KIWI BIRD ECOCAMP

University of Birmingham

Introduction to Energy Engineering

UNIVERSITY OF BIRMINGHAM

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Contents

INTRODUCTION

Kiwi Bird EcoCamp is an off-grid campsite located in 40 Valley Road, Greta Valley, Hurunui, Canterbury, New Zealand. It is situated in a green area next to Hurunui River and will be opened during the summer months (November – February). The EcoCamp is set over a 12.40 acre site and includes the following facilities:

200 tent pitches, sited in a beautiful quite area, available to hire.

12 hard standing areas for caravans with electrical hook ups.

Hot showers

Toilets

Washers and Dryers

Two large freezers

Sinks

Cooking facilities

Heated outdoors children’s swimming pool

Chalet for owners

Wi-Fi

Satellite TV

26,000 litre water storage

Lockable gates

Very close to important highways, garage, golf, tennis, polo and fishing areas

Our aim is to create a magical experience, for people who enjoy nature and its beauty, by creating a self-sufficient in off grid energy campsite. Our challenge is to create an EcoCamp which does not use electricity from the grid, but instead generates its own power in order to fulfil all campers’ desires.

Calculating the amount of power that every facility requires, and estimating if enough power can be generated in and efficient and clean way is the objective of this analysis. Renewable energy is preferred since it will not harm the environment, but will it be feasible to set up a campsite which does not rely at all on electricity from the National Grid?

Where is our EcoCamp situated?

The 12.40 acre site will be located in Canterbury due to the fact that the weather conditions are very beneficial for the chosen energy production strategies. Weather conditions that affect the production of power are wind, sunshine hours and sun intensity.

Wind

Typical wind speeds vary from 0 ms^{-1} to 9 ms^{-1}, rarely exceeding 9 ms^{-1}, during the course of the year. During the summer months the average wind speed is around 5 ms^{-1} whereas the daily maximum is 9 ms^{-1}. During the winter months the mean average wind speed is around 3 ms^{-1} and the daily maximum only reaches 5 ms^{-1}. Given that the campsite will be open during the summer months, these wind conditions really favour energy production with wind turbines, since the highest wind speeds occur during the opening months. In contrast Birmingham in the UK, during the summer months, only has wind speed on average of 3 ms^{-1} and a maximum value of 6 ms^{-1}.

Sun hours and Sun Intensity

The length of the day varies significantly over the course of the year. The shortest day is June 20 with 8:57 hours of daylight; the longest day is December 21 with 15:26 hours of daylight. Since Kiwi Bird EcoCamp will be open during the summer months when the sunshine per day is greater, power output will be greater.

Christchurch receives on average, 46% more annual sunshine than the other 3 cities in Britain. During the summer months New Zealand has an energy resource of 4 $kWhm^{-2}$ per day, whereas the UK only has 2.9 $kWhm^{-2}$ per day.

Due to these facts and also the wind statistics it is beneficial in terms of energy generation to locate our EcoCamp in New Zealand, more precisely in The South Island.

Layout of the site

The caravan park area has been calculated by assuming a maximum area of 5X12m^2 per caravan and similarly the tent pitch has been calculated by assuming a maximum area of 5X9m^2 per tent pitch. The layout of the campsite has been designed to facilitate mixing and interaction between groups of campers and caravan users by linking them with a path, which aids social sustainability. Furthermore paths to and from the reception and eating areas have been clearly established and will be lit by several battery powered studded lights planted in the ground. The tent pitch and caravan park are placed in open ground so that campers can make use of the space for leisurely activities.

The chalet comprises of a games room, café and security room all of which have blanket insulation (fibreglass) (Energy.gov, 2015) which is a relatively cheap option. Alongside this double & triple glazing will be used to minimise heat loss through windows which will enable the chalet to store and optimise energy without excessive loss. The café will only serve hot evening meals when the load on the energy system is lowest and after the storage system has gained some charge during the day. Considering the motives of campers, it is reasonable to assume that they want to enjoy the natural environment and so will not want to use electrical leisure activities, which is why the games room features ‘no energy’ games (pool, table tennis etc.).

The swimming pool will be insulated so will act as a vacuum i.e. there is minimal heat loss to the pool walls. Insulation will be applied to the walls and base to ensure the heat is trapped, as well as a cover being used when it is not in operation which is significant as evaporation accounts for up to 70% of heat loss in outdoor pools (Energy.gov, 2015). Showers will receive heated water from a solar powered water tank on the roof and the shower will also contain a filter so that used water will be filtered until it has been cleansed adequately and then will be used again.

Facilities and their power consumption

As can be seen from table 2(see appendix), some of the facilities that require the largest amount of power are heated. To reduce the power consumption these are going to be heated by ground source heating. This leaves 4228.4 watts at night and 7543.4 watts during the day that has to be powered by electrical energy.

We propose that caravans can only be charged during the night to reduce the peak power demand during the day. The figure of 2760 watts was reached by assuming that all 12 caravans need to be fully charged during the night, that each caravan is powered by 1.38KWh (Caravanclub.co.uk, 2015) giving a total of 16.560KWh. Over a 6-hour charging period this would require 2760 watts.

