



## **Team Rain Beer Report**

Alexandra Barnes | Bryan Sattler | Christine Kim | Mike Wang

Sustainability Studio | DMBA CCA Spring 2017

Instructor: Michael Sammet

# TABLE OF CONTENTS

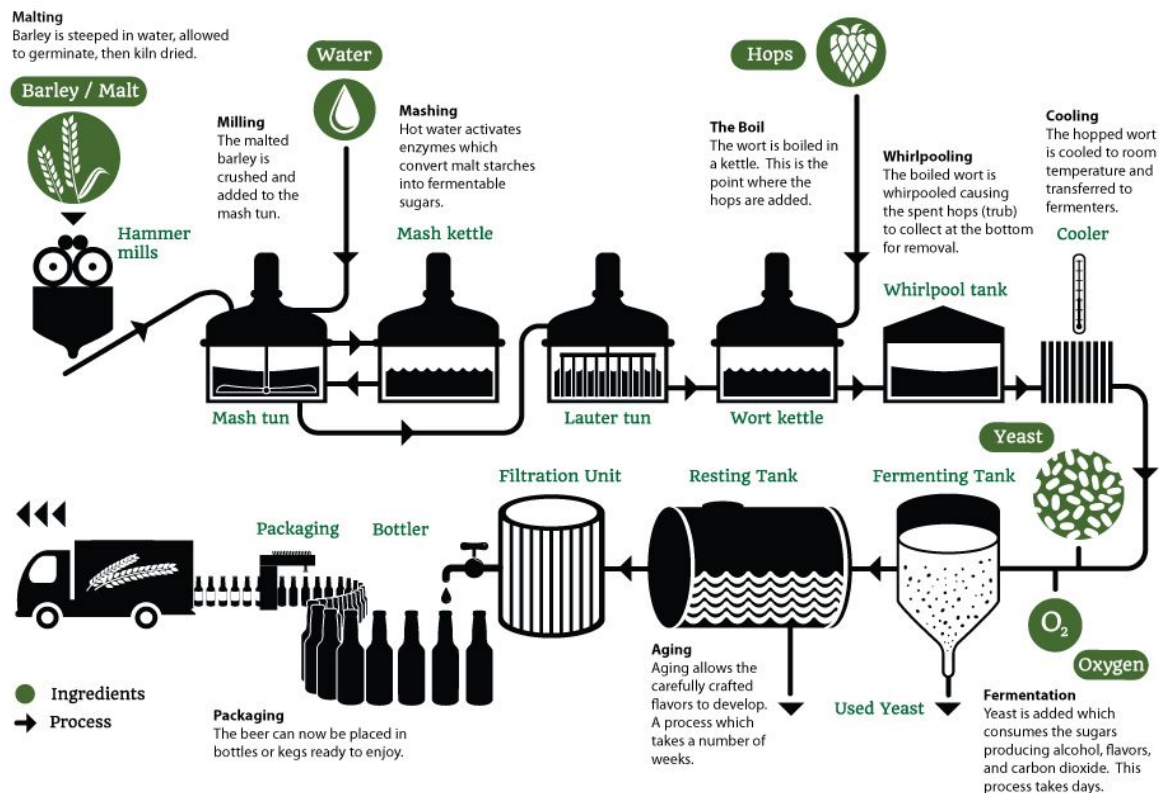
1. INTRODUCTION & MISSION
2. MARKET OVERVIEW & BUSINESS MODEL OVERVIEW
3. BUSINESS EVALUATION
  - a. Business Model Canvas
  - b. SWOT Analysis
  - c. Value Proposition Canvas
4. SOCIAL IMPACT VALUE PROPOSITION
5. IMPLEMENTATION PROCESS & SUPPORTING DATA
6. THEORY OF CHANGE
  - a. Green Roofs
  - b. Storage
  - c. Collection
  - d. Filtration & Disinfection
  - e. Hydroponics
  - f. Sustainable Return on Investment
7. IMPACT VALUE CHAIN
  - a. Value Proposition
  - b. Social Impact Chain
8. MONETIZATION OF SOCIAL VALUE
  - a. Quantification of Social Impact: Smart Metrics
9. THEORY OF CHANGE
10. COST PROJECTIONS & TABLE
11. CONCLUSION

## INTRODUCTION & MISSION

Urban Metabolism is a complex model, which facilitates the description and overview of the material, energy flows and impacts in an entire city. Given this intricate topic to address with a good or service wholistically, our team decided to direct our focus on an essential material in an urban metabolism; water. Our research then lead us to the topic of water collection and its consumption, and came across information regarding the concept to reduce the amount of fresh water needed to manufacture and consume alcoholic beverages.

We were particularly intrigued by this concept as this provides a social indulgence such as drinking alcohol which requires a large amount of water to produce to be a potentially guilt-free and sustainable. Not to mention people are often inclined to consume more than a recommended serving, and may binge drink on occasion. Beer is one of the most commonly consumed alcoholic beverages with some of the highest water needs to produce, so we set our focus on creating a sustainable beer alternative that requires less use of freshwater and much less reliance on external resources for agriculture, etc. than current standard beer-production practices.

