UBC Social Ecological Economic Development Studies (SEEDS) Student Report

An Investigation into the Implementation of a Brewpub at the New Student Union Building

Samuel Chan

Nazanin Houshmand

Perry Yan

Tony Mao

University of British Columbia

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To: Dr. Carla Paterson and UBC Stakeholders
By: Samuel Chan, Nazanin Houshmand, Perry Yan, Tony Mao

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Abstract

The new AMS Student Union Building will include a brewpub operation that aims to be environmentally sustainable, economically feasible and socially acceptable in the context of the UBC campus. This paper performs a triple-bottom line assessment looking at possible options in achieving all three goals.

In regards to environmental sustainability, this paper presents three major negative environmental impacts in the brewing process: wastewater output, waste grain byproducts and energy consumption. The paper looks at possible solutions in the treatment of wastewater, processes and partnerships to recycle the brewpub's waste grain and possible resolutions to the problem of energy consumption.

Assessment of the brewpub's economic feasibility falls into two categories: assessment of the brewpub's operating cost and projection of the brewpub's likely operating revenue. In the assessment of the brewpub's operating cost the paper discusses the cost of: initial equipment investment, periodic ingredient purchases, heat and power costs and employee salaries. Assessment of the brewpub's operating revenue includes: pricing of beer and a brief break-even analysis.

This paper assesses the brewpub's possible social impact by discussing the health and safety in regards to alcohol consumption, the community benefits in having an on-campus brewpub and opportunities for on-campus learning.

Based on this paper's research the following recommendations arise:

1. A GEA Westfalia Separator should be used for the treatment of the brewpub's wastewater as it offers incredible reductions in energy use and greenhouse gas emissions.

2. Waste grain byproducts of the brewing process can be fed to animals and/or used as fertilizer in the UBC Farm. The byproducts can also be used in the biofuel production process, perhaps working in conjunction with the UBC Biofuel initiative.

3. The brewpub could use biofuel to fuel the stoves heating the mash in the brewing process. Biofuels, in addition to being sustainable, also produces CO_2 offset of up to 85%.

4. The brewpub operating cost (given the proposed scope and objectives) will be: $200,000 initial investment for the brewing equipment, $14,000 annually in ingredients, $2,500 annually in energy and $375,000 annually in employee salaries.

5. The brewpub operating revenue will be $466,200 annually. The brewpub will profit after the third year with a projected 10 year net profit of $540,600.

6. By using organic ingredients in conjunction with a controlled drinking environment the brewpub could promote health and safety in the student community.

7. The brewpub could promote seasonal beers and events to relieve students of stress and in general endorse student wellness.

8. The brewpub could open its doors to students in Applied Biology and/or Chemical Engineering providing students with experience and information in working in a professional brewing environment.

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Glossary

- *Bbl* – US beer barrel unit of measurement. Equals 36 imperial gallons, or 43 US gallons or 164 litres.
- *AMSS* – Alma Mater Student Society. The active student representive association at UBC.
- *SUB* – Student Union Building
- *Hops* – A family of herbs commonly used as an ingredient the brewing process. Imparts a bitter flavor.
- *Malt* – Germinated grains by soaking in water to initiate the germination and quickly drying out the grains to stop the germination. Another common ingredient used in the brewing process. Imparts a sweet flavor.
- *kWh* – Stands for kilo-watt-hours. A unit of power consumption
- *GJ* – Stands for giga-joules. A unit of energy
- *Draft beer* – Beer served straight from the keg (also known as Draught or Tap beer).
- *Ethanol* – the type of alcohol typically found in alcoholic beverages.
- *Decanters* – vessel used in the decantation (that is separation of mixtures) of sediments (usually unwanted) from a liquid.
- *Separator* – vessel used to filter out the unwanted sediments from the decanters.
- *Mashing* – part of the brewing process where the malt is, as the word implies, mashed up to an almost paste-like consistency.
- *Fermentors* – tanks used in the brewing process to hold the malt during the fermentation process where the alcohol in the beer is produced.
- *Wort* – Liquid extracted from the mash during the boiling and lautering process.
- *Lautering* – The process where the wort is separated from the grains.

