An Investigation into the AMS Sustainable Food Truck

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Abstract

The AMS Sustainable Food Truck aims to satisfy the three requirements of the Triple Bottom Line analysis: sustainability towards financial, societal, and environmental goals. The rapid economic and population growth results in a rapid consumption of our natural resources. Sustainability ensures that we have and we will continue to have clean water and air, materials, and resources to protect human health and our environment. The Alma Mater Society (AMS) is planning to have a sustainable food truck which is part of the SEEDS many sustainability initiatives. The sustainable food truck will be powered by a hydrogen fuel cell as the primary source of energy, solar panels, and electric battery, as the secondary and tertiary sources of energy, respectively. The AMS sustainable food truck will be established by purchasing and modifying a hydrogen fuel cell bus from Whistler, B.C.. The food truck will be operating 10 days in a month with two cooks and a manager on shift. The food truck will only be using local and sustainable ingredients as well as using compostable packaging in order to meet the triple bottom line framework. This project is feasible with about 17% profit. Hydrogen fuel cell produces no air pollutants or greenhouse gasses, however, the availability of hydrogen is challenging and the number of fueling stations in Vancouver are also very limited.

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1.0 Introduction

The popularity of food trucks in North America has shown a fast-growing trend over the past decade. Food trucks are not only associated with quick, easy, and inexpensive food for the busy customer to grab on-the-go, but they also usually serve novel, authentic dishes. In other words, many food trucks have succeeded in providing customers with meal options that are "affordable, convenient, and hip". The booming popularity of food trucks is definitely affecting the brick-and-mortar restaurant world (Jennings, 2012). Starting a food truck business is obviously a lot more budget-friendly that starting a small local restaurant. In fact many famous food trucks have become million-dollar businesses over the past decade with a small initial start-up budget. When it comes to the fast-growing market of food trucks, social media advertising has definitely played a significant role.

With the soaring popularity of food trucks, many food truck owners have started to "go Green". Many have started to lean towards sustainable purchasing, to serve vegetarian and vegan options as well as meat options, and to use local, fresh, and sustainable ingredients, and finally to serve in sustainable packaging. Furthermore, many food trucks have started to use alternative sources of energy for fueling their trucks, as well as for powering their kitchen cooking ware. The "Liba" food truck in San Francisco, for instance, uses its used cooking oil to produce biodiesel and runs on it. The "Green Truck on the Go" food truck in Los Angeles is now using a solar-powered kitchen while others like the "On the Fly" food truck in Washington, D.C, is using a zero-emission electric truck (Mother Nature Network, 2015).

2.0 Objectives

The Sustainable Food Truck project was initially conceived a year and a half ago at UBC. Two previous SEEDS projects on the sustainable food truck have focused on the development of an energy management system for the truck. These two projects focus on the development of an energy management system for the sustainable food truck using Matlab and Simulink as modeling tools. The AMS Sustainable Food Truck project aims to conduct a triple bottom line (TBL) analysis of the design and operation of the AMS Sustainable Food Truck, hence investigating the social, environmental, and financial sustainability of the food truck project.

Our project which aligns with the AMS Lighter Footprint Strategy will not only reduce GHG emissions, and the environmental footprint associated with food trucks, but will also contribute to a healthier eating culture both on campus and off campus . Hydrogen fuel cell is the primary source of energy for this food truck, with solar and batteries as the secondary and tertiary sources of energy for this food truck. All three sources will be available for use in our design of the food truck, however the focus of the project is on the hydrogen fuel cell, while the operation of the solar panels and the battery system is also briefly covered.

3.0 The Food Truck

It should be noted that all equipment required in the sustainable food truck including microwave, fridge, deep fryer, griddle, and ventilation will be powered through the same energy system. Please refer to Appendix A for a full list of equipment. For the purpose of this project, one of the hydrogen fuel cell buses from the Whistler hydrogen fuel cell bus fleet will be purchased and modified to be used as the food truck. Section 3.1 below contains a full analysis of the Whistler HFC bus fleet and the results of its 5 year operation.

