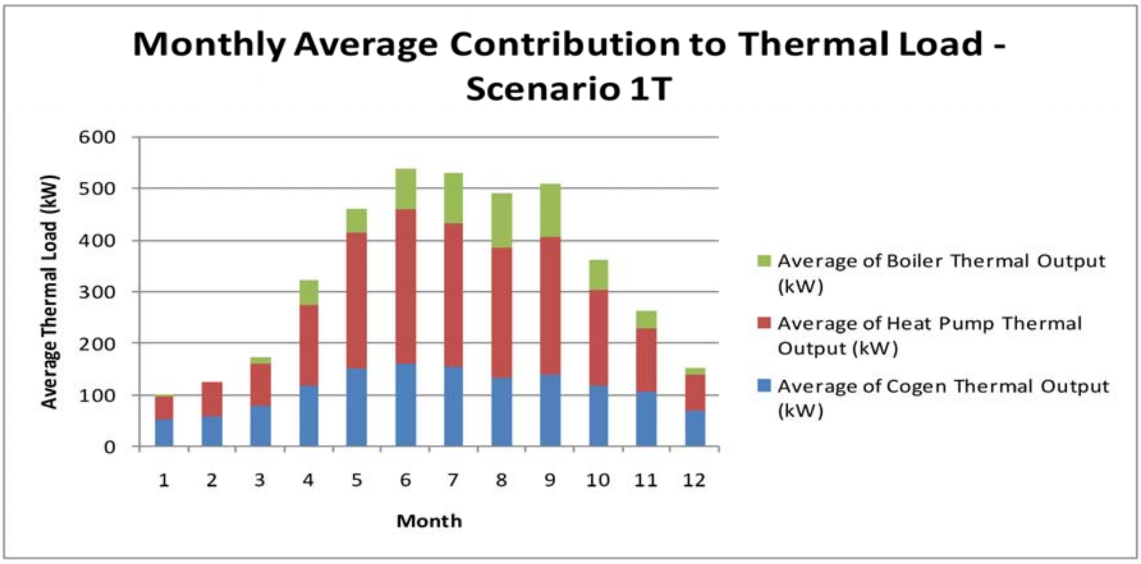


Figure 10: Thermal load profile for scenario 1 under thermal regime

From Figure 10 we can see that the thermal output from the cogeneration system and the heat pumps meet most of the summer demand but the natural gas boiler is still required during the winter months.

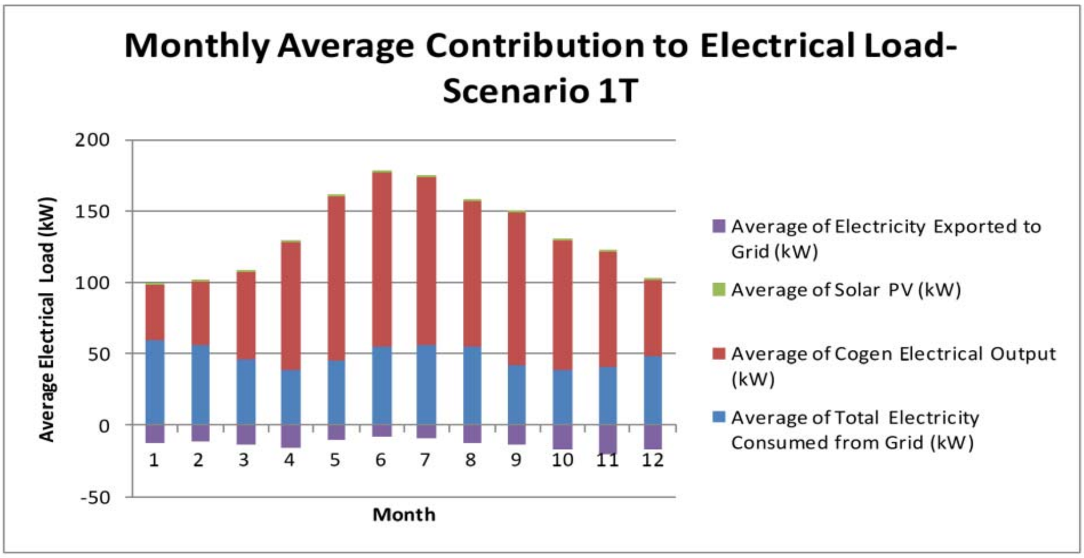


Figure 11: Electrical load profile of scenario 1 under the thermal regime

Figure 11 shows that the cogeneration system can satisfy around half of FLC's electrical power requirements but during the summer months especially there is a fair amount of excess electricity production that would require the system to be throttled back or even switched off.

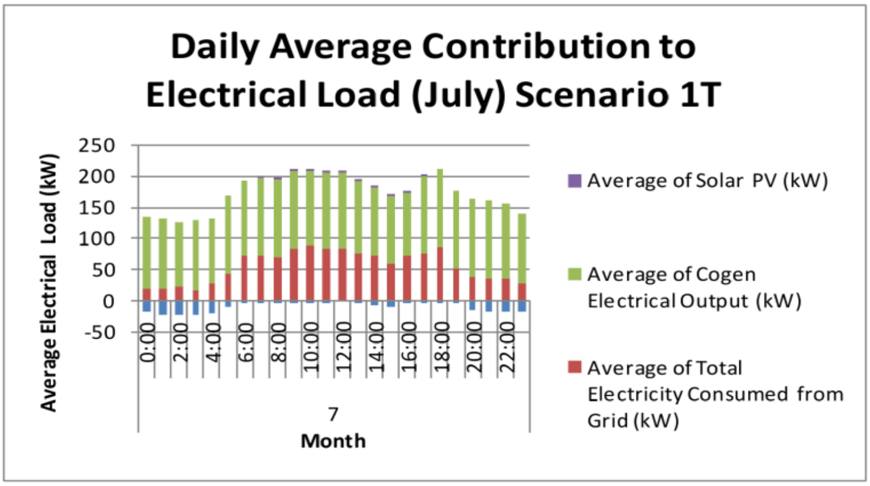


Figure 12: Daily average electrical load for scenario 1 under thermal regime

The graph in Figure 12 shows the average electrical loads for the average day during July. From this we can see the amount of power that would need to be exported to the grid or the amount that the cogeneration unit would have to be throttled back (up to 25kW). However, we can also see that cogeneration can reduce the peak power demand substantially. This provides much of the financial benefit.

6.2 Cogeneration with GSHP

Ground source heat pumps use thermal energy stored in the ground to efficiently heat water. Ground temperature does not vary appreciably with ambient temperature, so the efficiency of the system stays constant throughout the year. GSHP systems can achieve a COP (Coefficient of Performance) of 5, meaning that for every unit of electrical energy used to run the pumps 5 units of thermal energy can be generated. The GSHPs run efficiently through winter due to constant ground temperatures, and the electricity generated by the cogeneration system can be used to offset existing loads rather than simply running the heat pumps. The yearly financial savings from the GSHP system is thus substantially larger than the savings from the ASHPs. GSHP's, however, are much more expensive to install than ASHP, so paybacks are much longer. Greenhouse gas savings for the GSHPs are higher because they use less electricity to run than ASHPs.

GSHPs require a substantial amount of space in order to install the coolant loops in the ground. The FLC should be able to accommodate the loops as the heating infrastructure is located close to a large open space. A drilling rig is also required for installation. Coolant loops must be less than 45m away from the heat pump units. A preliminary investigation of the site found that there should be sufficient space to accommodate the GSHPs.

An example of the performance of the GSHP with cogeneration is presented in Figure 13, Figure 14 and **Error! Reference source not found.**Figure 15 for Scenario 3 (Table 1, using the thermal load following regime.

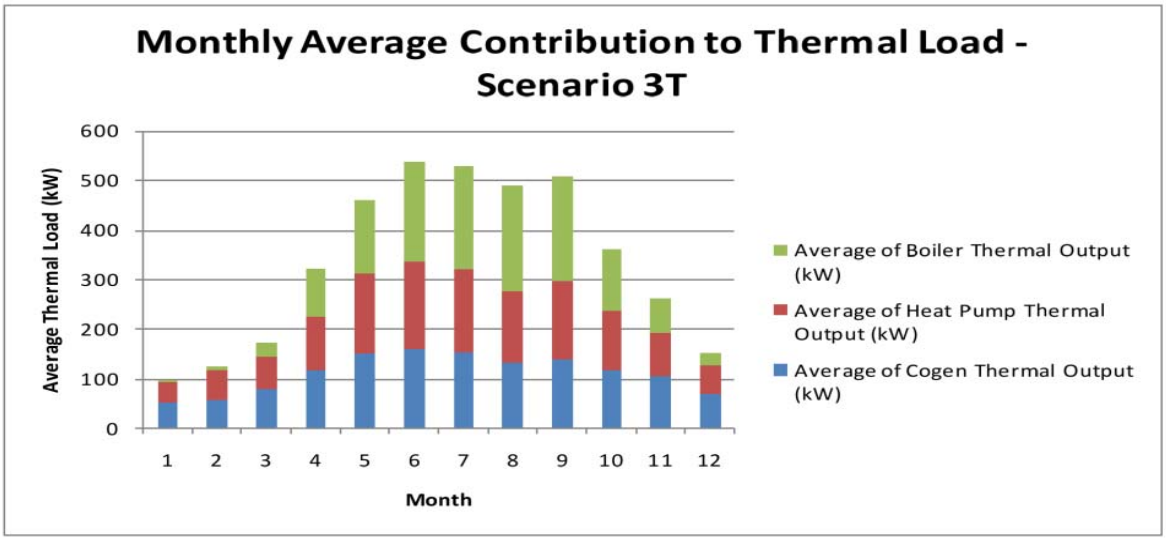


Figure 13: Monthly average thermal performance for scenario 3 thermal regime

In Figure 13 we can see that the cogeneration system supplies much more of the thermal load than it does under the peak regime because it is now running for many more hours than the peak period. The amount of gas required for the boiler is therefore lower.