Approximately 206.7 million barrels, or 6,407.7 million gallons of beer is consumed annually in the United States alone. To make this quantity of beer, approximately 60,000 olympic sized swimming pools worth of water are required, which if placed side by side, would roughly cover a surface area from the Bay Area to Kansas City (width) and from the Bay Area to Seattle (length).



Our mission is designing a sustainable beer production process, in doing so we aim to use 100% rainwater for the cultivation of barley and hops and the water inside the beer without losing the quality taste of beer.

Our plan to sustain a profitable business requires a location that is a low-cost urban city with high rainfall and moisture so that we may leverage the use of rooftops to collect, purify and integrate into our production process. The collected and re-purposed rain water would be allocated for both the hydroponics process of growing the barley and hops needed and use the balance of that water for the brewing process.

## **MARKET OVERVIEW & SUPPORTING DATA**

In traditional brewing production, 89% of the water is used for growing the hops, barley and other ingredients needed for the beer. With hydroponics, we require 90% less water than the industry standard, and it would come from the collected rainwater from rooftops. In addition to the benefit of using less water, crops grown via hydroponics have higher growing potential and almost 3 times the amount of oils, resins, flavonoids and acids from traditionally grown crops.

To power our indoor hydroponics farm and facility, we will be leveraging a subterranean heating and cooling system, used to create a heat battery via a network of insulated pipes which reduce heating and cooling costs by approximately 70%. This would be supplemented by solar panels; further reducing energy costs.

In a multi-leveled facility such as the one our team has designed for this specific application, we are able to fit approximately 10 times the amount of crops in our hydroponic urban farm than a traditional soil farm. With around 1,000 combined hops and barley plants, our average monthly yield would be enough to produce 1 million 12 ounce bottles of beer. With that in mind, to keep costs low, we plan to partner with various facilities and sublease their rooftops to reach the 140,000 sq/ft space needed to collect the 3.5M gal of water needed to produce the 1M bottles of beer. This will cost us approximately half a million dollars a year, but if we sell our beer at \$15/6pack, we come out with approximately \$2M in annual net profits.

## **BUSINESS EVALUATION**

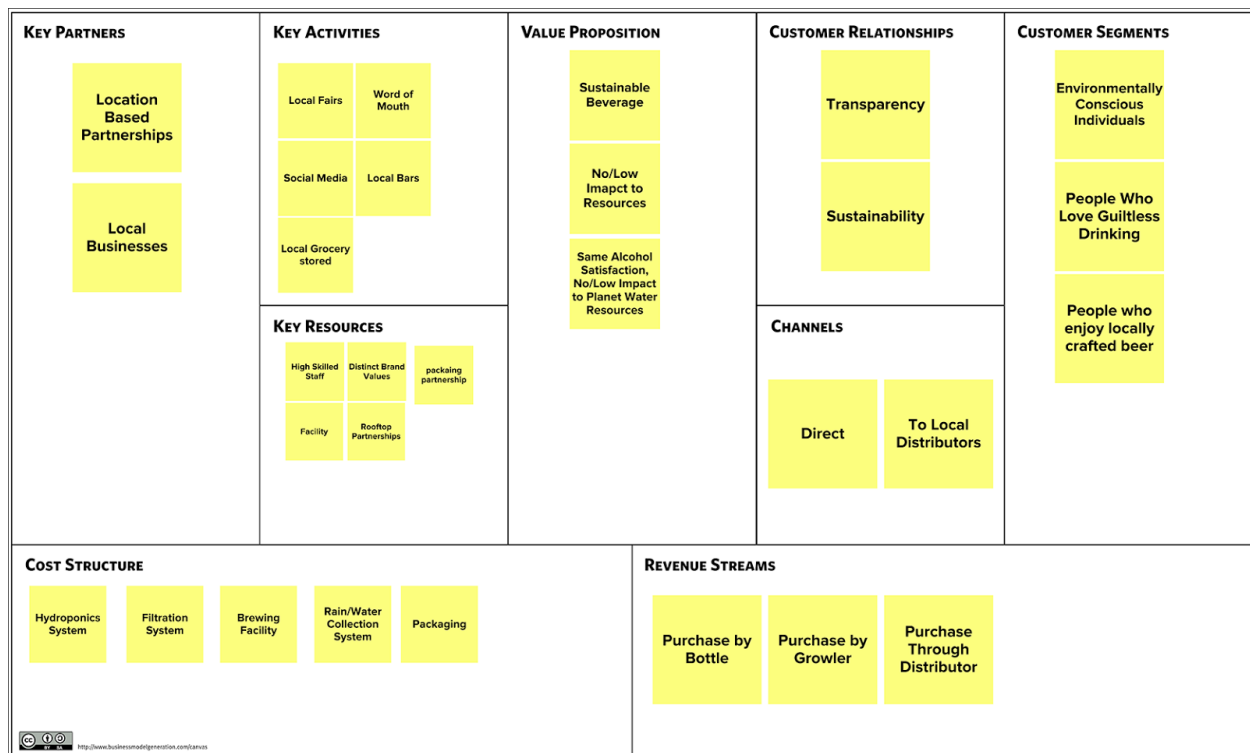
In our business model canvas, we broke our business into various key sections that revolve around our value proposition. Our sustainable brewing processes method provides value to those within the targeted segments of environmentally conscious beer drinkers. We think our customers would appreciate the transparency of our business; keeping everything local and

tightly nit within the community. Through these local partnerships, we can distribute and spread awareness via social media about our product, educate the community regarding water conservation by showcasing our sustainable process, and allow customers to come visit our brewery to purchase our product on site and learn about the process first hand.