3.1 Whistler HFC Bus Fleet Analysis

As mentioned above, one of the HFC buses will be purchased from Whistler transit to be used as the sustainable food truck. According to AMS Chef, Ryan Bissell, one of these buses can be purchased at a price of $90,000. A sustainability grant of $200,000 will be available to account for this purchase from Whistler transit as well as for all modifications necessary and the purchase and installments of the solar panels and the battery system. The Whistler hydrogen fuel cell bus fleet, which was the world's largest fleet with 20 hydrogen fuel cell buses on a $90 Million budget, came to an end in March 2014. This project which was started in 2010 just before the Vancouver Winter Olympics, to showcase B.C.'s lead in the renewable energy industry, has been used as a model for our project.

The hydrogen fuel cell buses were built and maintained by Ballard Power Systems while the hydrogen was produced by Air Liquide and shipped by truck from Montreal to the 1,000 kg hydrogen fueling station in Whistler. While transporting the hydrogen by a truck defeats the sustainability aims of the project to some extent, there hasn't been many other choices available

up to date. According to the President and CEO of the Canadian Hydrogen Fuel Cell Association (CHFCA), Eric Denhoff, the Whistler hydrogen bus fleet has helped reduce GHG emissions by 65%, even when accounting for the truck shipment from Montreal (Zeidler, 2013). Currently four small, pilot-scale hydrogen fueling stations operate in B.C.. The four fueling stations are each located in Whistler, NRC near the UBC Vancouver Campus, and two stations in Surrey. If the "Hydrogen Highway" project had continued, seven hydrogen fueling stations would have been built in North Vancouver, downtown Vancouver, Victoria, Surrey, and Coquitlam (CHFCA, 2014). As the "Hydrogen Highway" project discontinued, the hopes for a much cheaper and convenient infrastructure for hydrogen fuel cells in British Columbia has faded to some extent.

Additionally, maintenance costs of the Whistler hydrogen fuel cell buses have been significantly higher than those expected of internal combustion engines. One of the issues with the fuel cells is its inefficiency and breakdown during Winter. While, this was an issue in Whistler, it is not expected to be much of an issue in Vancouver due to the relatively warm weather all year round. Having said that, the hydrogen fuel cell is capable of being twice as efficient as an internal combustion engine.

Each one of the Whistler fuel cell buses are equipped with 8 hydrogen tanks totalling 60 kg of hydrogen, with which the bus can travel a distance of about 500 km. Based on these numbers, we have approximated our food truck to run 400 km or operate for 5 hours on 48 kg of hydrogen fuel.

3.2 Roaming Dragon Food Truck Analysis

The Roaming Dragon Food Truck is a very successful food truck operating in Vancouver, B.C. with revenue of more than $1M per year. The Roaming Dragon which was launched in June 2010, has received attention across Canada as an innovator in the street food market. The Roaming Dragon offers authentic southeast asian cuisine and claims to offer "Restaurant Food" at a very affordable price. Roaming Dragon also provides caterings to both small parties, as well as to major events. The Roaming Dragon Food Truck has appeared on Food Channel, NY Times, numerous Canadian magazines, and has received numerous awards such as the 2011 Best Food Cart award. We have studied the Roaming Dragon Food Truck business model for our sustainable food truck (Roaming Dragon, 2015).

One of the major success factors of the Roaming Dragon Food Truck is its authentic cuisine as well as its changing mainstream location. Furthermore, advertising and the use of social media have definitely been key factors in its success.

3.3 Hours, Location, and Other Operations Specifications

We are looking to have the AMS sustainable food truck at events such as the Block Party, AMS Welcome Back BBQ, Imagine Day, and numerous other events on campus as well as at off-campus festivals such as the Pemberton Music Festival. Furthermore, the food truck will be operating in mainstream high-volume locations such as Robson street where we will be expecting 120 customers per hour during the peak hours of the day. According to AMS project clients, for 7-10 days, the truck will be operating off campus in such a populated location with

120 customers per hour. Expecting each customer to spend a minimum of $8 and operating for five hours a day, the expected revenue here is $403,200 to $576,000 per year.

On campus, 30 to 50 customers are expected per hour. The food truck would operate five hours a day, with the number of days dependent on factors such as the weather. The expected revenue during these days is expected to be $1,200 to $2,000 a day.

4.0 Sustainable Purchasing

In addition to the two previous projects on the Sustainable Food Truck, another previous report on the Hungry Nomad Food Truck (HNFT) was also studied. The HNFT report contains public survey results evaluating the awareness and the importance of Ocean Wise certification, local food, organic food, and animal welfare to the general consumer. The results demonstrated that animal welfare is most important to the consumer while local production and Ocean Wise certification came second and third.