Brewpub

1.0 Introduction

A brewpub is simply a pub where the beer it sells is brewed on site. Doing so ensures freshness of the beer, control of quality and freedom in creativity on what types of beer to brew. Brewpubs are often also restaurants and sometimes may even offer accommodations (kind of like a motel).

As the most of the brewing process is done entirely on site, brewpubs are often much larger than standard pubs to house all the extra equipment and facilities required for brewing. The brewing process at brewpubs usually starts at the mashing stage where malted grains are grinded down to a paste-like consistency. After lautering and boiling the mash, the young beer is conditioned and filtered until it is ready for serving.

As a brewpub makes its beer, many environmental concerns can arise. Waste water, waste grain and the energy consumption required to fuel the boilers and coolers are all environmental concerns that need to be dealt with. Furthermore, brewpubs typically cost more to start and run than a standard pub as a brew master needs to be hired to oversee the entire brewing process and brewing equipment need to be purchased. A brewpub also offers many benefits to its community, offering insight into the brewing process as well as opportunities for fun and exciting events that may not be as tangible in a standard pub.

In this paper we discuss all the problems brewpubs face in terms of environmental impact, social opportunities (and problems), and economic feasibility. We then offer the solution we best think suits the objectives and needs of the new Student Union Building (SUB).

2.0 Environmental Assessment

The three aspects of the environment assessment of the brewpub that will be discussed are wastewater, waste grain, and energy in the refrigeration and chilling process.

2.1 Wastewater

Wastewater is a major waste product of brewing. Approximately three to ten liters of waste matter is produced for a liter of beer in breweries [1]. Wastewater may contain dangerous chemicals that can affect the environment negatively as well as having a negative impact on people's health. There are several chemicals found in wastewater, mainly produced during the fermentation process. These chemicals include: dissolved CO2, ten percent (by volume) of ethanol, and a fraction of volatile acids. Consequently, the waste water must be carefully treated in brewpubs. The figure below shows how wastewater is treated normally in breweries:

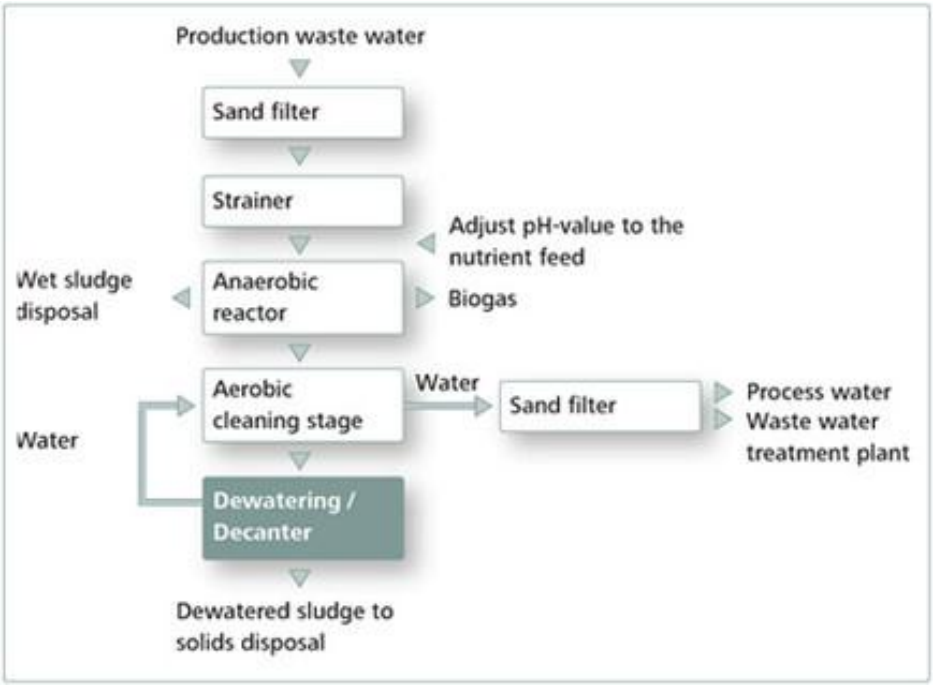

Figure 1: Wastewater Treatment in Breweries

Waste water is generated from remaining substances from production of beer as well as during the fermentation process and cleaning of storage tanks.