Typical showers require 7kW to power so with all 10 showers running at the same time this would be a total maximum of 70kW. By using ground source heating, and an average shower time of 12 minutes we have calculated that over a 6-hour charging period at night, it would be possible for a shower to require only 233W of power. This is an extremely large advantage over powering them electrically by halving our total peak consumption.

The figure for the swimming pool power was done by using $Gr.Pr \approx 64 \times 10^6 \times Length^3 \times \Delta T \approx 1.5 \times 10^{12}$ to show that the flow is turbulent and then using $h = 1.54 \times \Delta T^{1/3}$ and

$Q = h \times A \times \Delta T$ to calculate that a total of 1.332kW has to be inputted to keep a constant temperature. This is assuming that the sides of the pool are well insulated meaning that heat is only lost through the top surface and assuming that the pool is kept at a temperature of 25 degrees (For an outdoor pool in summer) and that the air is at a temperature of 22 degrees.

Table 3(see appendix) shows the required daily heat and electrical energy during the summer and winter months. Upper bounds for demand are used to show the maximum power demand.

(Ground Source Heat Pump)GSHP

For theory see appendix

The average air temperature in New Zealand is 14°C and therefore the temperature at 10m below the ground surface is 14°C. This temperature input can be increased to between 40 and 70°C dependent on the device used.

It is proposed that 2 separate ground source heat pumps are used for the campsite: one for the winter months, where the heat requirements are much higher, and another device for the summer months, where the heat requirements are much lower. This will reduce the energy cost in the summer and reduce the amount of lost energy

The devices chosen for this are the Kensa Single Compact and the Kensa Hybrid Twin Ground Source Heat Pumps due to their high efficiency, long life, low – maintenance and low noise output. (See table 5 in appendix)

These pumps require 10m of pipe per KW of heat energy being generated. Therefore to generate the 19KW of heat energy required, 200m of pipe will be used. This will cost approximately £8000 to install including purchasing materials. Both ground source heat pumps can work off the same pipeline reducing the installation cost.

This system requires very little maintenance with the main component likely to fail is the compressor. This device will last approximately 20 years before it needs to be replaced. The piping will last a lot longer as the fluid pumped into the pipes is specially designed to protect the pipes.

Water Generation

On site is a fast flowing stream with a large drop just outside of the campsite coming from the Hurunui River. This stream contains a lot of kinetic energy and therefore this can be utilised to generate electricity.

The device available from 'PowerSpout' (see appendix figure 5) allows for a large amount of energy to be generated from small amounts of water. By having a pipe that slowly narrows, the velocity of the water increases so as the water hits the turbine in the centre of the device it has more kinetic energy and can therefore generate more energy as the turbine turns.

Figure 4 (see appendix) shows the maximum electrical energy available from the 'PowerSpout' devices. Based on an input water flow rate of approximately $0.15m^3s^{-1}$, which is equal to $0.035ms^{-1}$ based on the input pipe diameter of 23.5cm (9.4in), 5.6KW of power can be generated from 10 'PowerSpout' devices working in parallel. The stream must therefore be divided 10 ways to ensure each device can output its maximum power as shown in figure 2.

Protecting the environment

The stream running through the campsite contains wildlife and so installing these devices can injure wildlife. Therefore grills and filters will be placed at the points marked 1 in figure 2. This will stop wildlife from entering the devices and therefore protecting the environment as well as protecting the devices from debris.

Device

Each device costs £811.5 including installation so therefore 10 devices will cost £8115.

Solar Energy Conversion System

According to Geni.org, New Zealand's solar energy resource is approximately 4 kWh/m² per day. It also has between 1900 and 2000 hours of bright sunshine every year (average of 5.4 hours a day). Using Panasonic HIT-245 solar panels, we would be able to achieve significant outputs given the resources available on the area chosen for our campsite.

During peak time, 6kW of power would be needed. The panel's efficiency as stated in the specification sheet provided by the manufacturer is 19.4%, with a maximum output of 245W at the rate of 42 V. On the campsite, each panel would be able to output the maximum power, as can be demonstrated below.

$$Pannel\ Efficiency = 19.4\%$$
$$Average\ Raw\ Power = 4{,}000\ W\ per\ meter\ squared$$
$$Possible\ Maximum\ Energy\ Production\ per\ m^2 = 19.4\%\ \times 4{,}000 = 776\ W$$

Since our panel can output a maximum of 245 W, the excess energy (about 501W) cannot be converted. In order to fulfil our campsite's need of 6 kW, about 25 panels would be needed. Each panel cost around £365.00. The total price would be £9125.00. The area required for 25 panels is about 35m², which is only a small part of our 5 hectare campsite.

The system will work as shown in figure 6(see appendix). The solar energy is converted into electrical energy and then goes to a battery bank, where the energy is stored. The battery bank is then connected to a step-up transformer, which converts the battery's voltage of 42 V to the standard 240 V used in conventional wall sockets. The transformer can handle peaks of up to 18 kW of power, which will be more than enough for our campsite.

The final pricing for the system here detailed is described in table 6(see appendix). These include installation costs.