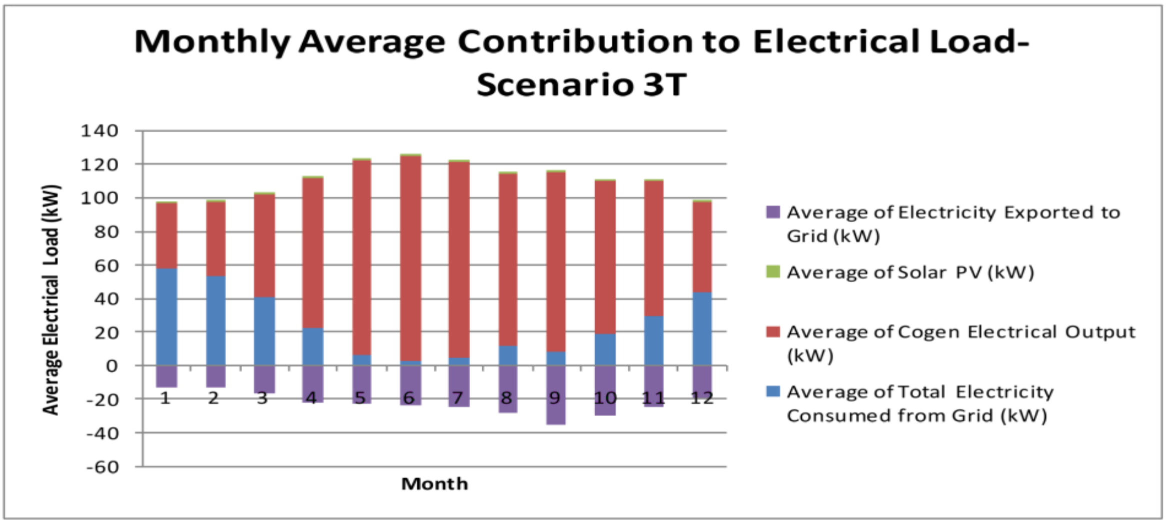


Figure 14: Monthly average electrical performance for scenario 3 thermal regime

The average cogeneration electrical output is far greater in the thermal load mode and therefore the engine would have to be throttled back to a certain degree.

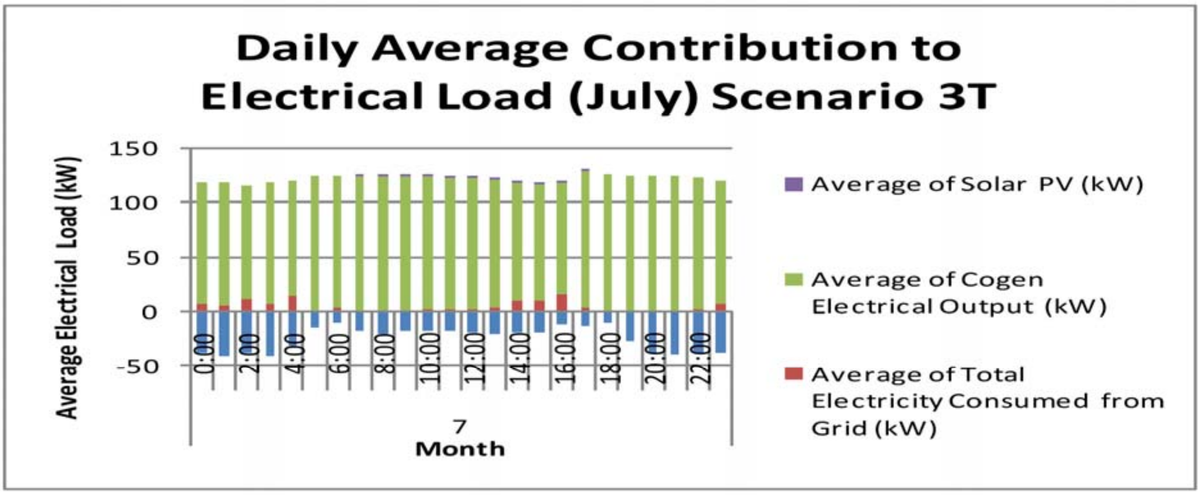


Figure 15: Daily electrical performance for scenario 3 thermal regime

During the month of July the cogeneration system can meet almost all the electrical load of the FLC. The cogeneration system would need to be throttled back to prevent excess electricity production.

6.3 Optimised GSHP solution

The modelling clearly demonstrates that ground source heat pumps with cogeneration offer the best abatement opportunities. The scenarios described above, however, were designed to be able to compare ASHP with GSHP. The optimal number of GSHP units can be found by maximising for NPV. This is done by looking at where the NPV peak is, and the greenhouse gas emission savings that correspond with that peak. When this is done for the 125kWe cogeneration unit we find that the optimal number of GSHP units is 15, giving annual greenhouse gas savings of 240 tonnes CO_2e. This process is presented in Figure 16 which optimises for NPV under the peak operating regime.

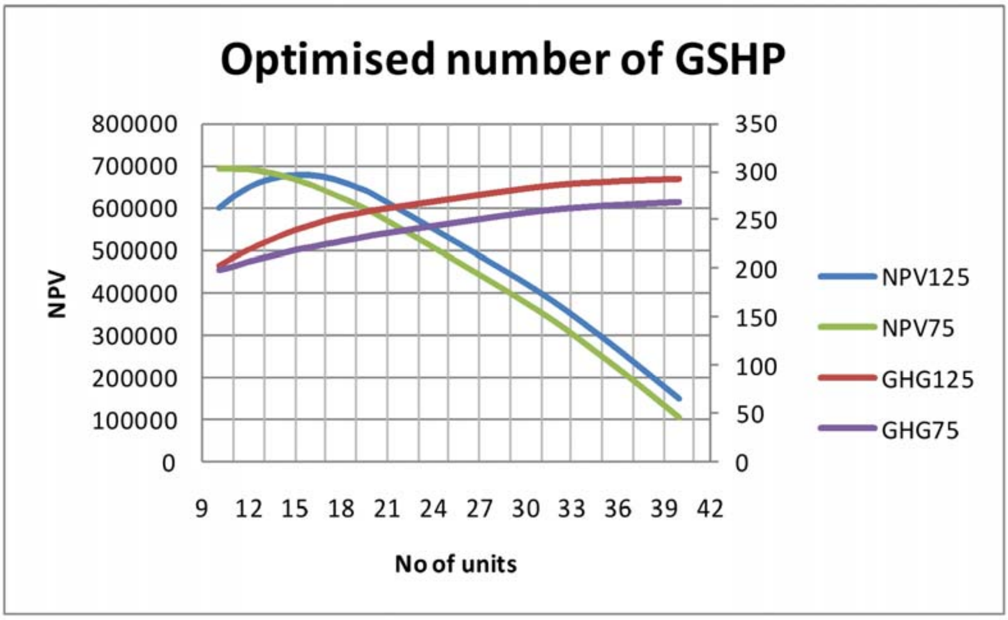


Figure 16: Optimised number of GSHPs under peak regime

For the thermal load following regime, 14 ground source heat pumps provide the greatest NPV with GHG savings of 386 tonnes CO_2e per year. Once installed, the City will be able to determine the operating regime which best suits its goals at any particular time. The analysis presented in Figure 17 shows that by following the thermal load, there are quite large savings of greenhouse gases available for the same capital cost.

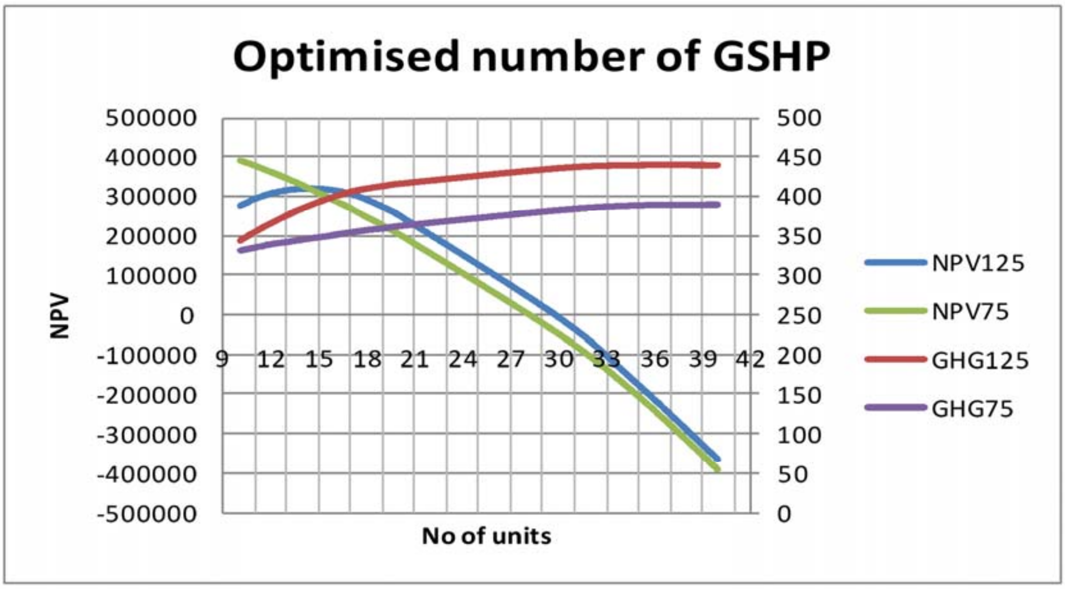


Figure 17: Optimised number of GSHPs under thermal regime

The financial results for a system using 14 heat pumps with the 125kWe CHP system, under the thermal load following regime (greenhouse gas savings maximised), are presented in Table 8, and the thermal performance is presented in Figure 18. The capital cost for this option is estimated at $780,159.

Table 8: Financial performance for 125 kWe cogeneration, 14 GSHPs, thermal regime.

Total Gas Cost ($)	Gas Savings ($)	Total Electricity Cost ($)	Savings Electricity ($)	Electricity Savings (kWh)	Utility Savings	GHG Savings (t CO2-e/year)	Capital Cost ($)	SimplePbP	NPV 6%	NPV per tonne CO2 abated
$155,060	28,594	$45,400	$58,456	341,888	$87,050	386.2	$780,159	9.0	229,156	30

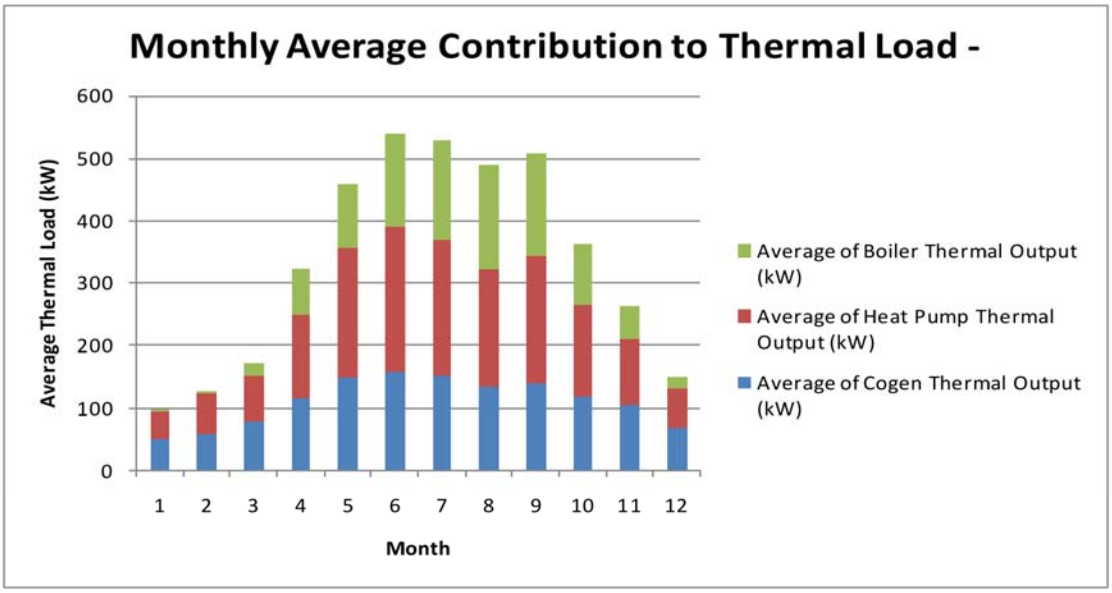


Figure 18: Financial performance for 125 kWe cogeneration, 14 GSHPs, thermal regime.