Our SWOT analysis depicts a different story, this analyzes our current strengths and opportunities for growth and improvement in our business. Our strengths stem from the fundamentals of our business proposition and the underlying product brewing process. Our weaknesses and threats primarily lie in the financial segments as the technology to produce beer via this specific process is still immature and unconfirmed; the cost of equipment and land will be an ongoing concern for the business as they are not fixed costs.

Each section of our analysis speaks similarly in terms of our pros and cons. We offer a unique product that is for the benefit of society and the environment; a theme we aim to highlight as much as possible. The pain points and weaknesses we identified indicate our financial capabilities to execute this potentially high cost process in a sustainable way.

## Business Model Canvas



## SWOT Analysis

### Rain Beer SWOT Analysis

#### STRENGTHS

Sustainable Resources and Less Consumption of Resources

Positive Impact to Planet and Consumption

Higher Yield per Square Feet

High Quality Product

#### OPPORTUNITIES

Indoor Farming Methods Allows for Other Crops and Businesses

Food Market

Expansion Towards Other Beverage Markets

#### WEAKNESSES

High Cost of Equipment

Space Requirement for Sustainable Business

Operations and Logistics Costs for Space Required

Low Output Quantities

Dependencies on Natural Occurrences (Rainfall)

Limited Availability of Product

Dependency on Location Based on Available Resources

#### THREATS

Other Sustainable Beverage Companies

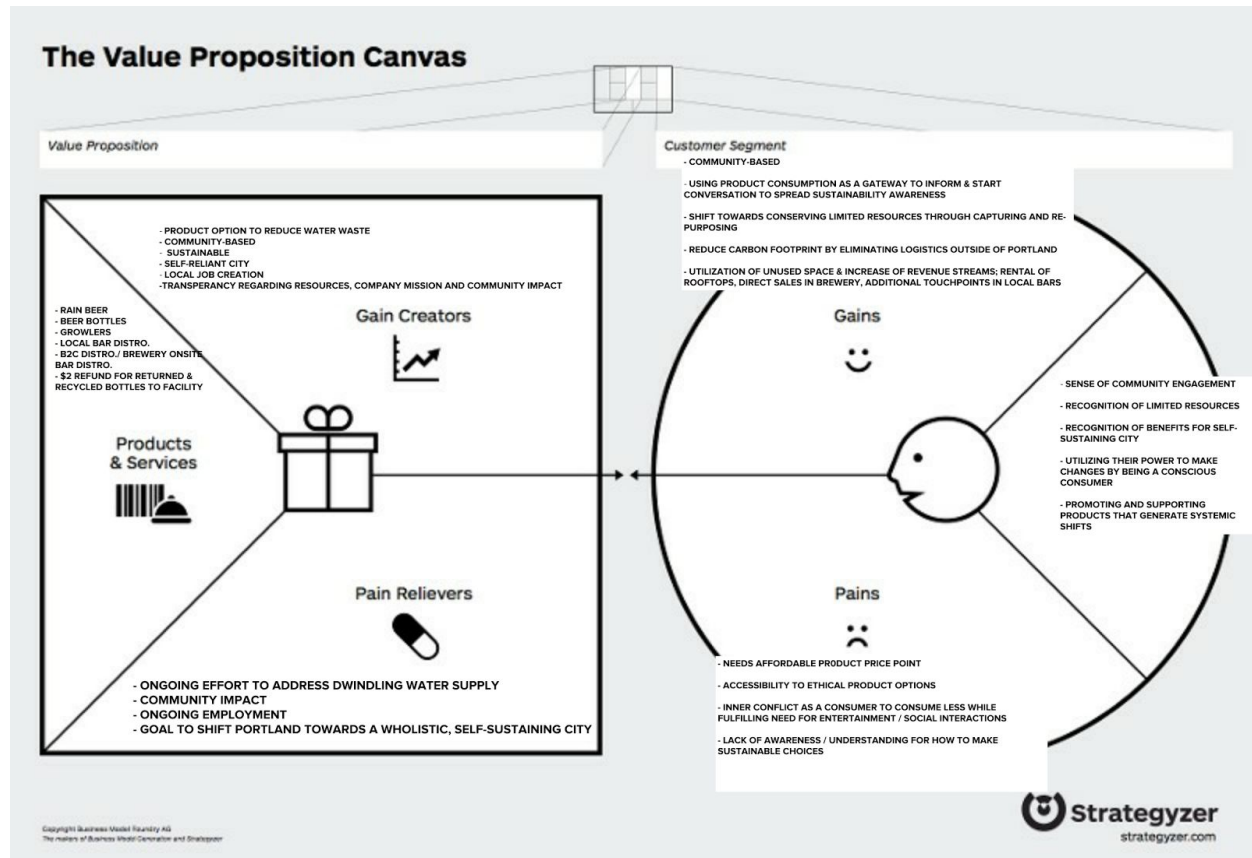
Increase in Equipment Lease Costs

health code regulations

Increase in Lease Costs

limited resources

## Value Proposition Canvas



## SOCIAL IMPACT VALUE PROPOSITION

### Implementation & Supporting Data

Rain Beer's production system is contingent upon the harvesting and storage of rainwater, as it is the key ingredient of our product which differentiates us from other beer products. Our annual sales target is 1,000,000 12 ounce bottles, which requires 1,302 barley plants, 3,125 hops plants and 3,491,860 ounces of water to be harvested. Given the sizes of the few largest industrial buildings in Portland, Oregon