Setting up the site

	Cost(£)	quantity	Total Cost(£)	Appendix
The site	120000	1	120000	
Swimming pool	420000	1	42000	2
Caravan Bases	80.50	12	966	3
Chalet	107,000	1	102,000	4
Utilities bock	107740	1	107740	5
Path Ways	13,445	1	13,445	6
Appliances	2762	1	2762	7
Total cost			388913	

Costs of being off the grid

<u>Power Generation and storage</u>

	Cost	quantity/ size	Total Cost(£)
Battery Bank	3,772.84	1	3,772.84
Solar panels	364.98	25	9124.50
water wheel generators	811.50	10	8115
Transformer	799.99	1	799.99
Total cost			21812.33

Heat Generation

	Cost	Quantity/ size	Total cost(£)
Winter heat pump	8660	1	8660
Summer heat pump	45035	1	4035
total cost			12695

The total cost of being of the grid is £34,507.33 (12695+21812.33)

Cost of being on the grid

To estimate the cost of being on the grid we need to make some assumptions

1. Summer is 4 months long and winter 8 months
2. Producing thermal energy from electrical is 100% efficient
3. Power bought from the grip is 12p
4. Summer days are 13 hours long
5. Winter days are 10 hours long

Season	Time of day	Duration(hours)	power (watts)	power(Kwh)	Cost(£)
Summer	Day	13	11500	149.5	17.94
Summer	Night	11	12000	132	15.84
Winter	Day	10	29000	290	34.80
Winter	Night	14	27000	378	45.36

The total cost for a summer day is £33.78 and for a winter day £80.16. The total cost for the summer months will be £4,053.60 (33.78x30x4) and for the winter months £19,238.40 (80.16x30x8). The total electricity bill each year would be £23,292

Money made from the campsite

The total money generated by the campsite will be £77,400. (For elaboration please see 'Revenue' appendix)

Payback and feasibility

The total cost of all our heating and power systems is £34,507.33, dividing this by the cost of being of the grid gives the length of time after which the site will be better off 34,507.33/23,292= 1.48years. This is a very quick payoff and therefor being of grid is both feasible and the methods have proposed are a viable option.
The total cost of the site is £423420.33 (388913+21812.33+12695) if the campsite makes £77400 a year the payback of the site will be 5.5 years (423420.33/77400).

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Appendix:

Meeting Minutes:

Meeting Minutes - [Energy Project]

Location: Law LT3 Minutes taker: Usman Ahmed

Date: **4th Feb**

Time: 09:00:10:00

Attendance

Usman Ahmed

James Burrell

Victor De Corpa Franca

Alexander Hoyle

Marina Valero Herrera

Absent

Sarah Glaves – Apologies received

Agenda Items

Initial research into campsite requirements

Action Items

Marina – research location of campsite

James – research water storage, energy generation

Victor – research types of panels and turbines, most effective systems

Alan – research costs incurred for typical campsite and payback needed

Sarah – research into viability of geothermal energy

Usman – research into energy storage methods

Next meeting at 09:00 in Shell lounge on 6th Feb

Other Notes

Other important details discussed during the meeting can be entered here.

Meeting Minutes - [Energy Project]

Location: Shell lounge Minutes taker: Usman Ahmed

Date: 6th Feb

Time: 09:00-10:00

Attendance

Usman Ahmed

James Burrell

Victor De Corpa Franca

Alexander Hoyle

Marina Valero Herrera

Sarah Glaves

Agenda Items

Energy generation methods to use for campsite

Location of campsite

Preparation for presentation

Action Items

Meet up on Monday 10th feb for preparation @ 13:00-14:00 NB: James has informed us he will not be available then but will be informed of his role later.

Other Notes

Other important details discussed during the meeting can be entered here.

Meeting Minutes - [Energy Project]

Location: Shell lounge

Minutes taker: Usman Ahmed

Date: 10th Feb 2015

Time: 13:00

Attendance

Usman Ahmed

James Burrell

Alexander Hoyle

Sarah Glaves

Marina and Victor have informed use they will be absent but are informed of their roles.

Agenda Items

Finalise presentation and assign roles

Action Items

Give presentation on 11th February 10, 2015

Other Notes

Other important details discussed during the meeting can be entered here.

Meeting Minutes - [Energy Project]

Location: Bramall Music building

Minutes taker: Usman Ahmed

Date: 18th February 18, 2015

Time: 10:00

Attendance

Usman Ahmed

James Burrell

Victor De Corpa Franca

Alexander Hoyle

Marina Valero Herrera

Sarah Glaves

Agenda Items

Meet Mark ward for consultation

Prepare and assign roles for presentation

Calculate costing & efficiencies for given energy generation methods:

A Usman - water

B Alan - geothermal

C Victor - wind

D Marina - solar

E Sarah – compressed air

F James - pumps

Action Items

Finalize presentation

Meet again with findings on Tuesday 13:00 at Shell lounge

Other Notes

Other important details discussed during the meeting can be entered here

Meeting Minutes - [Energy Project]

Location: Shell lounge Minutes taker: Usman Ahmed

Date: 24/02/2015

Time: 13:00

Attendance

Usman Ahmed

James Burrell

Alexander Hoyle

Marina Valero Herrera

Sarah Glaves

Agenda Items

Present findings and decide on final energy generation/storage systems

Creating site plan - layout

Divide report headings between group

Action Items

Meet on 25 Wednesday 10 am

Usman – sketch site layout

Other roles for report yet to be delegated

Other Notes

Other important details discussed during the meeting can be entered here.