According to the HNFT report, the pork, beef, and fish used in the HNFT were all sourced from BC, Alberta, and Alaska respectively, and the fish was Ocean Wise certified. When it comes to sustainable purchasing, there were a few ingredients which raised concern. While AMS will be providing the ingredients for the sustainable food truck, it should be mentioned that all these ingredients will be sustainable. Use of Ocean Wise certified food, as well as local and organic food will be carefully managed for this project.

The sustainable food truck is also planning to use compostable packaging to avoid serving food in plastics. Compostable packaging are usually made out of natural products such as palm fiber,

bagasse (sugarcane), and sometimes wheat stocks (Bridge Gate Alliance Group, 2015). The list of compostable utensils and their cost for a year is provided in the Appendix A, table 2.

4.1 The Green Table Network Designation

The Green Table Network Designation, which is managed by a Vancouver-based organization, is a designation that is given to food service businesses which go above and beyond to reduce their environmental footprint, while serving high quality and delicious food. The Green Table Network designation is only given after stringent assessment of the business and it includes criteria such as stringent recycling programs, use of efficient lightning, use of recyclable containers, and etc.. The Green Table Network designation will definitely be a designation the AMS sustainable food truck would like to attain.

5.0 Power Sources

As obtained from the previous SEEDs reports, the *Peak Shave Energy Managing Tool For Energy Subsystems Design of AMS Sustainable Food Truck* (Hou, 2014), the power systems management prioritizes using solar power, fuel cell, and electric battery, in that order. As stated previously, our project will however focus on the use of hydrogen fuel cell as the primary source of energy, while the solar and the battery power sources will be briefly touched upon. This section will look into the power sources of the truck and how much energy each system produces.

5.1 Solar Power

The solar panels are confined to a 20 m^2 surface area. We used the *Kyocera KD325GX* solar panel as a price reference. Its dimensions are approximately 1.6 m x 1.3 m, equal to a surface area of 2.08 m^2. Assuming the total surface area of the solar panels can slightly exceed 20 m^2, ten of these solar panels can be installed on the roof of the bus, supplying a total energy of 3,250 Watts per hour (W/hr) in optimal conditions. Each *Kyocera KD325GX* unit costs $367, making the total cost of the ten solar panels to be $3,670 (Northern Arizona Wind & Sun, 2015). However, the *Sunpower's E20/435* Solar Panel is smaller and supplies more watts. Its surface area dimensions are about 2.0 m x 1.0 m, equal to a surface area of 2 m^2 and allowing ten panels to fit on perfectly. It provides 425 Watts per unit, totaling to 4250 Watts (SunPower Corporation, 2011). However, installation must be done by licensed distributors, and they refuse to list a price without consultation.

5.2 Electric Battery

This section was done under the assumption that UBC will buy an electric car battery from a car manufacturer. The Chevy Volt 2014 battery supplies 16 kWh of energy, has a replacement cost of $2,300 and can allow up to 61 km of travel. The best car battery out there is the Tesla which comes in 60 kWh and 80 kWh models, allowing for over 400 km of travel. Tesla's Chief Technology Officer, JB Straubel, stated their batteries cost a quarter of the Tesla Model S, leaving their price to be between $21,000-28,000 (Kevin Bullies, August 7, 2013). These estimates allow us to determine a range for price per kWh.

5.3 Hydrogen Fuel Cell

As mentioned previously, one of the hydrogen fuel cell buses from the Whistler bus fleet will be purchased, and modified to implement the solar panels and the battery system. The hydrogen fuel cells in these buses are polymer electrolyte membrane fuel cells (PEMFC) produced and maintained by Ballard Power Systems. Each one of the Whistler fuel cell buses are equipped with 8 hydrogen tanks totalling 60 kg of hydrogen, with which the bus can travel a distance of about 500 km (Zeidler, 2013). While the Whistler hydrogen fuel cell bus fleet was used as an example for this investigation, it should be noted that our hydrogen fuel cell will only be traveling 400 km which is very insignificant in comparison to the mileage by the Whistler transportation buses.