we found that it was not fiscally responsible nor profitable for us to attempt to own or rent the 141,432 square feet needed to capture such a high volume of water. Therefore, we have chosen to partner with real estate developers and property owners to rent out roof space at a rate of \$3.00 per square foot for rainwater harvesting and storage.

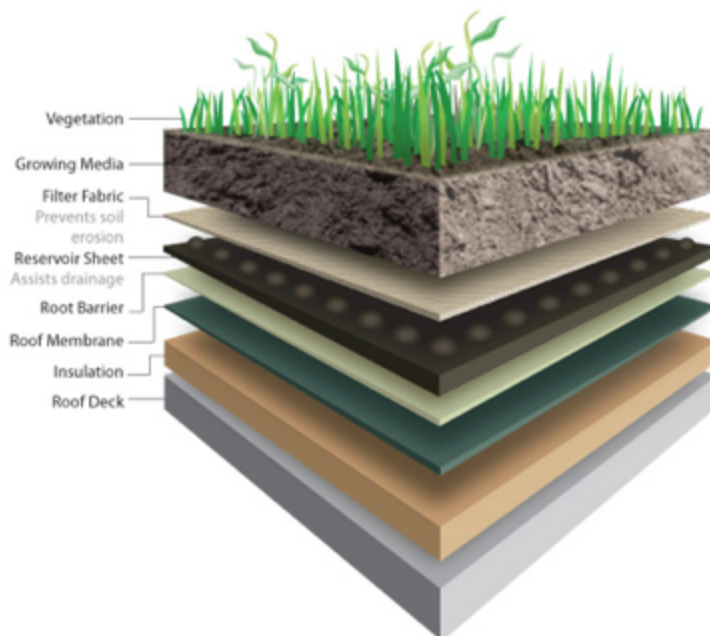
Between 2008 and 2012 the city of Portland's Environmental Services granted almost \$2 million in incentives to assist in funding over 130 projects, an equivalent of 360,000 square feet of green roofs that manage 4.4 million gallons of stormwater annually. The core of our mission as a

business focused on practicing systemic shifts to support the urban metabolism model, and thus ensure all water and ingredients used by our business are harvested within the urban city limits that we operate in. We believe that this proves Portland a perfect home for our business concept and will allow us to utilize roofs within a 15 mile radius of our brewing facility and eliminate water dependency from hinterlands. Our plan is to work closely with the city of Portland and the Green Roof info Think-tank (GRiT) as we invest in growing our business as well as raising awareness of the benefits of green roofs and revitalizing the incentive program to encourage similar businesses to do the same.

## Green Roofs

A major benefit for the city of having a substantial number of green roofs is that they reduce the strain on the local sewer systems from stormwater runoff. Our company takes this one step further and closes the loop entirely by storing the collected water and incorporating it into our product. Green roofs utilize natural process such as infiltration, plant transpiration, and evaporation for the collection of water. Since we are renting space of third party buildings, we have a duty to ensure that an infrastructure is in place so that the water is properly captured and the building itself is protected from water damage. To do so, we will only use green roofs that have an eight-layer system which includes: vegetation, growing media, filter fabric, a reservoir sheet, a root barrier, a roof membrane, insulation, and a roof deck (see figure 1.0 below).