It can be observed that this option reduces the use of the boiler significantly. Even in the winter months the boiler contributes a similar amount of heat to the waste heat from the cogeneration system.

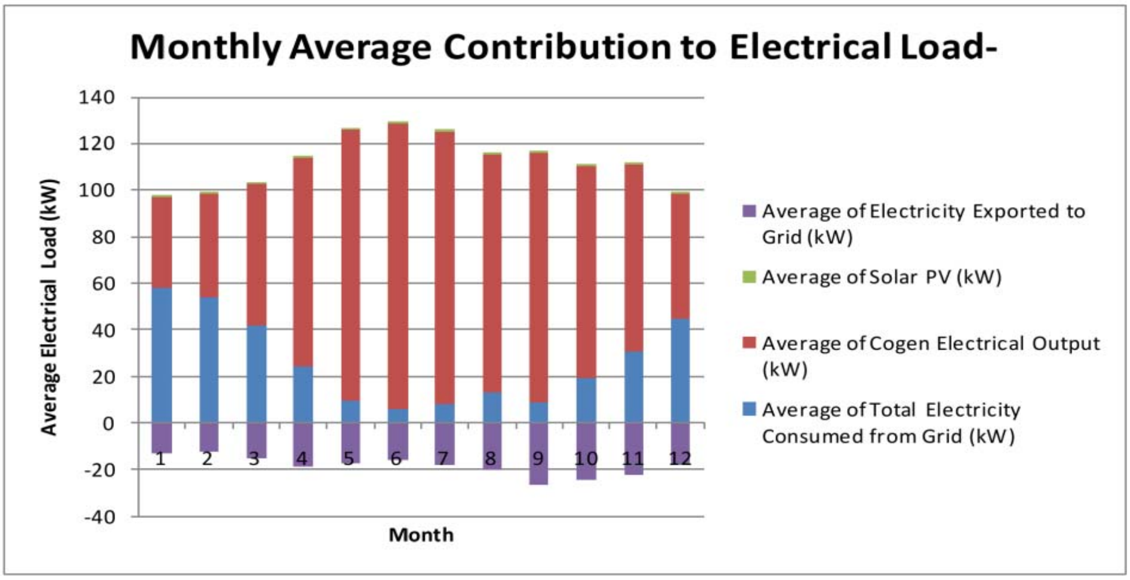


Figure 19: Electrical performance for 125 kWe cogeneration, 14 GSHPs, thermal regime.

For electricity, presented in Figure 19, we see that by following the thermal load the cogeneration works far more during winter which means that during winter most of the electrical demand is met by the cogeneration system. In summer, because of lower thermal demand, a smaller fraction of the electrical load is supplied by cogeneration.

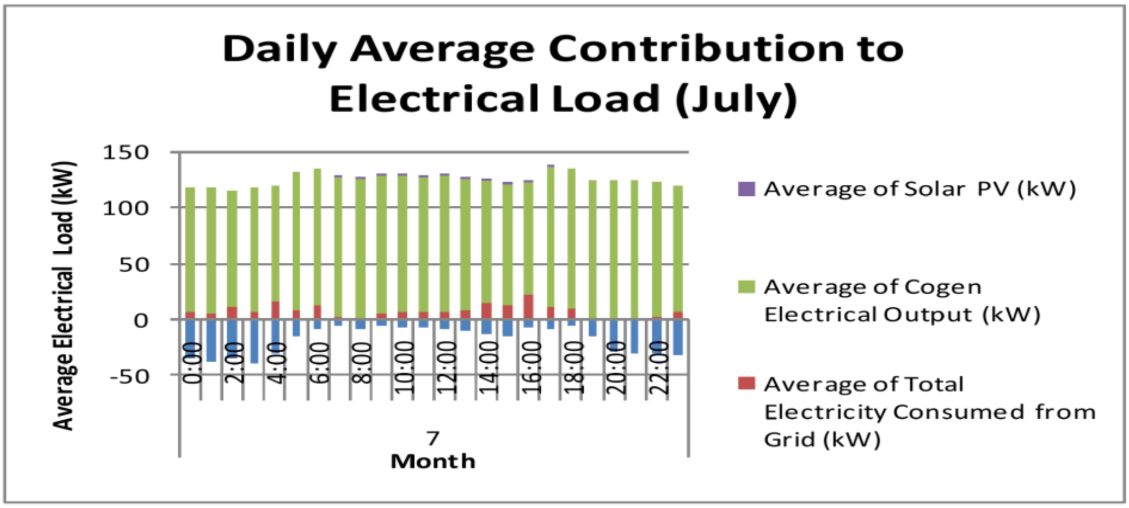


Figure 18: Daily performance for 125 kWe cogeneration, 14 GSHPs, thermal regime.

The graph in Figure 18 shows that during the winter months, cogeneration is the key energy provider. It also shows that up to 40kW of excess electrical energy is generated. The cogeneration system can be throttled back to ensure that no energy is exported to the grid.

This analysis also shows that the FLC could change operating regime at different times of the year. In summer, the peak regime will provide greater electricity savings when the demand for heat is lower. The graph presented in Figure 21is for the optimal case (as described above) but under the peak operating regime. We see here that in summer months the cogeneration provides a greater proportion of the electricity with greater financial benefits as it only displaces expensive peak power. In winter, changing over to the thermal regime will provide maximum greenhouse gas abatement and a greater contribution to thermal load from the cogeneration system. This operational optimisation would provide improved cost effectiveness for the overall system.

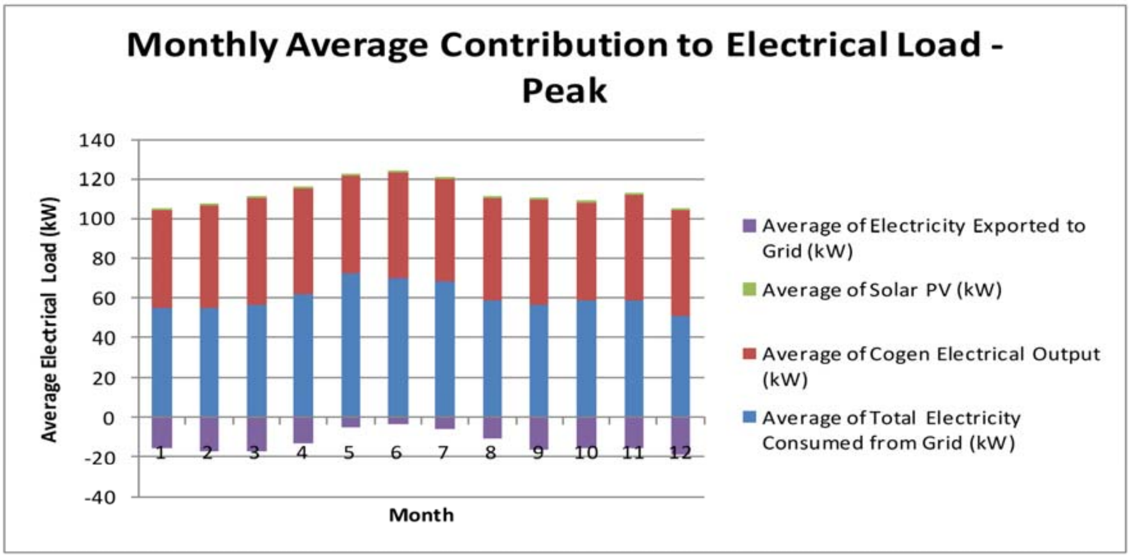


Figure 21: Electrical performance of optimal GSHP system at peak operating regime

An aerial photograph of the Leisure Centre site and the likely locations (blue areas) of the heat pump ground loops is shown below. The heat pump compressor and condenser units would be located near to the engine room.

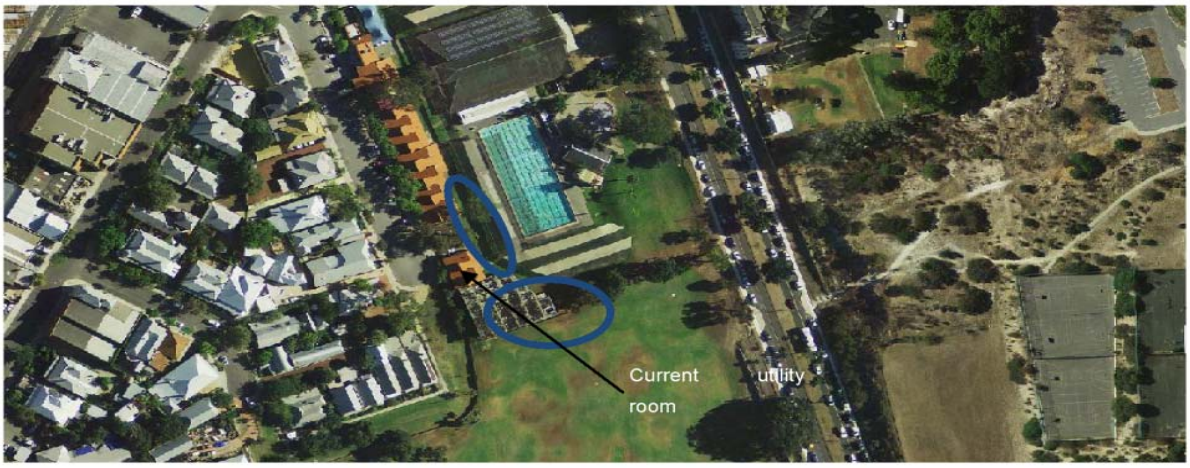


Figure 22: Aerial view of FLC and approximate positioning of GSHPs

6.4 Geothermal heating

The geothermal heating system was not modelled, however, we can assume that if implemented it would meet the entire thermal load for the FLC. It would add a significant electrical load to the FLC due to the extra pumping equipment. The large capital costs for geothermal are related to drilling and balance of plant, with operating costs at major maintenance intervals. For this calculation we have assumed that major bore maintenance will happen once every six years.