5.4 Power Source Conclusion

The following SEEDS project, by Guilherme Ono Sens assessed whether the food truck could run on those three components. Sens theorized the truck would be able to operate, under the assumption that ten solar panels are drawing 240 Watts, the fuel cell contains 30 kWh of energy, and a battery of 10 kWh; though he had noted that the truck's motor was not taken into account. The report's selection of solar panels and battery is expected to supply 325 Watts and 16 kWh respectively, which should provide better results under the assumption that hydrogen fuel cell contains at least 30 kWh of power.

6.0 Triple Bottom Line Assessment

It is important for today's businesses to incorporate sustainability in order to succeed. Doing so requires companies to acknowledge the needs and interests of not only the company but other stakeholders such as community groups, public, workforce and etc.. Sustainability with regards to a business can be defined as operating the business so that it recognizes and supports the economic and non-economic aspirations of people both inside and outside the organization on whom the business depends. While this is expected to provide higher longer term profit for businesses, it does not attract many businesses focused on short-term profit and shareholder's value. According to Timothy and Tanya (2011) the phrase "Triple Bottom Line" was introduced by John Elkington during the mid-1990s. This accounting framework for the businesses, went beyond the traditional measures of profit, return of investment, and shareholder value to include environmental and social dimensions (p.4). The triple bottom line analysis thus consists of three Ps: profit, people and planet.

6.1 Social

Social variable of triple bottom line analysis for a business refers to the social dimension of a community or region and could include taking into account the impact of a business on the overall education, health, quality of life and social capital of the surrounding area (Tanya and Timothy, 2011, p.5). A business that's socially aware of its community by various means, will ensure the loyalty of its customers. In order for the AMS Sustainable Food truck business to be successful and profitable, it has to incorporate the TBL framework. Our group has investigated why this business meets the social dimensions of the TBL framework. As it was mentioned earlier, the AMS Sustainable Food Truck aims to use local food and local vegetables. This

approach will result in enhancing the local economy, which then ends up creating more jobs and as such contributes to the local community. In addition, the increased consumption of local produce, will increase the local farmers' cash flow and reassert the importance of local agriculture in the consumer space while reducing unnecessary export and transportation costs. This will then expand opportunities for the local agriculture, which not only improves the infrastructure and creates jobs, but also provides more choices for consumers. This also enhances the local tax base and re-invests money into local farming (Poppy Arsil Elton Li Johan Bruwer Graham Lyons, 2014, p.5).

Furthermore, as the AMS chef, Ryan Bissell, has informed us, the truck will be using 100% non-processed food which will provide high quality, healthy options for the consumer. In addition, the sustainable food truck will use compostable containers instead of plastic containers which will contribute significantly to alleviate the pollution of the water and air. This will impact the community directly, by promoting their health and safety. These aspects of the project fulfill the "people" part of the three Ps.

6.2 Financial

A business that strengthens the economy it is a part of, is one that will continue to succeed in the future. In order for a business to sustain, first it needs to be aware of its revenue and profit. In order to do so, our group have come up with a financial model for operating the food truck for a year. We have calculated the annual costs and the revenue, which is the most important aspect before starting a business. Economic variables ought to be variables that deal with the bottom line and the flow of money (Tanya and Timothy, 2011, p.2). The financial model

will look into the costs of the food truck, cost of food, utensils, parking permit, employments and the truck's equipment. The calculations have been made upon various given information: the truck will operate 10 days in a month, for 5 hours. However, it will operate for about 3 days on campus which will have approximate 30 customers per hour, and the rest of the days will be operating in busy areas such as music festivals and downtown area where 120 customers per hour are expected. Each servings of food is about $8, and as it is shown in Table 1 in the appendix A, initially to start the business we need $38,900 for the initial equipment in the truck. Additionally, as it was mentioned earlier, $80k is needed to furbish the food truck. AMS has $200,000 to buy the food truck and furbish the track, and it will cost the total amount of $238,900 to start this project. Annual earning of the food truck was calculated to be $80,202. It will take AMS approximately 3 years to get their money back. This business will have about 17% profit, which fulfill the financial aspect of the triple bottom line. The detailed earnings and expenditure of the business has been laid out in the next three tables.