Typically, a technology system known as the GEA Westfalia Separator is mostly used for waste water treatment (GEA, 2012). It consists of decanters and separators operating continuously that

are efficient in clarification and separation, and is also energy efficient (GEA, 2012). Decanters are also efficient for removing the residues, solid wastes, and the cleaning agents of storage tanks. This affects the environment positively as well as reducing disposal costs.

Another alternative for wastewater treatment is to transport the waste water to the Iona Island Sewage Treatment facility via the Greater Vancouver Regional District (GVRD) sewer (Grant and Hill, 2002). The wastewater at the facility center is treated by removing 90 percent of biological oxygen demand (BOD) before the remaining water is released into the Fraser River (Metro Vancouver, 2011). This method would be easily integrated, as this is also how wastewater produced on other parts of the campus are treated by transporting to the facility center. However, as the GEA Westfalia Separator process has such huge benefits in emissions and energy efficiency, we recommend the GEA for treatment of the UBC brewpub's wastewater.

2.2 Waste Grain

During the process of brewing, there will always be around 92 percent of brewing ingredients wasted (America Brewer, 2007). One of our primary sources on waste grain was going to the SteamWorks Brewing Company, a brewpub located at Waterfront. At SteamWorks, we asked how they dealt with waste grains, and found out that waste grains can be used for plant fertilizers and animal feed.

In fact, waste grains have a lot of protein and fiber and actually work really well as healthy animal feed as well as being an effective fertilizer (America Brewer, 2007). Specifically, waste grains can be fed to pigs, goats, fish and cattle (America Brewer, 2007). This provides an interesting opportunity to partner with the UBC Farm. The **UBC** Farm could provide the brewpub with seasonal hops, grains, fruit and other ingredients in making all types of beer. The brewpub in turn supplies them with waste grains for use as fertilizer.

Furthermore, waste grains can be used in the production of ethanol, which is a main reagent in the production of various biofuels (America Brewery, 2007). In summary, all of those alternatives not only prove waste grains are environmentally-friendly but also resourceful by-products. We recommend that the brewpub in the new SUB form a partnership with the UBC

Farm to use the waste grain in a sustainable manner.

2.3 Energy Consumption

Energy consumption is another important issue to consider for breweries. There are a couple of different energy requirements in brewing especially during the initial production of the wort (Butler, 2012). To create the wort, the water first has to be heated 65 degrees Celsius before adding the malt for mashing. The water then has to be boiled for about 1.5 hours which will boil off about one-quarter of the water. The amount of energy required including heat losses to the environment depends on the beer production capacity (Butler, 2012). For a 10 bbl brewing load, about 14 gigajoules (GJ) of heat energy will be consumed.

As well as for heat, the pumping energy is needed to move the fluid around the brewery. This depends on how much fluid has to be moved and how fast as well as taking into consideration the size of pipes and lines, and the number of fittings, valves, and filters for the fluid to be pumped through (Butler, 2012).

Also, more energy is needed for cooling the fermenters since yeast produces heat during fermentation. Consequently, the heat has to be removed to keep the beer cool; otherwise, a hot fermentation will cause the beer to spoil. Usually, beer yeasts ferment around 20 degrees Celsius.

There are a few recommendations for UBC brewpub to manage energy consumption. As the UBC central steam network is being converted to hot water, the other choice would be natural gas. Moreover, biodiesel would be a good alternative to natural gas or oil for heating the mash. In fact, National Energy Technology Laboratory (NETL) recently did a study of the CO_2 offset of using biodiesel (Butler, 2012). We recommend the brewpub to use biodiesel from waste vegetable oil for the majority of the brewpub's energy needs as the CO_2 emissions is 85 percent less in comparison to regular diesel.

3.0 Economic Assessment

The economic assessment of the triple bottom line of the UBC New Sub brewpub project is an operating income analysis of the brewpub. The key goal for this brewpub is to exclusively serve its own beer in the pub, as it costs less for the student body, while also costing less for the UBC AMSS in the long run. The brewpub operating income can be decomposed into expenses and revenue. The expenses and revenue calculations of the UBC New Sub brewpub operation is modeled around 1000 bbl (US barrels) per year. We suggest 1000 bbl/year of brewing volume as it is equivalent to 20 bbl/week.