The Geothermal Centre of Excellence at the University of Western Australia found that the temperatures and depths which were project by Rockwater in their 2004 report were conservative, meaning that higher temperatures are available than originally anticipated. Capital costs, however, have increased by approximately 2.5 times since the 2004 report.

7 Shallow geothermal and heat pumps

Hydrogeological advice has been received which indicates that a shallow aquifers under the FLC is suitable for extraction. This aquifer (Leederville aquifer) is estimated to contain water at a temperature of between 25 and 26°C. This water can be extracted, passed through heat pumps on the surface that heat pool water and then the bore water is re-injected into the aquifer..

The budget costs for the drilling and heat pumps used for this analysis are presented in Table 9 and are from the Rockwater report supplied to the City.

Table 9: Costs of shallow geothermal drilling and heat pumps

Item	Budget cost	Total for 3 heat pump scenario
100kW Bosch Heat pump	$70 000 each	$210 000
Drilling costs for 150m extraction and re-injection hole	$233 750	$233 750
Other costs	$8 500	$8 500
Piping and installation	$55 000	$55 000
Total		$507 250

The costs for this option are far lower than deep (approximately 1000m below) geothermal because different drilling equipment is required and drilling is far simpler at shallow depth.

The costs for the cogeneration units are as in the analysis in the previous sections. Overall, costs for this option are lower for similar performance than the GSHP options detailed above. This is shown in the table below. These scenarios include a gas cogeneration system, so for each combination data is shown for the two operating regimes (thermal and peak) as was done for the GSHPs. The data in this table is based on the lowest estimate of COP for the 100kW Bosch units which was estimated in the Rockwater report and is based on the manufacturer's figures for heat pumps and the lowest estimate of water temperature. The COP used here is 5.2. This takes into account the electricity used to extract the bore water and also makes the most conservative assumptions for water temperature and the temperature that pool water will be heated to.

Table 10: Shallow geothermal, heat pump and cogeneration modelling results

Scenario	Total Gas Cost ($)	Gas Savings ($)	Total Electricity Cost ($)	Total Peak Elect Sourced (kWh)	Peak Elect Savings (kWh)	Gas GHG (t CO2-e/year)	Electicity GHG (t CO2-e/year)	GHG Savings (t CO2-e/year)	Capital Cost ($)	NPV 6%
125kW Cogen, 2x100kW HP, Peak	$131,923	51,731	$44,102	7,265	248,404	447.8	422.9	239.4	$641,951	681,609
125kW Cogen, 2x100kW HP, Thermal	$156,406	27,248	$44,295	115,731	139,938	538.4	186.1	385.6	$641,951	290,737
75kW Cogen, 2x100kW HP, Peak	$117,179	66,475	$70,395	93,871	161,798	393.2	494.0	223.0	$597,531	637,970
75kW Cogen, 2x100kW HP, Thermal	$137,399	46,255	$69,999	184,903	70,766	468.0	289.6	352.5	$597,531	323,967
125kW Cogen, 3x100kW HP, Peak	$107,956	75,698	$54,757	30,416	225,253	359.0	478.0	273.1	$711,951	822,470
125kW Cogen, 3x100kW HP, Thermal	$136,250	47,404	$52,837	138,882	116,787	463.8	220.1	426.2	$711,951	404,705
75kW Cogen, 3x100kW HP, Peak	$92,724	90,930	$84,980	129,964	125,705	302.6	559.6	247.9	$667,531	724,316
75kW Cogen, 3x100kW HP, Thermal	$116,247	67,408	$83,691	220,996	34,673	389.7	346.4	374.0	$667,531	372,140

From this table, EMC recommends that the optimal arrangement is 3 heat pumps and the 125kW cogeneration system. This is based on the average NPV for the two operating regimes (Thermal and Peak) for each combination pair. The average NPV for 3 heat pumps and the 125kW cogeneration is $613 000.

Below are some of the operational graphs for this arrangement. Figure 19 shows the proportion of thermal energy from the heat pumps, cogeneration and the boiler (thermal regime).

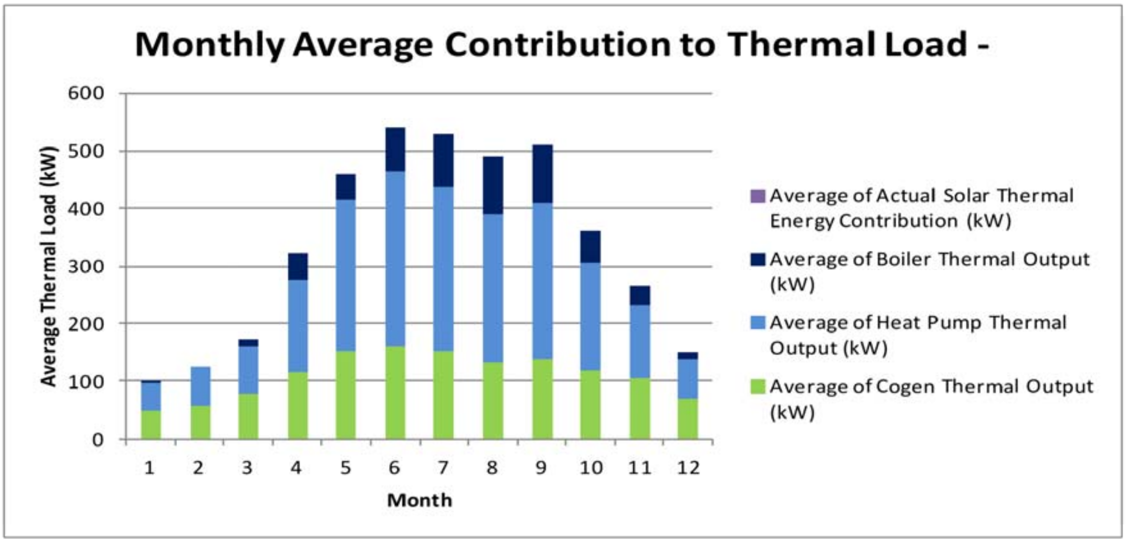


Figure 19: Thermal load contribution for shallow geothermal heat pumps

The daily profile in summer and winter is shown in Figure 20 below. Figure 21 shows the winter load under the thermal regime. These graphs show that in summer, gas boiler output is almost eliminated. In winter the gas boiler will still be required but only to meet peaks in demand. It can be seen that its use will be drastically minimised.

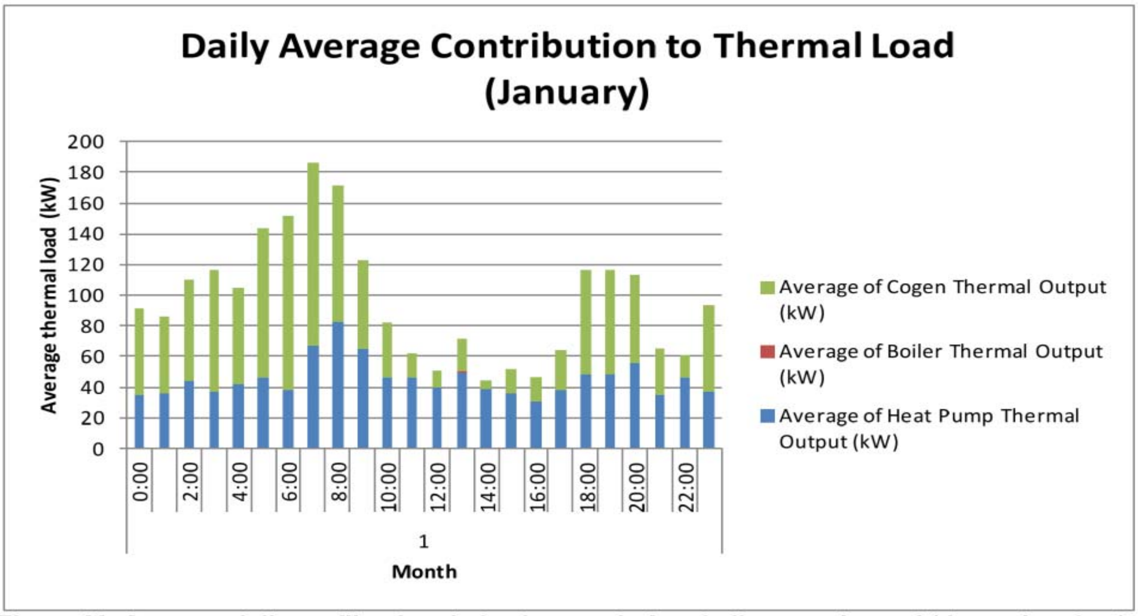


Figure 20: Summer daily profile of optimised scenario for shallow geothermal (thermal regime)

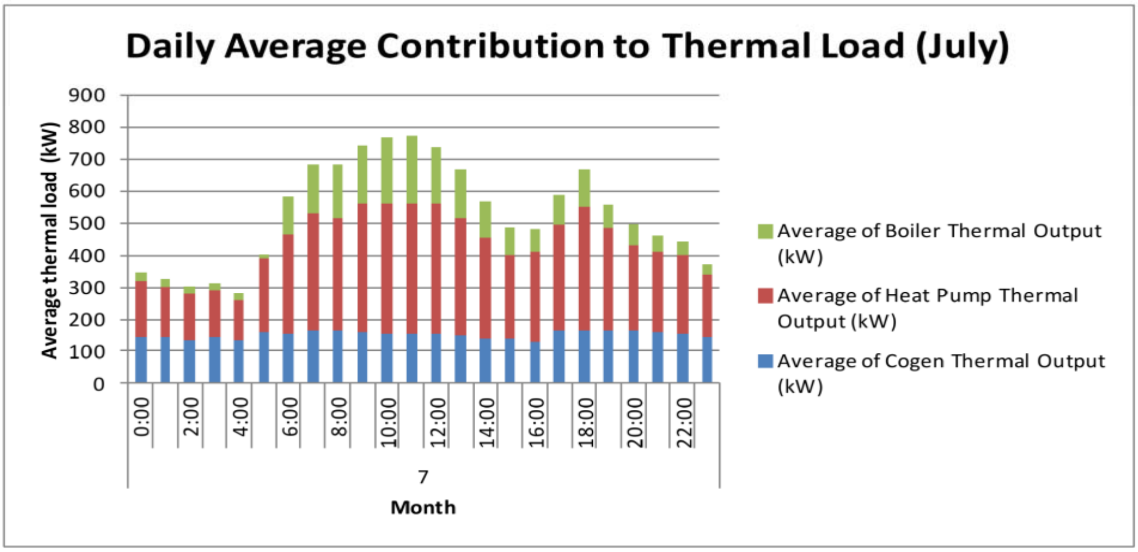


Figure 21: Daily winter profile of optimised scenario for shallow geothermal (thermal regime)

The monthly average contribution to electrical load of the system is shown below.