Meeting Minutes - [Energy Project]

Location: Shell lounge Minutes taker: Usman Ahmed

Date: 25th February 2015

Time: 10:00

Attendance

Usman Ahmed

James Burrell

Marina Valero Herrera

Sarah Glaves

Victor

Agenda Items

Research for final presentation

Finalizing presentation facts & figures

ACTION ITEMS

Other Notes

Meeting Minutes - [Energy Project]

Location: Shell lounge Minutes taker: Usman Ahmed

Date: 2nd March 2, 2015

Time: 13:00

Attendance

Usman Ahmed

James Burrell

Marina Valero Herrera

Sarah Glaves

Victor Corpa

Agenda Items

Research for final presentation.

Finalizing presentation facts & figures

ACTION ITEMS

Usman- Add labels to site layout drawing

Meet again tomorrow (3rd march) to practice presentation @ 17:00 in shell lounge

Assign presentation slides to speakers

Liaise online to delegate roles for final report

Other Notes

Apologies received in advance from Alan.

Costings of setting up the site

1)Swimming pool

The swimming pool we intend to build will be 10x20m and 2 m deep, the price of a swimming pool is approximately $50 (£33) per square foot(poolpricer.com), this mean our pool will cost us approximately £420,000.

2)Caravan bases

We will need 12 caravan bases, the largest size base caravan will need is 2.3mx7 meters, and a base needs to be 100mm thick (caravanning4u.co.uk) this mean we will need 1.61m^3 of concrete for each base. Because its a large volume of concrete will use ready mix concrete which costs £50 per m^3, each base will therefore cost £80.50

3)Chalet

For the chalet we intend to use a company called A1 home who build house from a kit, for a property which is 22.76m by 7.57 fully build will be £100,000. Thats for a 2 bath 3 bedroom property with a 2 car garage, Because we intend to have the reception area and offices attached to the house, we will use the garage for this purposes. The cost of building the wall per m² will be £80(selfbuild.co.uk), the wall is 5.5m (with a gap for a door) is long 2.3m high. The cost of bricking up the wall will be £1012, and with a door £2000, to furnish out the office and reception area we will allow an extra £5000

http://www.a1homes.co.nz/plans/8/EH153

4)Utilities block and games room

PArt	cost per m² (£)	Size (m²)	Cost (£)
Foundations	80	375	30000
Walls	80	253	20240
roof	100	375	37500

Total Cost	87740

Prices for foundation and walls from maquarius.com

The total cost to build the unfurnished property will be £87740, with furnishing and other equipment the total cost will be £107740