6.3 Environmental

Companies, which are using the Triple Bottom Line framework, must also take into account the environmental dimension. These companies must take the initiative to reduce or eliminate their environmental footprint. The AMS Sustainable Food truck is using a hydrogen fuel cell, which in comparison to other food trucks in business will have zero greenhouse gas emissions. Hydrogen is one of many burgeoning technologies, which in the near future may gain widespread acceptance. Although biodegradable and compostable packaging has been just under the surface for implementation in the business space, the next few years will push the use of this packaging into mainstream adoption. The AMS project is striving to inform the public that

“green” business practices are more profitable in the long run. This truck acts as an example for other businesses who may want to change their practices. Although the initial investment in green technologies and practices is steep, these pay off over time. This is the main barrier for other companies who are interested in adopting environmental practices.

7.0 Conclusion

Through the course of our investigation, we recommend the project proceed as planned. As we found through our research within the Triple Bottom Line framework, the project proves to be profitable, and technically viable. Socially, a hydrogen-powered and environmentally friendly food truck promotes the use and operation of sustainable food trucks within Greater Vancouver. The project has positive impact environmentally due to its zero emission fuel source and biodegradable packaging. Looking over the approximate earnings and the expenditures for a year for the food truck, it meets the financial dimension of the triple bottom line. This framework is still evolving in its implementation towards analysing the feasibility of developing more environmentally conscious business practices. Despite the fact that this framework has some ambiguities in calculating the social and environmental dimensions of the business, we used this framework to analyse the project despite these drawbacks. Hopefully in the future a better way to quantify these costs is developed so that even the smallest of businesses can implement these techniques from the start. That development would allow businesses to make a more robust and thorough analysis so that they may pivot and implement these practices.

Glossary

AMS	Alma Master Society
CHFCA	Canadian Hydrogen Fuel Cell Association
GHG	Greenhouse Gas
HFC	Hydrogen Fuel Cell
HNFT	Hungry Nomad Food Truck
PEMFC	Polymer Electrolyte Membrane Fuel Cell
NRC	National Research Council
SEEDS	Social Ecological Economic Development Studies
TBL	Triple Bottom Line
UBC	University of British Columbia
UBCFS	UBC Food Services

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Appendix A: Equipment Price List and the Business Model

AMS Sustainbale Food Truck

EQUIPMENT PRICE LIST

Last Updated: *2015-04-05*

PRODUCT NUMBER	NAME	RETAIL PRICE/UNIT
1	Stand-up Fridge	$3,500.00
1	2-door cooler	$4,000.00
1	deep fryer	$3,500
1	36" flat top	$6,000
1	4 drawer low-boy fridge	$4,500
2	panini press	$2,400
1	hood vent system	$1,000
1	water management	$5,000
1	POS	$5,000
1	induction burner	$4,000

Table 1. List of Equipments with the prices provided by the AMS

Utensils List

Dashboard «

Number per Package	Item Description	Condition	Vendor	Price for one package	Price for 4650 costumers/year
1000	Compostable 7" To-go-plate	new	Wholesale	$79.50	$397.50
200	Compostable 3-compartment	new	Wholesale	$70.03	$1,628.20
500	Compostable paper cup	new	Wholesale	$71.60	$716.00
2000	Spoon	new	Wholesale	$121.95	$365.85
250	Napkin	new	Wholesale	$6.00	$114.00
Total				**$349.08**	**$3,221.55**

Table 2. List of Utensils with the prices provided by the our group

Business Model For the AMS Sustainable Food Truck		
Cost		**NOTES**
$200,000	Grant	
	Amount Needed to start the business	
$446,400	Total Earning	
	Food Truck	
$3,222	Utensils	
$1,160	Parking Permission	
$133,920	Food Supply	30% of earning goes to Food supply
$89,280	Accidential	20% of earning goes to maintenance
$25,000	Branding/Marketing	
$14,400	Social Media	$1200/month Social Media
$82,800	Pay two cooks and the server	$16/hour for 2 cook and $14/hour for server
$16,416	Hydrogen Fuel	60 kg to run 500km ($2.28/kg Hydrogen)
Result	18% profit	
	Earnings	**NOTES**
120	Number of Costumers per hour for 7 days a month	
30	Number of customers per hour for 3 days a month	
4650	Number of Costumers per month	
55800	Number of Costumers per year	
$446,400	Approxiamte number of sale per year	$8 per unit of food

Table 3. Business Model for the Food Truck