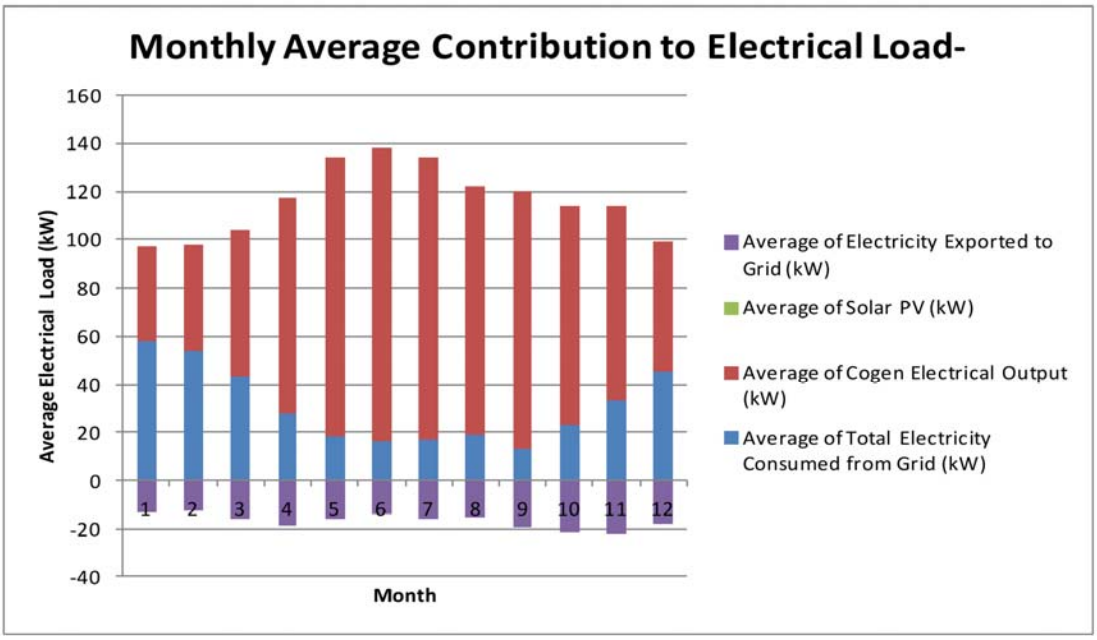


Figure 22: Electrical load supply for optimised shallow geothermal scenario

7.1 Comparison between direct exchange GSHP and shallow geothermal

This report has discussed two ways of using heat pumps for heating: direct exchange ground source heat pumps and shallow geothermal heat pumps. These two methods can be compared to determine which provides the best outcome for FLC. In order to do this, the two best options that have been highlighted for each method will be compared. For direct exchange GSHP that his 14 heat pumps and a 125kWe cogeneration system and for shallow geothermal that is 3x100kWth heat pumps with a 125kWe cogeneration system. The shallow geothermal is being evaluated on the worst-case scenario of temperatures. The results of this comparison are in Table 11. The first two lines in Table 11 are for the shallow geothermal and the second two are the results for the optimised solution from the previous section for direct exchange GSHPs.

Table 11: Comparison of direct exchange GSHP and shallow geothermal

Scenario	Total Gas Cost ($)	Gas Savings ($)	Total Electricity Cost ($)	Total Peak Elect Sourced (kWh)	Peak Elect Savings (kWh)	Gas GHG (t CO2-e/year)	Electicity GHG (t CO2-e/year)	GHG Savings (t CO2-e/year)	Capital Cost ($)	NPV 6%
125kW Cogen, 3x100kW HP, Peak	$107,956	75,698	$54,757	30,416	225,253	359.0	478.0	273.1	$711,951	822,470
125kW Cogen, 3x100kW HP, Thermal	$136,250	47,404	$52,837	138,882	116,787	463.8	220.1	426.2	$711,951	404,705
125kW Cogen, 14x21kW HP, Thermal	$130,237	53,418	$45,791	9,851	245,818	441.5	434.1	234.5	$780,159	616,173
125kW Cogen, 14x21kW HP, Peak	$155,060	28,594	$45,400	118,750	136,919	533.5	190.4	386.2	$780,159	229,156

The results Table 11 show that the two options have similar capital costs. Shallow geothermal is marginally cheaper by $70 000. However, NPV and payback is better for shallow geothermal because of the slightly lower capital cost and the improved savings over time as a result of the higher COP for shallow geothermal. The average of NPV for the shallow geothermal (average of thermal and peak regimes) is $614 000 compared to $423 000 for the direct exchange GSHP. The shallow geothermal options also show improved GHG abatement potential as a result of the improved efficiency of the heat pumps.

Based on this analysis, EMC recommend that the City give strong consideration to pursuing the shallow geothermal option. If the technical risks of this option are considered too high for the City, the direct exchange systems can reduce the risk for similar, but poorer financial and environmental results.

8 Effect of solar PV on site electricity profiles

The model has also been developed to determine the effect of solar photovoltaic (PV) panels on the centre's electricity requirements. The table below shows the effect of solar PV based on a cost price of $6 000 per kW installed.

Table 12: Solar PV savings and returns

Gas Savings ($)	Savings Electricity ($)	Utility Savings	GHG Savings (t CO2-e/year)	Capital Cost ($)	SimplePbP	NPV 6%
-	$10,755	$10,755	38.1	$186,000	17.3	10,500

This table shows that solar PV is a relatively poor investment from a financial point of view.

The effect of the panels on electricity use profiles is below.

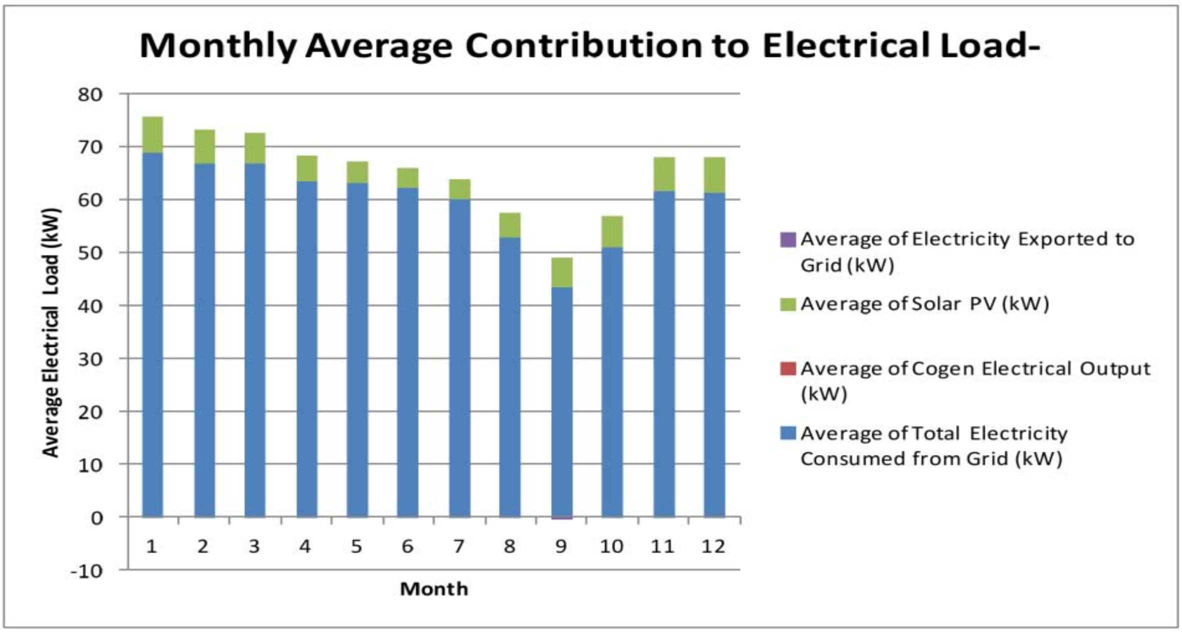


Figure 23: Effect of solar PV on electrical profile over the year

Figure 23 shows that 30kW of PV supply a relatively small proportion of total electricity requirements. Figure 24 indicates that there is a small reduction in peak load achieved with solar PV.

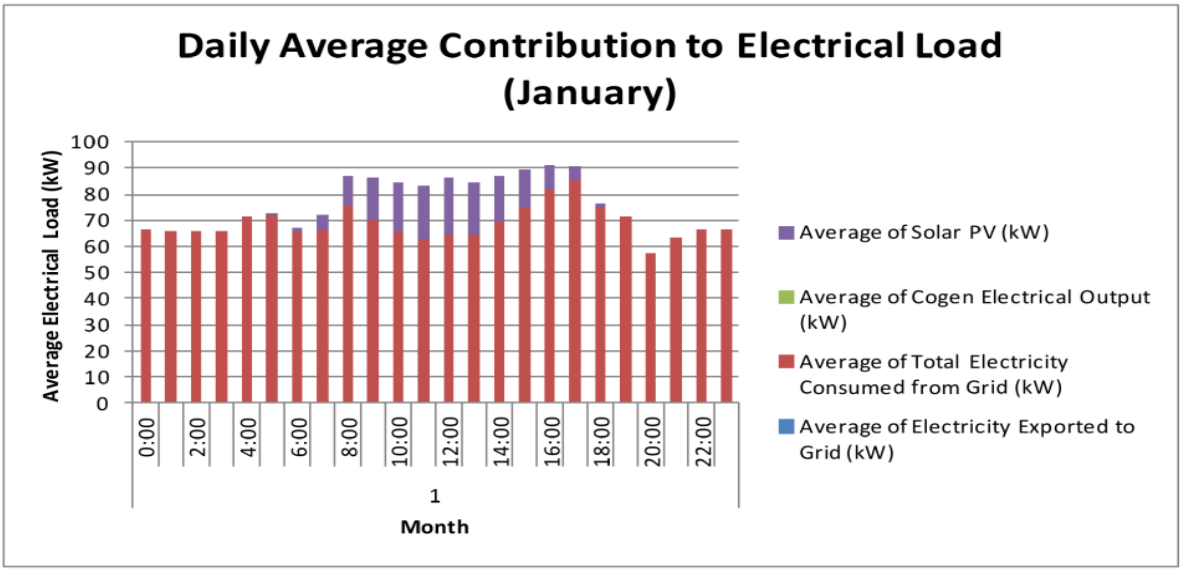


Figure 24: Effect on electrical load profile over typical summer day

9 Control options

The installation of any of the various options discussed in this report will likely be associated with a change in the current control technology being used for the pool heating system. The current set up with one heat exchanger may be improved by the addition of plate heat exchangers in the plant room for the each pool and associated control. This can be done relatively easily and cheaply with common control and automation equipment. Other recreation centres have separate heat exchangers for different pools as this provides more accurate control of pool temperature. Automated initiation of heating will also provide greater temperature control. There are various new methods for control of simple systems and these can be investigated as part of the project implementation.