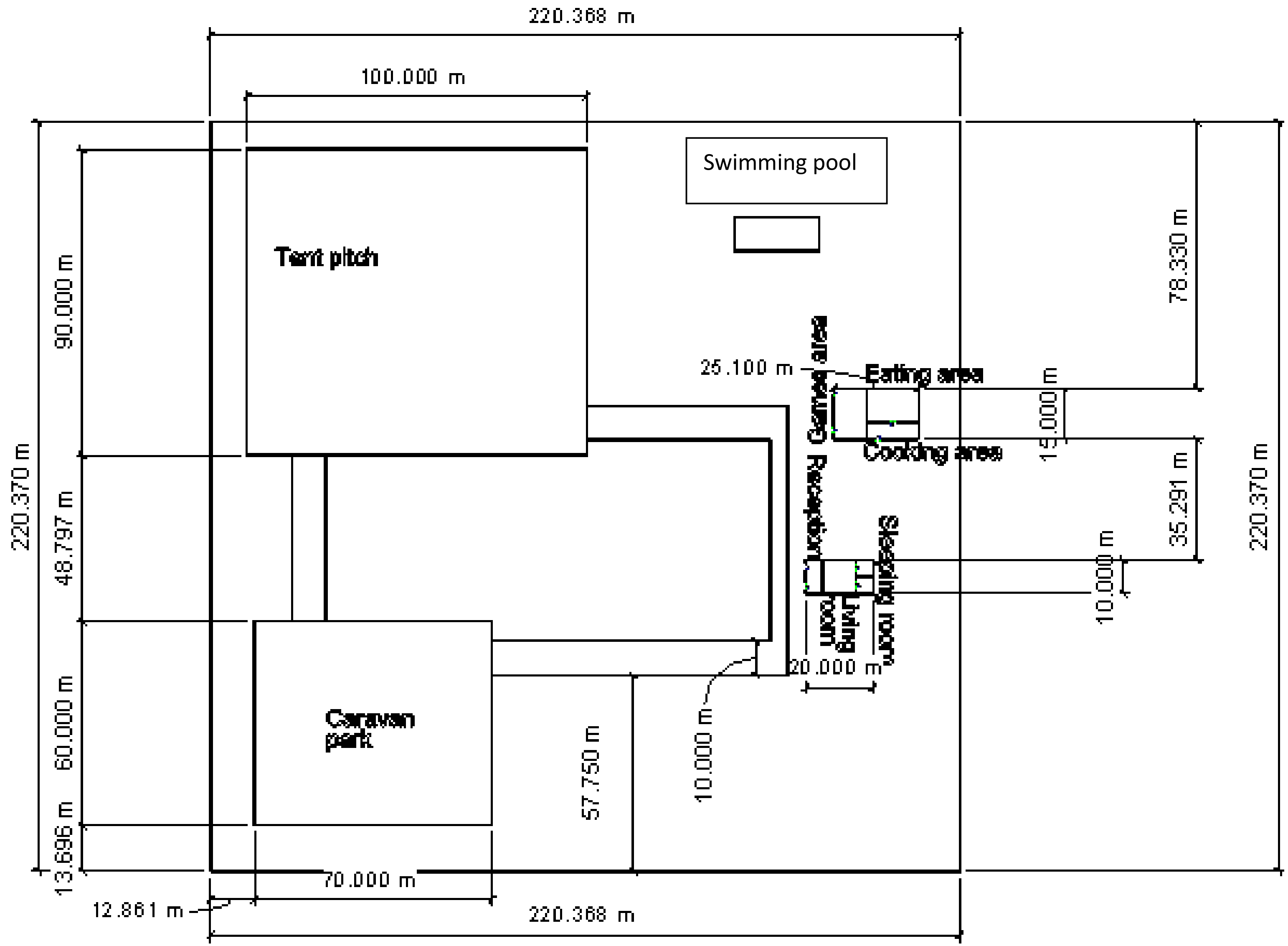
5)Pathways

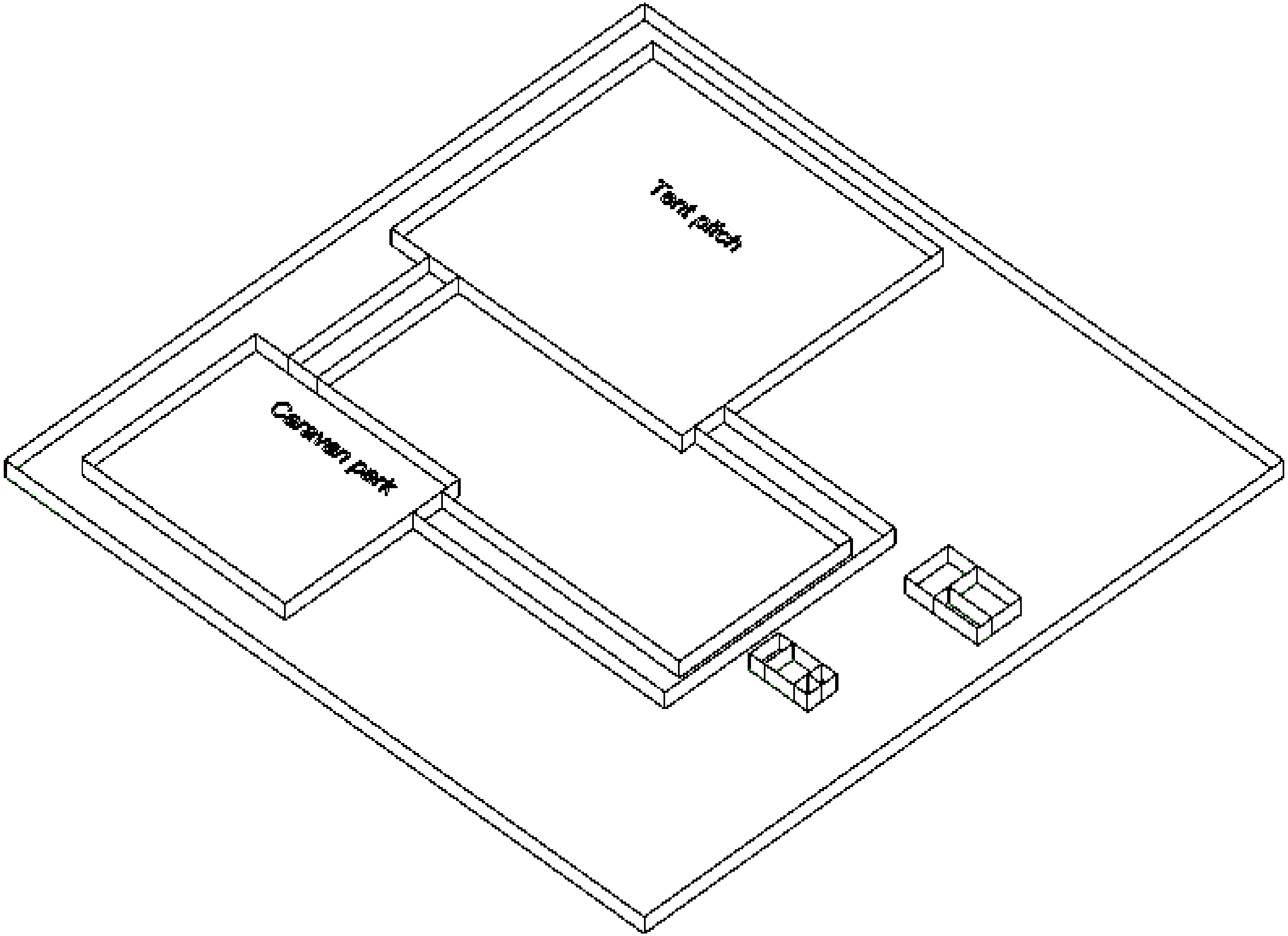
Around the site there will be a set of concrete pathways to allow people to get form one place to another easily, the paths will be made from the same type and depth concrete as the bases. There is a total area of 26890m² of pathways and the depth will be 100mm hence a total volume of 268.9M^3, at £50 per m^3 the total cost of all the pathways will be £13,445

6)Equipment and Appliances

The chalet and utilities block will us lots of equipment and appliances.