**Figure 1.0** Eight Layer System Diagram



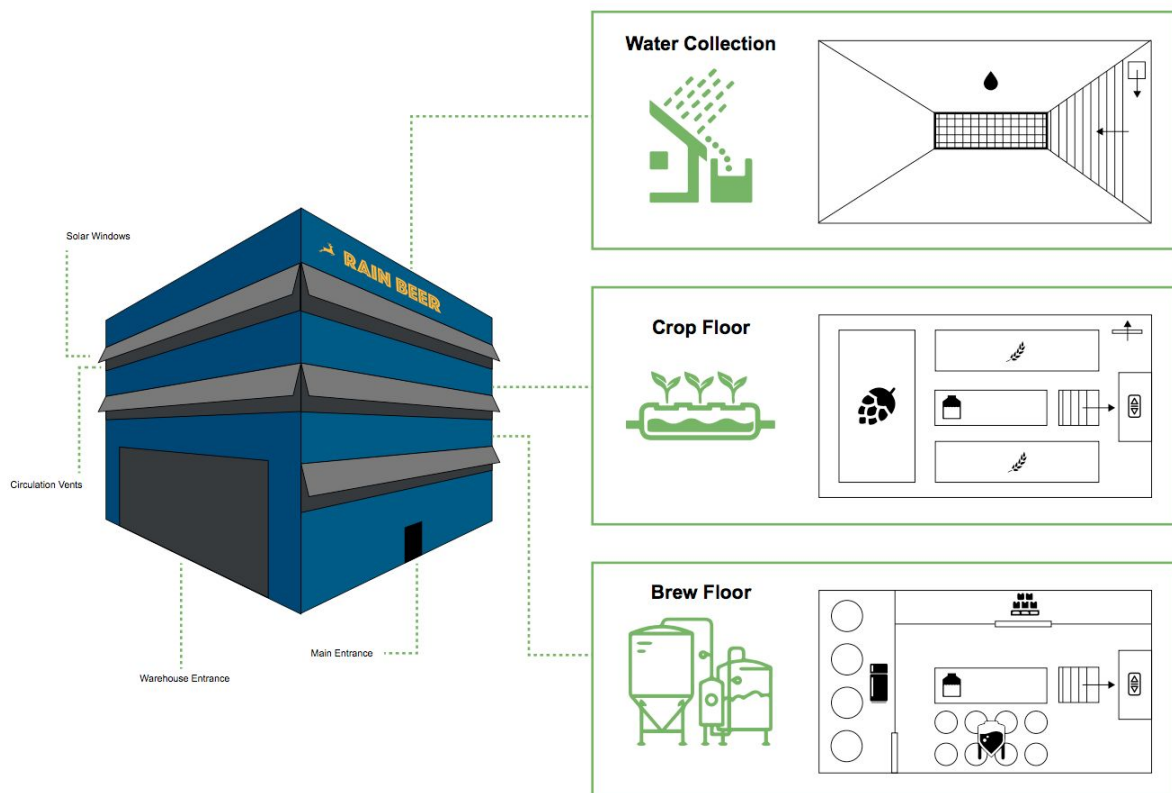


One major concern of using green roofs for rainwater harvesting potable water is the potential pollutants and contaminants that may come from microbes, debris, and roofing materials. To avoid issues with water purity, we will be following the recommendations outlined by the Texas Commission on Environment's report, *Harvesting, Storing, and Treating Rainwater for Domestic Use*. While these standards are not intended for commercial use they can be leveraged for our purposes. The following criterion will be used as a part of our evaluation process for selecting roofs and the systems we will utilize for the corresponding catchment areas:

- Smooth, nonporous materials to minimize water absorption and reduce the collection of microbes and debris.
- Avoid roofing materials using composite, asphalt, or asbestos, fungicides, algaecides, or any biocide compounds.

(Please refer to figure 2.0 as a visual reference for the details of our facility and unique process)

**Figure 2.0** Rain Beer Facility & Unique Process Diagram



## **Storage**

Once the rainwater has been harvested and accumulates in the green roof system, gravity pulls it down into the storage tank through distribution piping and first-flush diverters. As a secondary precaution, we will use a fixed rate diverter as opposed to a fixed volume diverter to safeguard against potential contaminants which must be completely flushed from the roof before the diverter is filled and flows into the storage tank. Water will be stored in 2,500 gallon vertical water storage tanks specifically designed for rainwater collection. The tank we have chose has a specific gravity rating of 1, complies with FDA standards [21 CFR 177.1520 \(1\) 3.1 and 3.2](#), and comprised of UV stabilized and BPA-free polyethylene resin making it safe for potable water storage.

## **Collection**

We plan to manufacture, on average, 83,000 bottles of Rain Beer each month, which will require 2,273 gallons of water per month for harvesting and brewing. With a decentralized rainwater harvesting model such as ours, we must employ contractors that will collect water from our storage tanks captured from partner roofs. We estimate that water will need to be collected two to three times per month based upon an average annual rainfall of 44 inches. To transport the water we will lease two tank trucks specially designed for transporting potable water with a capacity of 4,000 gallons. The state of Oregon has provided drinking water hauling guidelines that we will incorporate into our standard operating procedures to ensure the delivery of safe drinking water which include but are not limited to scrubbing, flushing, and disinfecting the tanks. In addition, record keeping of transportation and maintenance are required to avoid legal liability exposures that document the following:

1. Water source used
2. Pick-up and drop-off location
3. Date, time, and chlorine residual after filling the tank
4. Notes regarding the receiving tank and additional significant information.

## **Filtration and Disinfection**

After the water has been delivered to our brewing facilities, it must run through a series of filtration processes. According to a 2011 report by the Texas Water Development Board, Effect of Roof Material on Water Quality for Rainwater Harvesting Systems, green roofs can produce high dissolved organic carbon concentrations (DOCs) which can be harmful to humans upon consumption. Traditional approaches to make water potable include the use of chlorine but can result in an unwanted byproduct that could cause health issues such as cancer. In addition to filtering out DOCs our system will filter out commonly found pollutants like dirt, aluminum, animal feces, etc. Water for both brewing and hydroponic crop irrigation will be run through filtration and disinfection processes based upon best practices required by the National Sanitation Foundation (NSF).

Rain Beer will make an investment double filtration and disinfection system that includes an Ultraviolet (UV) Light and Reverse Osmosis. First, water is run through our UV light purification system which is capable of destroying up to 99.9% of harmful microorganisms including E. coli, Cryptosporidium, and Giardia with no disinfection by-products. Then, it is run through a Reverse

Osmosis nano-filtration membrane filter which removes particles as small as .001 microns preventing contaminants such as radium, pesticides, dissolved organic carbon concentrations, cysts, bacteria, and viruses. We believe this will guarantee that our water is as pure as possible and is odorless to place the emphasis on the richness of the flavors that come from the hops and barley.