3.1 Brewpub Operating Expenses

The operating expenses can be broken down to the following: equipment investment, raw ingredient purchases, combined heat and power costs, and employee salaries. Refer to Table 1 for tabulated expenses and revenue.

3.1.1 Equipment Investment

The largest investment required for a brewpub startup is the purchase of brewing equipment. The following equipment is needed for brewing: malt miller, mash tun, brew kettle/whirlpool, frame heat exchanger, process control system, hot liquor tank, storage tanks, refrigeration system, and accessories such as tubing, valves, and consumable filters (Green, 2011).

It is suggested that a brewing capacity of 10 bbl will be used, as it is realistic to brew two large batches of beer in a week in order to meet the 1000 bbl/year margin. The average Canadian student (aged 19-30) consumes 2.1 pints of beer per sitting (Garriguet, 2008) – meaning that 20 bbl per week can serve at least 343 people per day, or 2400 people per week.

We feel that this amount of beer production is sufficient to meet the demand of the current UBC Pit Pub. Upwards of CAD$200,000 will be invested in brewing equipment (Green, 2011). A typical brewing system will have a manufacturer rated life time of 10 years (FLECKS Brauhaus Technik GmbH, n.d.) before maintenance is required, however maintenance will be done year-round.

3.1.2 Raw Ingredient Purchases

The main raw ingredients of beer are malting barley, hops, yeast, and water. Two key objectives of the brewpub will be to source raw ingredients from local farms in order to reduce use of vehicular transportation, and to encourage students to learn about the UBC farm and other local farms.

Two local (in the Lower Mainland region) ingredient sources include the UBC Farm and the Delta Farmland & Wildlife Trust. In addition, the Yakima Valley in Washington is a potential ingredient source.

The average wholesale cost of malting barley and hops are $320/tonne (Agriculture and Agri-Food Canada, 2011) and $9921/tonne respectively (Kneed, n.d.). An average of 24 tonnes of malting barley and an average of 0.65 tonnes of hops are used to produce 1000 bbl of beer per year (Sound Brewing Systems, Inc., n.d.). A sample of yeast can be re-used over 100 times (Van Zandycke, 2010).

The cost of brewing yeast is negligible; we suggest that yeast should be home-grown instead of being purchased. The ratio of volume of water usage to beer volume is about 3.3 to 1 (Sound Brewing Systems, Inc., n.d.)

3.1.3 Heat and Power Costs

A major goal of the brewpub is to operate with high energy efficiency for the brewing processes. As UBC is one of the leaders of sustainability in the world, having a brewpub as an energy-efficiency test bed will be beneficial to UBC's green status.

For example, recently researched methods of waste heat recycling from waste effluent condensate may be utilized in the brewpub to increase heat usage efficiency (Muster-Slawitsch et al., 2011), and as a result, lower the combined heat and power (CHP) costs of brewpub operation.

The main heating costs are attributed to the mashing and boiling processes ("Brewing", 2012). An average brewpub producing 1000 bbl/year consumes about 10,000 to 15,000 kWh of

electrical power per year, and about 140 GJ of natural gas heat per year (Sound Brewing Systems, Inc., n.d.). Assuming an electrical power cost rate of $0.09 per kWh (BC Hydro, n.d.) and a natural gas cost rate of $4.00 per GJ (FortisBC, n.d.), a conservative estimate for total costs will be $1910 annually.

3.1.4 Employee Salaries

The head employee of a brewpub is the brew master. A typical brew master in Canada will make $75,000 to $100,000 annually, and brewing assistants make $40,000 to $50,000 annually (SimplyHired, n.d.). In addition to the brewing staff, there should be a pub staff (cooks, waiters, security) count of 15-20. For an estimate salary of the pub staff, we used an average annual salary of $15,000 per person.

3.2 Brewpub Operating Revenue

The operating revenue is solely dependent on draft beer sold in the pub. Our goal is to exclusively sell the beer brewed in-house in the brewpub.