Item	Total cost
3 ovens	747
Microwave	55
washer, dryer	700
2 freezers	260
cctv	500
Outdoor lighting	500
Total cost	2762


220.368 m
100.000 m
Swimming pool
Tent pitch
90.000 m
220.370 m
78.330 m
25.100 m
Games area
Eating area
15.000 m
Cooking area
35.291 m
220.370 m
48.797 m
Reception
Sleeping room
Living room
10.000 m
20.000 m
Caravan park
60.000 m
57.750 m
10.000 m
13.696 m
70.000 m
12.861 m
220.368 m


Tent pitch
Caravan park

Management of time

WEEKS	ACTIVITY
1	Launch Lecture – first meeting as a group
2	Deciding scenario and talking about different ideas: facilities, power generation, location
3	Ínterin Presentación
4	Meeting with Mark Ward (M – Solar Panels) (U – Storage) (J – Pumps) (V – Wind Turbines) (A – Costs) (S – Compresses air solution)
5	(M – Intro) (U – Drawing of camp) (J – Safety Issues) (V – Methods) (A – Costs) (S – Future plans)
6	PowerPoint for final presentación
7	Final Report write up. Check everything is covered

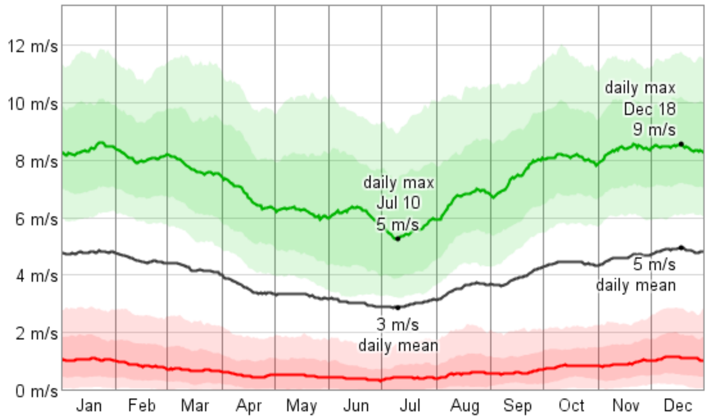


Figure 1: the average daily minimum (red), maximum (green), and average (black) wind speed. (https://weatherspark.com/averages/32739/Christchurch-Canterbury-New-Zealand)

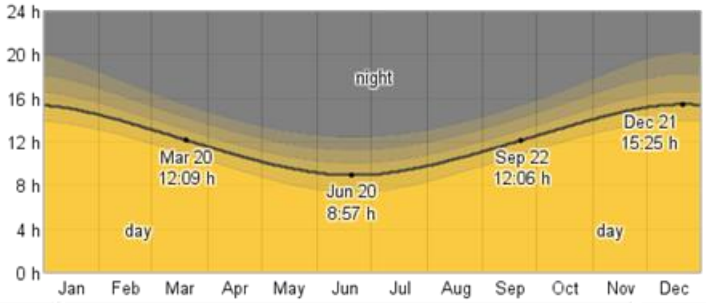


Figure 2: The number of hours during which the Sun is visible.(https://weatherspark.com/averages/32739/Christchurch-Canterbury-New-Zealand)

	Christchurch	London	Edinburgh	Birmingham
Sunshine	2,050	1,500	1,350	1,400

Table 1: Annual sunshine comparing cities in New Zealand and the UK. (http://www.enz.org/nz-climate.html)

Below is a list of the facilities which will be included in the camp and their power consumptions.

FACILITIES	POWER (WATTS)	NUMBER OF ITEMS	TOTAL POWER (WATTS)		
Swimming Pool	1332	-	1332	H	
Caravans	460	12	2760		N
Heating (Chalet)	18,600	-	18,600	H	
Heating (Games room and cafeteria)	34,100	-	34,100	H	
Plug Sockets (Chalet)	100	5	500		D, N
Indoor Lighting (LED)	11	15	165		N
Outdoor Lighting (LED)	11	50	550		N
Washers/Dryers	416.7	3	1,250		D
Freezer	21.7	2	43.4		D, N
Showers	233	10	2,330	H	D
Oven (2 in cafeteria and 1 in chalet)	1,580	3	4,740		D
Microwave	800	1	800		D
CCTV equipment (Cameras and monitor	10	20	210 including monitor		D, N
TOTAL			67,380.4		

Table 2 - (H indicates if Ground Source Heating is used and D and N indicate if this facility is used in the day, night or both)

	Summer		Winter	
	Day	Night	Day	Night
Heat (exact)	1332	3662	18,600	19,065
Electrical (exact)	7543.4	4228.4	2728.4	1446.7
Heat (approximation)	1500	5000	19,000	20,000
Electrical (approximation)	10,000	7000	10,000	7000