## **Hydroponics**

Using rainwater for the brewing process is a big step forward towards building a sustainable brewery. We aim to take that ambitious goal even further by also a hydroponics system to irrigate and grow our crops in-house at the brewing facility. 89 percent of water that goes into the production of beer is consumed by barley and hops which makes this a great candidate for water conservation through the use of hydroponics. Our hydroponics system includes two types of units, one for barley and the other for hops. The barley crops will use a 6-level unit that has 24 channels with a capacity of 468 square feet allowing us to grow more than 8 times our goal of 1,302 plants per year. Hops will be grown using 17 units that support 32 plants per system yielding 3,125 plants per year. On average, this equals out to approximately ten times the crop yield and uses 90% less water from traditional soil-based farming methods. The entire building will have natural lighting to support sufficient sunlight for the crops with LEDs to supplement natural lighting during the fall and winter months.

By utilizing hydroponics gives us advantages that other crop growers do not have such as control over nutrient sources, temperature, and humidity to ensure crops year round without yield failure. We have also discovered that water can be used for a secondary, equally important, purpose. By installing a Subterranean Heating and Cooling System (SHCS), a network of tubes on an insulated level four feet below the greenhouse, we can create a heat battery. Hot and humid air will be circulated through the pipes onto the cooler soil to create dew. The water vapor converts into liquid in the air, re-releasing heat into the soil. Heat energy is stored in the soil during the summer and during the winter the opposite happens. A single 6-inch fan can be used to power the entire greenhouse area while reducing heating and cooling costs by approximately 70%.

## **Sustainable Return on Investment**

Water is an essential part of life and a functioning, self-sustaining urban city. It was the focus of our research and solution to find a more efficient way to leverage unused and/or wasted, viable resources which are often allocated from external supporting areas to sustain the needs of a city. While 70% of the planet is made up of water, only 2.5% of that is freshwater we can consume and use to sustain life. That resource is dwindling, getting less and less, and while our focus is not on a solution for the overall problem for the planet, we hope to address an important aspect of human consumption by demonstrating a small, systematic shift starting with once city in hopes this concept will be applied in a growing number of future cities, and will lead to a dramatic reduction of the drainage and waste of this vital resource.

Our focus has been narrowed down to alcohol consumption, in particular, beer. By finding a sustainable and environmentally friendly way to produce this much binged and/or wasted

beverage solely produced for entertainment value, let alone survival, we can help alleviate some of the freshwater demands for this country and hopefully, this planet.

Our goal wasn't to solve the overarching issue of water waste, but to show small, creative ways we can design for a smarter, more efficient future that values ingenuity regarding re-purposing resources that have otherwise been discarded in the past in lieu of vital resources that are not essential to yield desired results. Our proof of concept is to choose an arbitrary industry where this way of thinking can easily be implemented, and then cause a major spread of awareness through a fun, social libation experience and still yield a considerable profit and business.

## **Value Proposition**

Rain Beer, a locally sourced, produced and distributed beer within the low-cost, high rainfall city limits of Portland, Oregon, offers the same alcohol satisfaction as other established beer-products in the market through alternative brewing solutions that have little or no impact on the city's limited resources including water.

Traditional beer brewing practices involve large amounts of clean water use to both grow the hops in an non-urban, agricultural site away from the brewery and for the actual brewing process. This then requires additional energy-use through transit of the hops from the agricultural site outside of a city to the brewery.