3.2.1 Beer Pricing

According to a survey done with students in the UBC sub (sample size of 49), the average amount that a student would pay for a pint of beer would be $3.70. We recommend that the sales price deviate around this price (before sales tax). Assuming that the brewpub sells 50% of its maximum beer volume (500 bbl /year out of a possible 1000 bbl/year) at this price, the revenue will be $466,200.

3.2.2 Break Even Analysis

According to AMS Finance VP, Elin Tayyar, the break-even goal, including infrastructure expenses, is 20 years (as cited in Mann, 2011). For our analytical model, we did not take the infrastructure expense into account as it is an unspecified amount out of the UBC New Sub $100 million budget.

Referring to Table 1, given an annual net profit of $74,060, it takes about two years after the first year to make a profit.

	Initial Cost	Annual Cost	Annual Revenue
Brewing Equipment	$200,000	$0	$0
Liquor License [12]	$550	$1,100	$0
Raw ingredients			
*Malt Barley	$0	$7,680	$0
*Hops	$0	$6,450	$0
Energy			
*Electricity	$0	$1,350	$0
*Heat	$0	$560	$0
Employee Salary			
*Brew Master	$0	$100,000	$0
*Brew Assistant	$0	$50,000	$0
*Pub Staff	$0	$225,000	$0
Cooks, Waiters, Security (Count = 15)			
Revenue @ Pub	$0	$0	$466,200
*Assuming selling 500 barrels/year			
Annual Net Profit	$74,060		
First Year Net Profit	-$126,490		
10 Year Net Profit	$540,600		

Table 1: Tabulated Expenses and Revenue of Brew Pub Operations

4.0 Social Assessment

UBC campus has had a few social drinking places for its students for many years. Two of which, The Pit and The Gallery, are located at the current SUB. The Pit is famous for its Pit Night Wednesdays, and The Gallery for Toonie Tuesdays ($2 beers on Tuesday nights). Even though, both places have been a tradition for many years. After surveying students (count 49), most agreed that having a brewpub is a great idea, as long it is named "The Pit" and the average price is no higher than $4 per sleeve of beer. In addition, the survey indicates the misinformed nature of UBC's student body in regards to the current pubs, which can easily be solved using different marketing strategies. An example of a good marketing strategy is using social networking websites to promote events at brewpub (Houshmand & Chan, 2012).

4.1 Health and Safety

Since the function of the new brewpub is to serve the local, the students of UBC are the ones mostly affected by it. Every day, students undergo a great amount of stress resulting from tests, assignments and projects; what better way to release stress than having a drink?

Study shows, beer is in fact a great stress reliever and having a beer per day could decrease the possibility of having coronary heart disease by 30% and of having a stroke by 20%. However it should be drank in moderation or it could have reciprocal effect (Friedman & Klatsky, 1993).

One option to ensure that students do not abuse their alcohol consumption is to have a limit to the amount that one can intake during the day. For example, the University and/or the brewpub could have a standard limit on the hourly consumption of alcohol for each patron that will subsequently be enforced by the staff.

Since the students of today are the future of tomorrow, the well-being of the beer provided by the brewpub must be assured; the brewpub is the first step towards a healthier drink. The advantage of home-brewing beer over the manufactured kind is ingredient control. The AMS would have the full power over the ingredients and flavors for each beer. For example, replacing chemically artificial products with organic kind, imported from UBC's own farm results in a more nutritious drink. The UBC farm has offered to provide the pub with 10lbs per each of their seven different

varieties of hops. In addition, the farm can have strawberries and blueberries available for seasonal beers (Bell, 2012).

4.2 On campus social center

Every year, different coffee shops such as Starbucks have seasonal drinks. Can there be a seasonal brewed beer? A close visit of a famous brewpub, SteamWorks at Waterfront, answers the question. Every season SteamWorks regulars get excited about the brewpub's season appropriate flavored beers; having a similar concept of seasonal beer implemented in to the brewpub is an easy way to have the students cheering for the upcoming season and it is also a clever marketing strategy. In addition, having special drinks such as coffee flavoured beer during exam period provides the caffeine needed for the late night studies.