Table 3 – Power consumption

FACILITIES	**POWER (WATTS)**	**NUMBER OF ITEMS**	**TOTAL POWER (WATTS)**
Swimming pool	1332	-	1332
Caravans	460	12	2760
Heating (Chalet)	18600	-	18600
Heating (Games room and Cafeteria)	34100	-	34100
Plug sockets (Chalet)	100	5	500
Indoor lighting(LED)	11	15	165
Outdoor lighting(LED)	11	50	550
Washers/Dryers	416.7	3	1250
Freezer	21.7	2	43.4
Showers (Water heated to 50°C over a 6 hour night)	233	10	2330
Oven(2 in Cafeteria and 1 in Chalet)	1580	3	4740
Microwave	800	1	800
CCTV equipment (Cameras and monitor)	10	20	210 including monitor
TOTAL	-		**67380.4**

Table 4

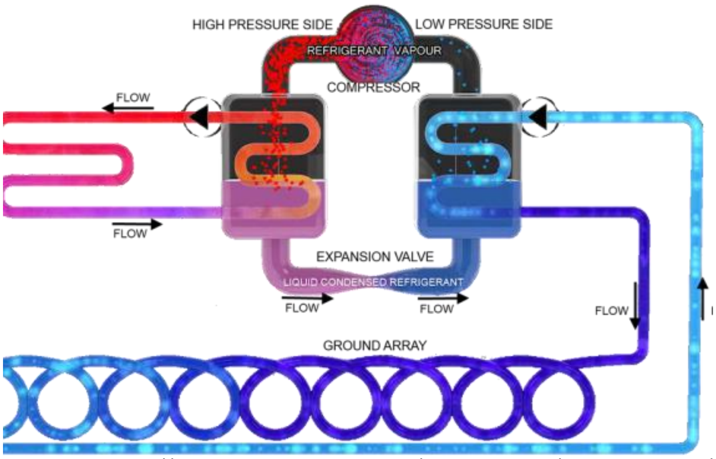


Figure 3 – GSHP system (http://www.kensaheatpumps.com/the-technology/how-gshp-works/)

Theory

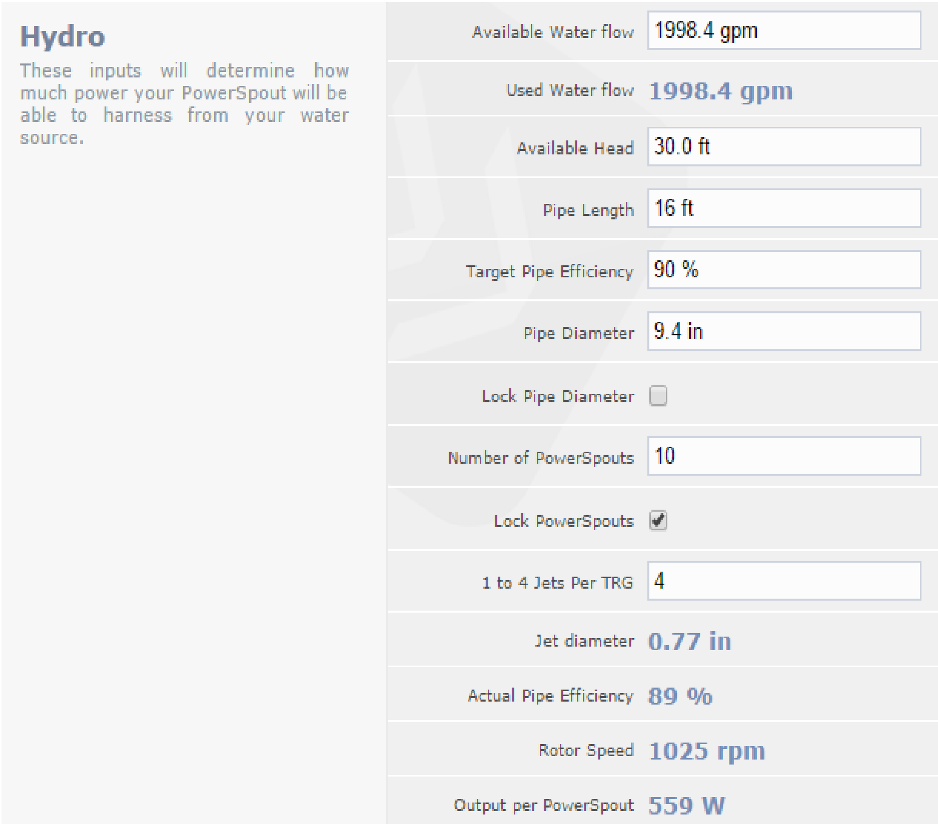
Ground source heat pumps pump a large amount of fluid underground where it is heated by the ambient underground temperature. This warmed fluid is then returned to the surface where it is passed through a heat exchanger to transfer the heat from the ground into a refrigerant vapour. This vapour is then compressed using an electrical compressor. This increases the pressure and by doing this, it also increases the temperature of the vapour. The vapour is then passed through another heat exchanger where the heat from the, now hot, vapour is transferred into a water stream. This produces hot water which can be used for taps, showers and can be pumped into radiators and underfloor heating systems.