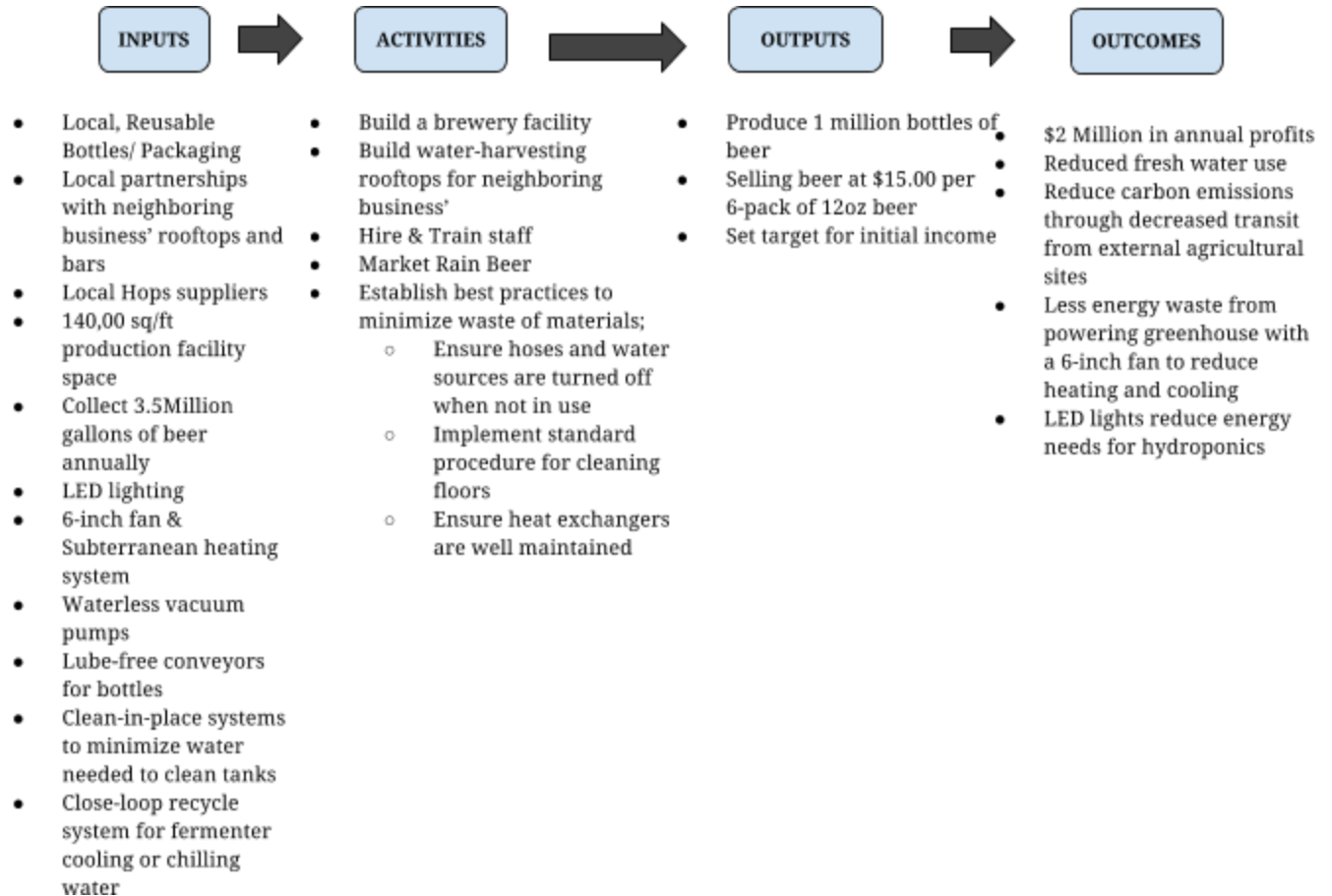
The goal of Rain Beer is to provide one small, systematic shift towards having urban producers efficiently utilize their local resources with little or no impact via local rainwater collection and urban farming, thus they can help cities move towards being self-reliant rather than dependent on external resources in order to function.

Rain Beer does so by developing an on-site rainwater harvesting roof for their facility and partners with neighboring facilities in the industrial, North portland region to rent their unused rooftops and further collect water so that they can filter and use this towards both their on-site hydroponic hops system to grow and harvest beer hops, and also the beer production process to provide a delicious beer with a similar alcohol content and integrity of taste as other beer distributors. This beer will be available at local Portland businesses who wish to carry our product such as beer stores and bars initially, and after the first few years when we have hit our revenue targets, Rain Beer will open an on-site bar for direct to consumer sales as an additional revenue stream. This will require a larger headcount, more energy use for lighting and heating, bathrooms and service permits that we will recalculate once Rain Beer has the ability to create this space.

The bottles and growlers will also be made from local, recycled materials and offer the customers an opportunity to bring back empty containers for a \$2-4 rebate and/or credit towards their next Rain Beer purchase.

The goal of this product will be to not only make one small movement towards a sustainable, circular economy practice, but will also initiate a dialogue and friendly discussion to further educate and familiarize our community with the values and benefits of this mission via proof of concept.

## Social Impact Chain



## MONETIZATION & SOCIAL VALUE

### Quantification of Social Impact: Smart Metrics

Outcome	Metric
Company Profit / earnings	dollars
Energy consumption	kWh per month
Gas use	Gallons per month
Waste	Pounds per month
Freshwater usage	Gallons per bottle produced
Volume of wastewater used per product	Gallons per bottle

We are reinventing the very concept of local production and water utilization. Our product offers a local and sustainable method from concept to deployment using only the resources an urban environment has to offer in an otherwise wasteful industry. Our very simple, small scale contribution to a circular economy promotes and initiates an ongoing dialogue as to how we can better utilize the resources we currently have and going forward, we hope to be able to set up similar systems in other cities to further normalize this way of both being mindful of our dwindling resources in a cost-efficient way.

# THEORY OF CHANGE

## Short and Long Term Needs

Needs	If	Short Term Then	Long Term Then
<ul style="list-style-type: none"><li>• In the US 6,407 million gallons of water is used to make a gallon of beer.</li><li>• 89% of the water used in the production of beer is used for barley and hops.</li></ul>	<ul style="list-style-type: none"><li>• If Rain Beer uses hydroponics to harvest the barley and hops and use filtered rain water, we would only use 3.5 million gallons of recycled water.</li></ul>	<ul style="list-style-type: none"><li>• Increase in local employment.</li><li>• Partnership with restaurants and markets.</li><li>• Decrease the use of water to harvest barley and hops.</li></ul>	<ul style="list-style-type: none"><li>• Social awareness of sustainable manufacturing and harvesting process.</li><li>• Further development of sustainable energy and material usage.</li></ul>

## Mission

Our mission is to design a sustainable beer production, in doing so we aim to use 100% rainwater for the cultivation of barley and hops and the water inside the beer without losing the quality taste of beer.