10 Operational risks

The installation of new technology always poses operational risks. The technology options studied here are well established with many domestic and international case studies, and are not expected to pose a great risk in terms of performing their key tasks.

The relative prices of electricity and gas are the most significant threats to the cost effectiveness of the various options. Different options will be affected by gas and electricity prices to differing degrees.

10.1.1 Cogeneration

The key operational risks for cogeneration:

- Overproduction of electricity requiring the plant to be throttle back
- Overproduction of thermal energy
- Large increase in gas prices compared to electricity prices
- Lack of operators in the WA market may create hassles ensuring a high level of customer service??
- Relatively untried technology for heating pools
- Ability to export electricity if regulatory hurdles can be overcome.

10.1.2 Air Source Heat Pumps

The key operational risks for air source heat pumps are:

- Freezing of evaporator during winter, reducing energy efficiency
- Defrost cycle reduces energy efficiency
- Large increases in electricity prices will reduce the cost effectiveness of ASHP

- Lack of operators in the WA market may create hassles ensuring a high level of customer service??
- Relatively untried technology for heating pools

10.1.3 Ground Source Heat Pumps

The key operational risks for air source heat pumps are:

- Reduction in energy efficiency due to reduction in ground temperature in winter. This is a theoretical possibility but trials have been done
- Leakage of refrigerant in ground loops
- Smaller, but significant risk of large increases in electricity prices which reduce the cost effectiveness of heat pumps
- Lack of operators in the WA market may result in poor customer service
- Relatively untried technology for heating pools

Once the City settles on a final configuration, or subset of configurations, a more detailed risk matrix can be constructed to detail the specific risks and mitigation mechanisms.

10.1.4 Deep Geothermal

The key operational risks for deep geothermal are:

- Pump failure
- Fouling of exchange equipment
- Resource depletion
- Delay in sourcing/installing replacement parts
- Increase in costs of repairs over time.

10.1.5 Shallow geothermal and heat pumps

The operational risks are:

- Pump failure
- Fouling of exchange equipment
- Resource depletion
- Increase in costs of repairs over time
- Refrigerant leaks
- Fouling of re-injection screens

This option also has substantial risks with drilling. These risks are outlined in the 2011 Rockwater Desktop study on low temperature geothermal resources.

10.1.6 Combination technologies

The combination of cogeneration and heat pumps does provide some protection in the sense that multiple technologies will have different risks. In other words, if one of the technologies fails, there will still be the effect of the other. In this case, heat pumps will still provide some benefit even if the cogeneration is not operational. Further, the existing natural gas boiler will be retained, providing a fallback, manually-controlled heating option should multiple failures occur.

11 Recommendations

The modelling exercise carried out by EMC generally demonstrates that combinations of different technologies can provide better outcomes than if single technologies are deployed.

Our work on cogeneration and heat pumps suggests that the combination to achieve an optimal financial and greenhouse gas emissions abatement outcome is the 125kWe cogeneration unit with 3x100kW heat pumps using the shallow aquifer as a heat source. Running this system under the thermal regime provides the highest greenhouse gas reduction. This option has a slightly lower capital cost but improved operating fundamentals and therefore is a more attractive option over time compared to direct exchange GSHP. However, there are likely greater implementation risks with the shallow aquifer options and these needs to be weighed against the potential extra savings from using the aquifer water.

12 Appendix 1 – Additional information on cogeneration

Reference:
http://www.seav.vic.gov.au/manufacturing/sustainable_manufacturing/resource.asp?action=show_resource&resourcetype=2&resourceid=23

Cogeneration

This infosheet contains information about:

- what cogeneration is all about;
- how it is used; and
- some examples of its application.

12.1 Description

Cogeneration is a means of supplying a sites power and thermal energy needs from the combustion of a single fuel and as such is significantly more fuel efficient than conventional technologies (that is power in the form of electricity and/or shaft power from one plant, and thermal energy in the form of heat and/or cooling from a separate plant).

There are a range of commercially available and established cogeneration technologies including: reciprocating gas or diesel engines, gas turbines, and steam turbines. Fuel cells on are on the verge of commercialisation and has the potential to expand the range of sites for which cogeneration is applicable.

There is considerable difference between each technology in terms of performance characteristics, their suitability for a particular application, and the fuels used (which can include natural gas, hydrogen, LPG, bio-gas, coal, diesel, oil, biomass etc).

For sites where cooling is required (such as building air-conditioning or for process cooling), the steam or hot water generated by a cogeneration plant can be used to generate chilled water using an absorption chillier rather than electrically driven refrigeration (trigeneration).

Cogeneration will usually provide an overall energy conversion efficiency somewhere in the range of 70–75%, if all useable heat is recovered. This compares to the 25–30% conversion efficiency of a typical single-cycle centralised power station. Figure 1 presents a schematic which compares the relative energy efficiency of conventional generation and cogeneration.

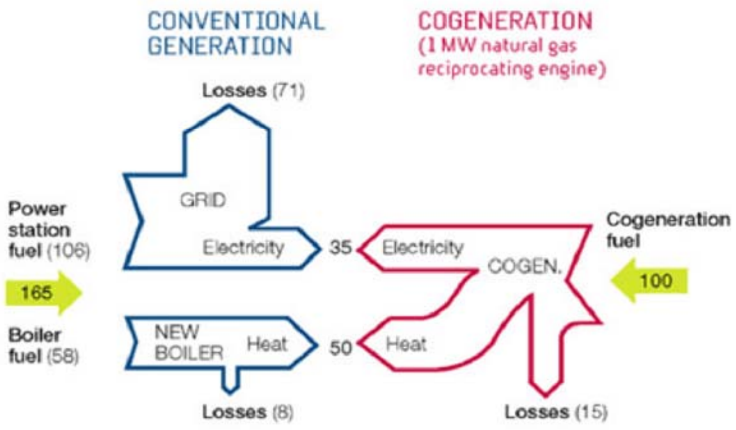


Figure 1: Schematic depicting relative Conventional and Cogeneration Energy Efficiencies

The key benefit of cogeneration is that it can provide a substantial increase in fuel efficiency and therefore achieve significant cost and greenhouse gas benefits. Generally speaking cogeneration can be used at any site which has significant and extended thermal and power requirements. Traditionally at these sites the thermal and power requirements would be sourced or generated separately. That is to say: thermal loads are typically supplied by boilers or electric chillers and the electricity obtained from energy (electricity) retailers or standby generation. Cogeneration meets both the power and thermal requirements of a site from the combustion of the same fuel within a single facility. In Victoria, operating cogeneration facilities are operating at 32 sites with a total installed capacity of 435 MW. Typical applications include: hospitals, large manufacturing facilities, and leisure centres. The primary fuel used in these facilities is natural gas, however there are also applications which use coal, process by-products, wastewater and landfill gas. An assessment of the technical potential for cogeneration has been undertaken for the Victorian manufacturing and commercial sectors and sub-sectors [3], based on the premise that where natural gas is currently being used for thermal energy supply there is potential to install cogeneration instead [3]. This assessment shows that within the manufacturing and commercial building sectors there is approximately 740 MW and 310 MW respectively of unrealised cogeneration potential.

12.2 Users of technology

- significant power and thermal load requirements, which occur over an extended part of each day or preferably continuous, over the whole year, which are expected to continue well into the future;
- a relatively consistent thermal to power load ratio;
- reliable access to fuel supply at a fixed cost ;
- suitable site access and space requirements;
- need for high energy supply reliability (ie standby generation)

- is the existing boiler plant on-line for more than 3000 - 4500 hours per annum (ie 8 to 12 hours per day, every day)?
- is the present thermal fuel consumption more than 2000 to 5000 GJ per annum?
- is the present annual electricity consumption greater than 750 MWh pa?

- is the maximum electricity demand greater than 100 kW?

- does the host wish to own or "lease" (via a third party BOO contract) the cogeneration assets?
- what is the preferred financing arrangement: project financing / internal financing / energy performance contract / BOO and energy supply contract / other?
- what other benefits can cogeneration deliver? / is there a marketing advantage in having cogeneration / do customers have a requirement for environmental performance?

12.3 Appropriate uses

- common industrial applications include: pulp and paper, food manufacturing, petrochemicals, brewing, textiles
- common commercial applications include: hotels, hospitals, schools?/universities, swimming complexes, large commercial developments, medium/high density residential

12.4 Examples of use

- is the existing boiler plant on-line for more than 3000 - 4500 hours per annum (ie 8 to 12 hours per day, every day)?
- is the present thermal fuel consumption more than 2000 to 5000 GJ per annum?
- is the present annual electricity consumption greater than 750 MWh pa?
- is the maximum electricity demand greater than 100 kW?
- prior to considering cogeneration, prospective cogeneration host sites should have an effective energy management system in place and have implemented all reasonable initiatives that prevent wastefulenergy use.
- primer mover or engine (converts of fuel energy into shaft power and heat)
- generator (converts shaft power into electricity)
- heat recovery system (recovers engine “waste” heat for use for process heating)
- absorption chillers (recovers engine “waste“ heat for process cooling)
- ancillaries (including items such as: control systems, substations, emissions control)

- usually used for larger applications (2 MW to 200+ MW)
- have higher capital costs, but lower operating costs compared to reciprocating engines
- have lower noise levels, noise enclosure may not be required
- generally do not have fast start up capability
- poor part load operation (generally required to operate at >90% of rated capacity)
- gas/micro-turbines may require expensive fuel compression equipment
- steam turbines can be operated using any combustible organic fuels.