4.3 Opportunities for on-campus learning

The brewpub also provides a great facility for students of Applied Biology and/or Chemical Engineering for brewing research. A brewpub would have all the facilities and machines of a larger conventional brewery and offers a learning opportunity matched only by actual commercial breweries and/or microbreweries. Students may even be offered opportunities to try out their own technologies and brewing recipes using the brewpub facilities. For example, a graduate student in Applied Biology researching brewery wastewater treatment would have access to data regarding wastewater output of a typical brewpub. He/she could also run tests of his/her thesis on this output (i.e. a microbiology filtering system that recycles the water). The learning possibilities with the brewpub are endless (Honeybourn, 1994).

5.0 Conclusion and Recommendations

A brewpub in the new Student Union Building would make UBC the first Canadian University to have an on-campus brewpub. A brewpub would bring about a lot of benefits as well as lots of potential problems that a normal pub wouldn't bring to light. The recommendations in this paper aim to take advantage of the benefits while minimizing the problems all in the context of a brewpub by UBC for UBC.

In our environmental assessment, we recommend UBC use the GEA Westfalia Separator to treat the wastewater output from the brewpub due to its reduction in greenhouse gas emissions as well as its excellent energy efficiency. We recommend the brewpub work in partnership with the UBC Farm to establish a cycle where waste grains shipped to the Farm for use as fertilizer while the Farm provides the brewpub with seasonal herbs, grains and fruit for use in seasonal beers. Lastly, we propose the use of biofuels, possibly created from some of the waste grains itself, to power many of the heating and cooling facilities in the brewpub as it minimizes the pub's CO_2 footprint in comparison to using conventional fossil fuels.

Our economic assessment had us analyzing the total annual cost for operating an on campus brewpub and the projected year-to-year revenue and profit of the establishment. Our numbers has us recommending we keep the brewpub to 1000 bbl/year output, equivalent to serving over 300 students per week. We propose to hire a brew master and at least one assistant at salaries of $100,000 and $50,000 respectively. Furthermore, we recommend the brewpub not spend more than $200,000 on the brewery equipment. The size of the brewpub can be than shrunk/expanded based on the recommended serving capacity and would likely be between 5000 to 10000 ft^2.

Lastly, our social assessment concludes with recommendations towards promoting student health and safety, providing a relaxing atmosphere and providing learning opportunities for campus students. We recommend the promotion of health and safety in the new brewpub by affixing a firm drink limit as well as using organic ingredients in the brewing of the beer. We also recommend the organization of seasonal events and/or menu items to encourage student life wellness. Lastly, we recommend the AMS to form partnerships with the department of Applied

Biology and Chemical Engineering to provide students in those faculties with first-hand experience in testing and learning about the commercial beer brewing process.

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Appendix

1.0 Survey Results

How much would you spend on beer?	How often do you go to pit/gallery?	How do you feel about the possibility of them closing for a new brewpub?	Other comments...
4	b	b	
4.5	c	a (food?)	
3	d	a (food?)	
3.5	d	b	
4	c	b	
3.5	b	a (food?)	keep pit night
3.5	c	b	two different locations would alleviate crowds
4	never	b	
4	d	b	
3	d	a (food?)	
5	c	b	
3	d	d	
3	b	d	wants pit to stay + new brewpub
6	c	b	
4	c	c	i don't particularly care
3.5	c	b	
4	c	c	
4	c	b	
3	b	a (food?)	
2.5	c	c	
3.5	c	b	cool
4	d	b	
4	b(gallery more)	d	
3	b	d	
0	c	c	
5.25	b	d	Allow meal plan to pay for beer! Loves pit night
3.75	b	a (food?)	
3	c	c	Excited
4.5	c	b	
4	c	a (food?)	
3	d	c	
5.5	d	a (food?)	

4	c	a (food?)	Wants 2; both gallery and pit
3	c	c	
4	c	c	
Average price of beer			
3.70			
Column 2:			
a=more than once a week; b=once a week; c=once per month; d=where?		Percentage	
a	0	0	
b	7	0.205882353	
c	18	0.529411765	
d	8	0.235294118	
Column 3:			
a =i love it; b=i don't care; c=not a big fan; d=i hate it		Percentage	
a (food?)	9	0.264705882	
b	13	0.382352941	
c	8	0.235294118	
d	5	0.147058824	
Sample Size = 34			