The pumping of the water around the system as well as powering the compressor uses electrical energy but the system as a whole produces more heat energy output than electrical energy input. This system is also more efficient that using electrical heaters for the same purpose.

At 10m below the ground, the temperature is almost constant at the average air temperature (*Al-Khoury, 2012)* Ground source heat pumps take advantage of this to make an almost constant source of heat throughout the year. They can also work in reverse, pumping warm air from inside the house underground, working as an air conditioning system as well as helping to maintain the temperature below the earth surface.

Device	Heat Output Capacity (KW)	Electrical Power Consumption (KW)	Output temperature (°C)	Cost (Cost (£)
Kensa Single Compact	3.5-12	1.2-3.6	55	4035
Kensa Hybrid Twin	15-21	3.9-5.3	62	8660

Table 5- *(http://www.kensaheatpumps.com/)*



Hydro

These inputs will determine how much power your PowerSpout will be able to harness from your water source.

Available Water flow	1998.4 gpm
Used Water flow	1998.4 gpm
Available Head	30.0 ft
Pipe Length	16 ft
Target Pipe Efficiency	90 %
Pipe Diameter	9.4 in
Lock Pipe Diameter	☐
Number of PowerSpouts	10
Lock PowerSpouts	☑
1 to 4 Jets Per TRG	4
Jet diameter	0.77 in
Actual Pipe Efficiency	89 %
Rotor Speed	1025 rpm
Output per PowerSpout	559 W

Figure 4-Energy output from PowerSpout - *http://www.powerspout.com/advanced-calculator/*

Figure 5-(http://www.powerspout.com/)

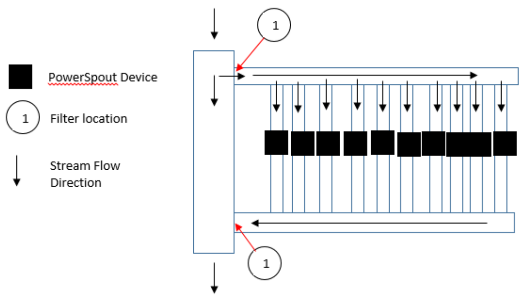


Figure 6

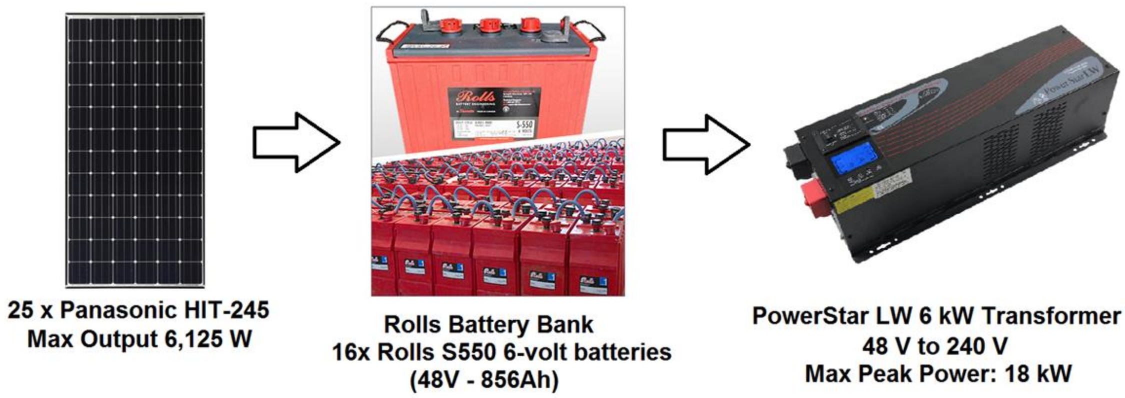


Figure 7 - *Solar Energy Storage and Transmission system*

Module	Quantity	Individual Price	Final price
Panasonic HIT-245	25	£365.00	£9,125.00
Rolls Battery Bank	1	£3772.84	£3772.84
PowerStar LW 6kW Transformer	1	£799.99	£799.99
		Final Price:	£13,697.83

Table 6

Revenue

To calculate the amount of money that can be made from the visitors were going to assume that:

1. On average each party stays for 2 nights
2. Cost is per pitch- £12 for tents and £18 for caravans
3. Customers coming at times other than at the weekend are negligible
4. Costs are constant throughout the season
5. The site is on average at 80% capacity each weekend
6. The site is open for 4 months and there are 4 weeks in a month hence 16 weeks
7. Each party has on average 3 people all of which will use the shower at £0.5
8. Only half of visitors use the washing machines at £1.50 per use

If the site is at 80% capacity that means there will be 160 tent pitches being used (0.8x 200) and 10 caravan pitches used (0.8x12). This means the money generated each night by tents and caravans is £2100 (160x12+10x18) that means we will generate £4200 each weekend and over the 4 months £67,200 (4200x16).
Money will also be generated from the coin operated showers and washer. If all visitors use the shower each morning £255 a day will made ((160+10) x3x0.5p) hence £8,160 a year will be made. If a half of visitors use the washing once each visit £127.50 (170x0.5x1.50) will be made each weekend and a total of £2,040 (127.50x16) per year.