## Who, What, When, Where and Why

### Why

There is a lot of water that is used in crafting beers, 89% of the water used goes towards agriculture.

### Who

We are targeting beer enthusiasts.

### What

We plan to be the Tesla of beers, promoting the taste and craft of the beer that is also sustainable.

### How

To reduce the water usage in beer production, Rain Beer will deliver a sustainable beverage that has the same taste and effects of drinking alcohol with a low impact to the planet's water resources. To achieve this we have a hydroponics system to grow barley and hops and use rainwater for the hydroponics and the for the beer itself.

## **COST PROJECTIONS & TABLE**

We have thoroughly researched all of the costs to launch our new venture and have created profit and loss projections for the first three years of business. In the first year we will need to make a substantial investment of \$2,925,312 to start our business include the systems for rainwater harvesting, hydroponic farming, brewing, as well as legal and inventory expenses. Therefore, we will need to further develop our financial plan to seek investment from an institutional investor.

These projections depend on assumptions about our business and the economy. We assume a strong economy, without major recession, and increasing demand over 3 years of seven percent (year-over-year). We also assume that there will be no unforeseen changes to the environment or precipitation. Based upon our research of economic trends related to alcohol consumption, specifically beer, and the rainfall over the last 30 years in Oregon we are confident that our plan will succeed.

Our break-even analysis will be based upon operating costs, that is costs we will incur to cover our business expenses, including wages, brewing facility rent, additional green roof rent, utilities, insurance, and other expenses. We anticipate revenue to start generating in our third month after our first harvest and preceded by a three month marketing and advertising campaign. Our estimated monthly fixed costs are \$102,820 with revenue of \$208,333.

As aforementioned, the first year of business will require a substantial investment. Due to the large capital outlay there will be a loss of \$1,880,290. However, in year two with a 7% increase in sales we expect to see a profit of \$1,147,492 after interest and taxes. Overall, we are projecting a very conservative budget and will seek to find other revenue sources as we grow. Since we will be the first brewery of our kind we are basing most of our numbers off of the costs associated with traditional brewers, barring the rainwater harvesting and hydroponics systems, so we anticipate that our costs will be much lower than stated below and our profit margin much higher. Our pro forma profit and loss and be seen in the following table.



Pro Forma Profit and Loss	Year 1	Year 2	Year 3
<b>Revenue</b>			
Sales	\$2,500,000	\$2,675,000	\$2,862,250
Total Revenue	\$2,500,000	\$2,675,000	\$2,862,250
<b>Cost of Goods Sold</b>			
Less Cost of Goods Sold	\$84,460	\$90,372	\$96,698
Total Cost of Goods Sold	\$84,460	\$90,372	\$96,698
Gross Margin	\$2,415,540	\$2,584,628	\$2,765,552
<b>Operating Expenses</b>			
Payroll	\$264,000	\$264,000	\$324,000
Sales and Marketing and other Expenses	\$200,000	\$200,000	\$200,000
Vehicles & Transportation	\$2,000	\$2,000	\$2,000
Equipment	\$2,866,994	\$0	\$6,000
Leased Equipment	\$178,000	\$178,000	\$178,000
Utilities	\$12,000	\$12,000	\$12,000
Insurance	\$14,400	\$14,400	\$14,688
Rent	\$484,296	\$484,296	\$484,296
Payroll Taxes (2.6%)	\$68,640	\$68,640	\$84,240
Legal & Professional Fees	\$10,000	\$5,000	\$5,000
Licenses	\$500	\$500	\$500
Other	\$5,000	\$5,000	\$5,000
Total Operating Expenses	\$4,105,830	\$1,233,836	\$1,315,724
<b>Profit Before Interest and Taxes</b>			
EBITDA	-\$1,690,290	\$1,350,792	\$1,449,828
Interest Expense	-	-	-
Taxes Incurred (7.6%)	\$190,000	\$203,300	\$217,531
<b>Net Income</b>	<b>-\$1,880,290</b>	<b>\$1,147,492</b>	<b>\$1,232,297</b>

## CONCLUSION

There is much to be done in the realm of sustainability for urban environments, which house the majority of the world's population. Our attempt to create one small, sustainable and profitable example is to stimulate awareness and discussion towards implementing small shifts in every industry towards a common goal; focusing to preserve and sustain our most precious resources; in this case it is fresh water. By zeroing in on our proof of concept for Rain Beer's urban farming via hydroponics within our facility, and a rainwater collection process, we hope to not only produce a product that will prove sustainable and ethical methods can produce an equally competent product and viable business model in comparison to competitors, but also to eliminate skepticism around the notion of sustainable business solutions and business profitability being mutually exclusive.

Our current plan is to pilot this concept in targeted, high rainfall, urban cities. Once our process proves sustainable and profitable, we can expand our company's core values down the line to address the agriculture and food industry. Imagine eating and drinking at a farm-to-table restaurant or bar that not only grows its own produce, but does so with sustainable, locally sourced water. Achieving a goal of everything consumed having zero negative impact to the community.