- lower unit capital costs (due to their ease of mass production / ease of scalability)
- lower unit operating costs (due to reduced unit maintenance requirements, and higher electrical efficiency compared to conventional technologies)
- lower noise and greater thermal and electrical efficiencies.

12.5 Advantages & Disadvantages

- can have a local air quality impact (nitrogen oxide emissions are of particular concern)
- significant up-front capital cost, and as such is not sufficiently viable for many sites
- some cogeneration units are not amenable to rapid thermal load changes (therefore conventional equipment may still be required to meet short-term changes in load)
- reciprocating engines: is $1000 to $1500 per kW electrical output (up to 3 MW)
- gas turbines: $1000 to $2000 per kW electrical output (2 to 10 MW range)

13 Appendix 2 - Cogeneration at UNSW

Reference: http://www.energy.unsw.edu.au/NewsInfoUNSWCogeneration.shtml

A small cogeneration system operates in the Unigym building on lower campus to principally serve the heating needs of the indoor swimming pool complex.

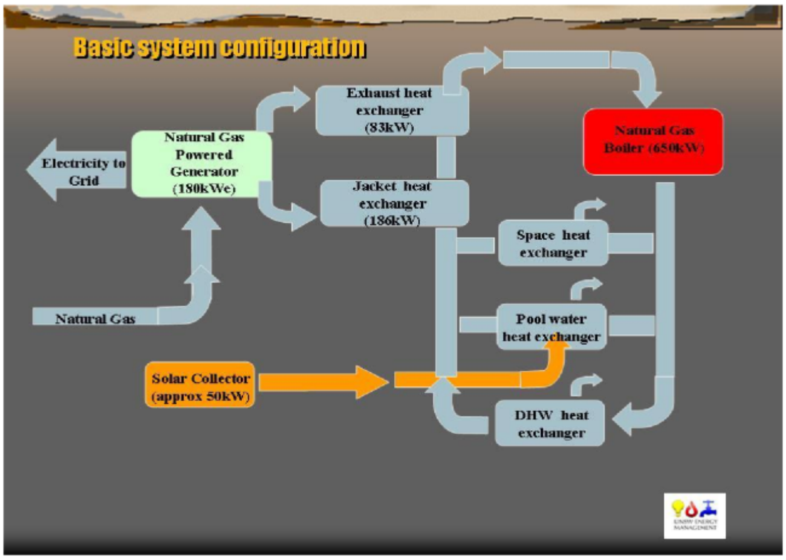
What is cogeneration?

Cogeneration involves the joint production (locally) of two forms of energy from the same source. In our case, the two forms are hot water and electricity, from a natural gas supply. This arrangement significantly increases the standard efficiency of energy transfer, leading to long-term financial savings and greenhouse gas reduction.

The system comprises a 185kWe gas fuelled, spark ignition electrical generator set, located in the existing Unigym plantroom, in conjunction with a 650kW gas fired hot water generator (gas boiler).

The Electrical Generator set is provided with heat recovery from the jacket water and exhaust flue gasses. The heat recovery system is then connected to the Pool Heating Water, Space Heating Water and Domestic Hot Water Systems.

Renewable and low carbon solutions for Fremantle Leisure Centre



The system is configured to operate in cogeneration mode during times of 'Peak' * and 'Shoulder' Electrical Tariffs, with the boiler operating during the 'Offpeak' Periods. At times when the thermal demand exceeds the capacity of the cogeneration plant, the hot boiler will also operate as a supplementary heater.

The electricity generated is largely consumed within the Unigym complex running pumps, fans and lighting.

** The university pays different rates for electricity depending on the time it is supplied. These periods are referred to as Peak, Shoulder and Off-peak. This means that the cogeneration system will generally run most weekdays from 7am to 10pm.*

14 Appendix 3 – Report by Geothermal Centre of Excellence at UWA

SGS1210-9 NATIONAL HOTEL PROPOSAL FOR FOOTPATH UPGRADE AND EXTENSION FOR ALFRESCO DINING

ATTACHMENT 1

Proposed upgrade of the High Street footpath for an application for approval of an alfresco dining area in High Street, in association with the ongoing restoration of The National Hotel.

Michael Willicombe, ArchDesign Studio

Introduction

The National Hotel is an iconic Heritage Hotel in the heart of the West End and the modern City centre of Fremantle. Closed for many years following extensive fire damage the Hotel is finally rising from the ashes (sorry for the pun!) to re-open its doors as a fully operational high quality Hotel, with accommodation, Bars and Function rooms.

As an integral part of these restorations we are seeking to finally give the Hotel the streetscape setting it deserves with an upgrade of the pavement area in front, with the creation of an attractive streetside alfresco dining area. In so doing we will re-engage the Hotel with the public and the important street corner location of High Street and Market Street.

Streetscape background

In recent years Council has looked to upgrade Market Street and, more recently, High Street. The footpaths have been widened and some improvement to the streetscapes have occurred, with more space for pedestrians and a re-balance of importance away from vehicles and back to pedestrians and the people in the area.

In High Street the street upgrades have been limited due to pressures to retain on street parking and also kerb re-alignments have not moved as far as they could, or should have. Particularly in the case of the old Hotels in High Street not enough has been done in terms of pavement widening to support the continuing opening of the Hotels (or to encourage the re-opening of other Hotels…).

Existing National Hotel streetcape

The existing streetscape setting of the National Hotel is noticeably constricted by the pressures of traffic and an intersection with traffic lights. The upgrade in High Street carried out quite recently inexplicably limited the extent of the footpath widening in front of the Hotel and didn't even run the full extent of the building, a loading bay being located in front of the western end of the High Street façade and heritage verandah.

As noted in the planning application for the restoration of the building we applied to relocate the loading bay away from the building and away from the verandah (to protect the verandah from trucks reversing into it in the loading bay, as well as to create a suitable visual curtilage for the heritage verandah).

1

Proposed application for street works

With this application we are seeking to upgrade the footpath in front of the Hotel only in High Street, by altering the alignment of the kerbing in front of the Hotel. This will allow the creation of an area that is big enough to work successfully as a streetside alfresco area and to revitalise this section of the street. Our proposal is, we believe, what the original upgrade of the High Street should have looked like.

In simple detail terms with our upgrade we are proposing the following:

1. Realignment of the existing kerbing as shown on the application plan;
2. Moving of the Loading bay along the street by one bay.

In terms of Proposal 1 the benefits are self evident in making it possible to transform this important street corner from one that is just a traffic lights intersection into one where alfresco dining and street life is created. This proposal creates the opportunity to extend both the street life of the Mall and of South Terrace/Market Street in to High Street and the West End.

In terms of proposal 2 while there is the loss of one parking space in High Street (moving the loading bay along one space), the streetscape benefits far outweigh the downside of this loss. Indeed in terms of lost parking spaces there are plenty of areas in The West End where more efficient design of parking could create many new on street parking spaces. Two examples spring to mind:

1. Bannister Street where swapping the parking from one side of the road to the other would create an additional 6 parking bays (the other side of the street has only two crossovers to restrict parking...
2. In Pakenham Street sections of the street are deemed to dangerous for car parking (building condition) and yet are deemed safe for pedestrians…

Conclusion

The application here for the proposed alterations to the pavement in High Street would create a new vibrancy to this street corner and a new benchmark standard for street intersections and hopefully stimulate similar developments in other parts of the City which until now have been overlooked by Council and owners/developers.

With approval of this application we hope that other Hotels in High Street will instigate similar upgrades to create genuine opportunity for owners to take advantage of their heritage hotels and yes to maybe even re-open their doors… and utilise the great built environment that is the High Street.

Council determination

With the processing of this application through the Council's Strategic and General Services Committee we request that the members of that Committee be invited to meet with us on site to review the application and its merits, and any concerns those members might see with the application. In this regard I can be contacted by email or phone.

Michael Willicombe

2

Notes on the application:

The proposed upgrade is limited to:

1. the adjustment of the kerbline as shown and reinstatement of the existing paving design to that new alignment;
2. the use of during trading hours only drop in poles and chain to delineate and control the seating area of the alfresco dining area;

Note: this is proposed in a similar manner to barriers used by the Sail and Anchor but in far more subtle and refined manner (see attached detail)

3. the use of during trading hours only removable tables and chairs (subject to Council approval of design).
4. the costs of carrying out the proposed works noted above.

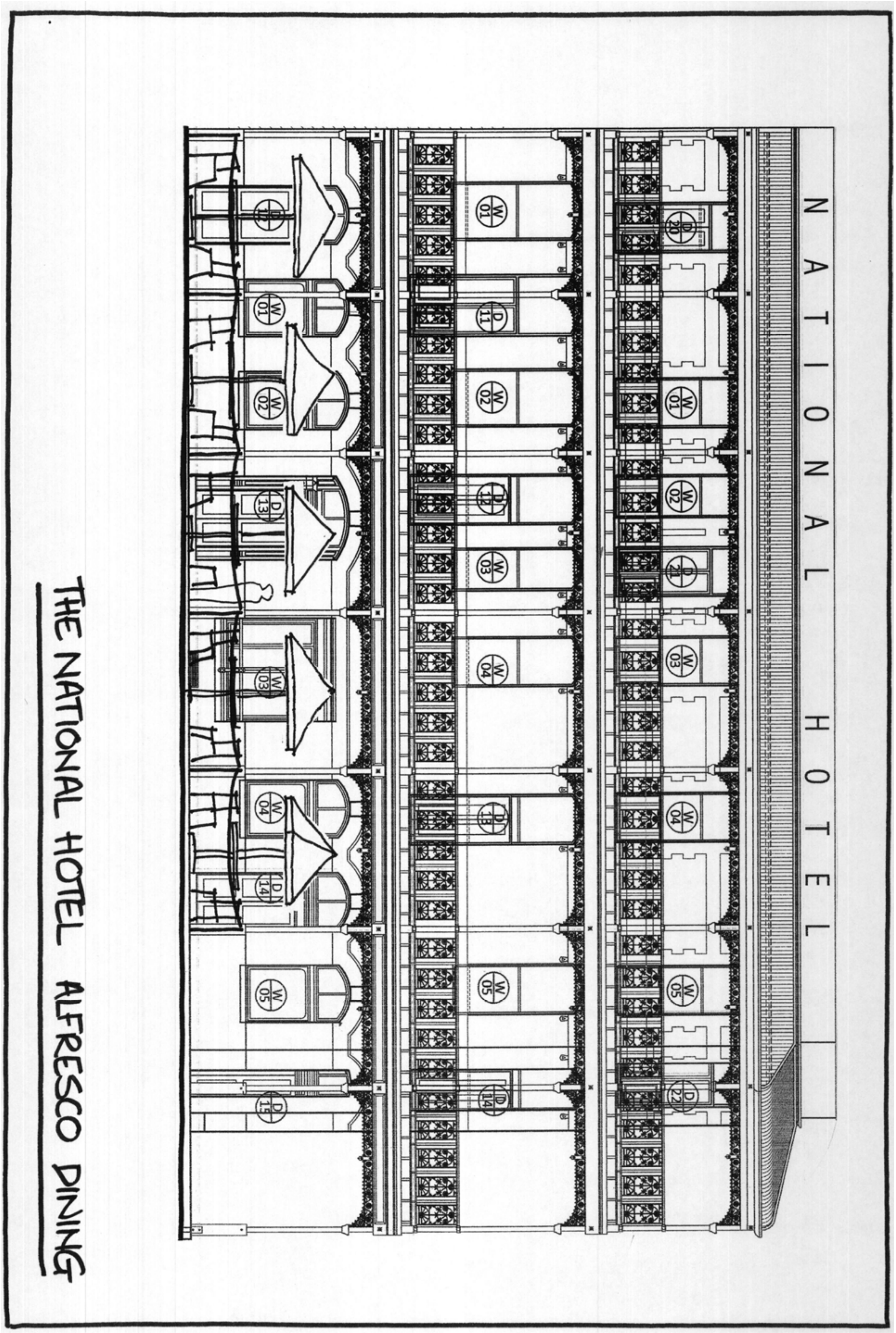
The proposed design does not include the installation of any permanent street furniture and/or semi permanent pot plants but the owners of the Hotel are happy to pay for any suitable additional items such as this that Council might deem is warranted in this upgrade.

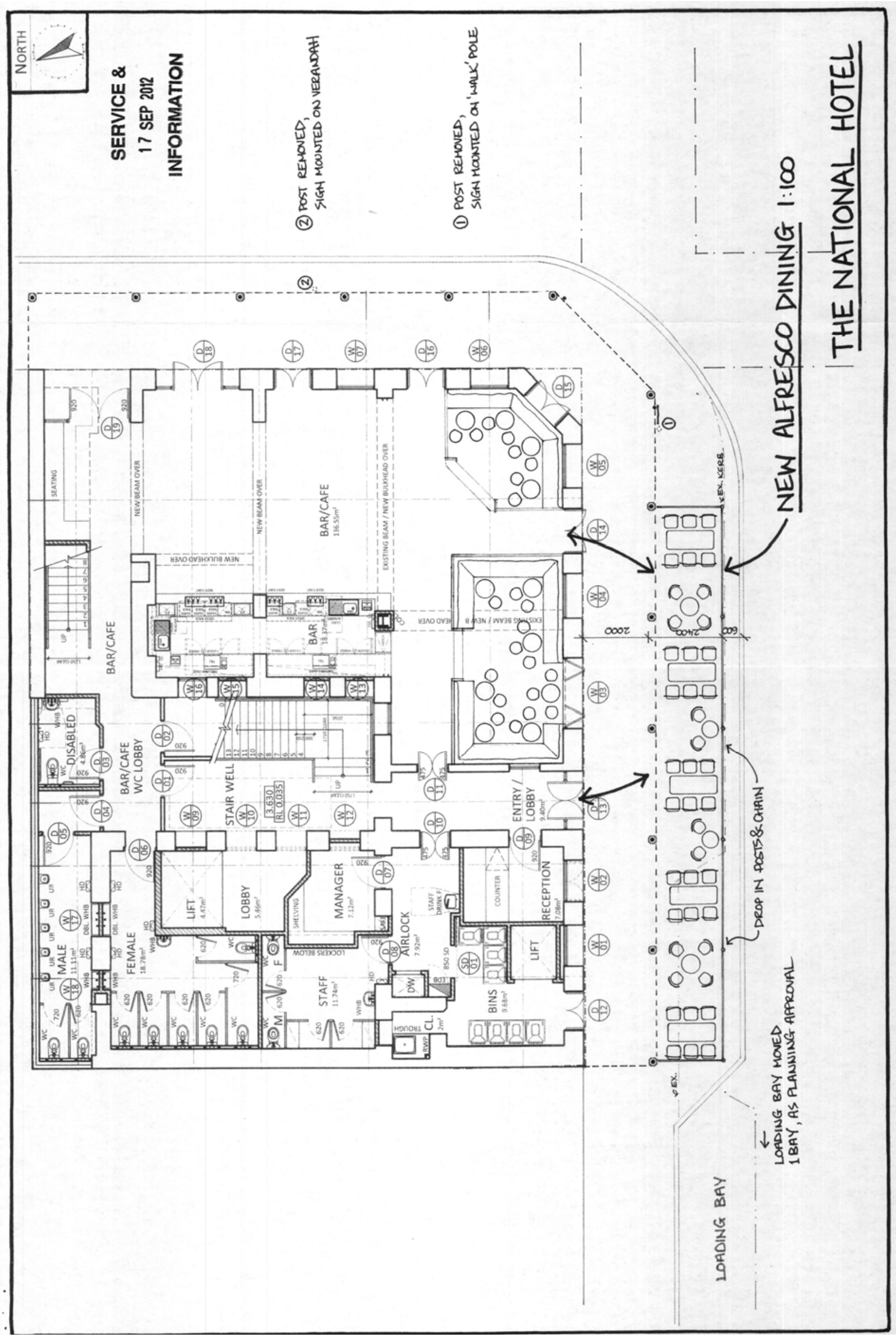
The proposed design does not require any alterations to the existing building and does not require any alteration to road drainage in the street.

The owners are happy to pay any application fee due for Council to consider this application and also any reasonable associated fees in relation to Councils' trained staff liaising in terms of the urban design requirements of the design.

Contact:

Michael Willicombe
ArchDesign Studio
3A Chudleigh Street
Fremantle 6160
Surf1@hotmail.com
08 9336 7974
04382 77668


THE NATIONAL HOTEL ALFRESCO DINING
NATIONAL HOTEL


NORTH
SERVICE & 17 SEP 2012 INFORMATION
② POST REMOVED, SIGN MOUNTED ON VERANDAH
① POST REMOVED, SIGN MOUNTED ON 'WALK' POLE
NEW ALFRESCO DINING 1:100
THE NATIONAL HOTEL
DROP IN POSTS & CHAIN
LOADING BAY MOVED 1 BAY, AS PLANNING APPROVAL
LOADING BAY
BAR/CAFE
BAR
STAIR WELL
LIFT
LOBBY
MANAGER
AIRLOCK
STAFF
BINS
RECEPTION
ENTRY / LOBBY
BAR/CAFE WC LOBBY
DISABLED
MALE
FEMALE
SEATING
NEW BEAM OVER
EXISTING BEAM / NEW BULKHEAD OVER
NEW BULKHEAD OVER
LOCKERS BELOW
COUNTER
SHELVING
TROUGH
2000
2400
600

SGS1210-10 YOUTH ACTIVITY AND SKATE PLAZA LOCATION – ESPLANADE RESERVE

ATTACHMENT 1

Area 1 See map for location: Current Skywheel to Dismantle site

Factor	Advantages	Disadvantages
Skate Specific Design and Planning	Compliments draft master planning	Potential size: 1110sqm Pedestrian crossing access Less shade Linear shape only Street style attracts experienced skaters Less variety for other users and beginners Minimalistic design approach
Economical & Financial		Presents conflict with Operation Skywheel. Moving Skywheel: $6-10K Facility hidden if Skywheel stays Dismantle to be relocated.
Environmental	Easiest site to isolate irrigation	15 new growth Norfolk Pines: $75-150K to replant or $3K to destroy Need a year to replant trees. Irrigation costs: $15-20K
Community Youth Interaction	Good hub of activity if Skywheel can move west. Dismantle compliments Current passive recreation zone	

Area 1 of 4

Area 2 See map for location: Covers the entire mound

Factor	Advantages	Disadvantages
Skate Specific Design and Planning	Largest size area: 1895sqm Provides more options for diverse design Partly shaded area Largest scope multiple users: skate, bmx, scooters riders all interpret the park differently. More size to cater for beginners to experienced.	
Economical , Financial & Environmental		Largest lawn area for irrigation costs up to $50K. Mound will need to be flattened to make the site useable. Expense to get it useable over a flatter surface Sentimentality to the mound Proximity to Carriage Cafe
Community Youth Interaction	Current passive recreation zone Creates a dense hub of activity Dismantle compliments	

Area **2** of **4**

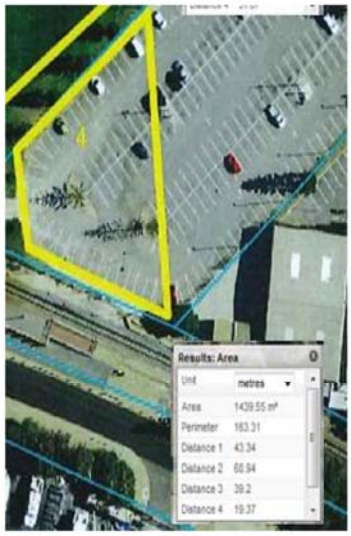
Area 3 See map for location: Railway line towards Cicerellos

Factor	Advantages	Disadvantages
Skate Specific Design and Planning	Site allows for future expansion: up to the pedestrian crossing if a Norfolk Pine is removed. Second best location for scope of style diversity and experience. Compliments draft master planning Well shaded area	Size: 1001sqm Limited by size for variety. Too many features can be squashed in Less space for flow.
Economical , Financial & Environmental		Access limited for disadvantagestruction Damage to trees likely Lawns will get compacted Irrigation costs: $25 – 30K A mature tree may need to be removed for access.
Community Youth Interaction	This site will broaden the activation of this end of the park. Between two pedestrian crossings, good food traffic Future developments in this area compliment this location. Presents the least conflicts of all areas. This site will broaden the activation of this end of the park.	

Area **3** of **4**

Area 4 See map for location: Esplanade car park # 11

Factor	Advantages	Disadvantages
Skate Specific Design and Planning	Size is variable: up to 1440sqm. Provides the second largest location for multiple users: skate, bmx, scooters riders all interpret the park differently. Compliments adopted master plan	Size and style is limited to available bays. No shade
Economical & Financial		Income: $3600 per bay per year. Car park 11 has 80% capacity use on average Example, a 1440 sqm skate facility could take up around 50 bays =$180000 loss every year. Impact to Italian club operation
Community Youth Interaction		Blocks current main vehicle access This site would be hidden from line of sight behind the mound creating a security issue.
Environmental	No environmental concerns No irrigation costs	



Area 4 of 4