

UBC Social Ecological Economic Development Studies (SEEDS) Student Report

Sustainable Patio Heater at the Perch

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University of British Columbia

APSC 261: Technology and Society I

Nov. 27, 2014

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Submitted to Dr. Paterson

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Executive Summary

This project was done for APSC 261, an Applied Science undergraduate course at the University of British Columbia. APSC 261 deals with the “interdisciplinary enquiry known as STS (Science, Technology and Society)” (Paterson, 2014a). In this 3 month course, we spent most of the time working on a Sustainability Project, which is the subject of this project report. This project is part of UBC’s SEEDS (Social Ecological Economic Development Studies) Program, which facilitates the collaboration of UBC staff, students, and faculty to “address real issues pertaining to the sustainable operation of units on the UBC campus” (Paterson, 2014a).

Our group selected and completed an APSC 261 Sustainability Project called ‘Patio Heaters’ in the September 2014 term, working with the Perch Restaurant of the newly constructed Student Union Building (UBC SUB). As stated in the UBC SEEDS Project Proposal Form (Paterson, 2014b), the goal of our chosen project was to research and find a more sustainable alternative heating solution to propane heaters, for purpose of extending the months of operation of the outdoor patio for the Perch restaurant in the new SUB. During this project, our main contacts were Chiyi Tam of AMS Sustainability and David Gill, Seeds Coordinator.

The Perch restaurant is situated on the top floor of the new SUB and has an outdoor patio that is suited for outdoor dining during the summer months. The management has changed its initial plan to only use the patio in the summer, and wants to open the patio for use during the spring and fall months, on appropriate days. This involves operating the patio in less-than-ideal conditions, such as chilly or windy weather, though not when it is raining.

The baseline heating solution that was initially considered as a heating solution were to use propane heaters. However, the unsustainable fuel source of this solution conflicts with the UBC Alma Mater Society’s green branding under which the SUB and the Perch Restaurant falls under. Furthermore, propane heaters may give off an odor of propane, which decreases user comfort, another priority of the restaurant’s stakeholders. The stakeholders stated that they would consider any option that is presented to them, as long as it is economically, environmentally, and socially sustainable.

This project was completed over the period of about 2 months, for an undergraduate university course at the University of British Columbia. Through the UBC SEEDS program, students are given the opportunity to share with the UBC community their research, findings, opinions, conclusions and recommendations. Thus, it should be kept in mind that this report is a student project and not an official document of UBC. Moreover, this reports may not reflect the current status of activities at UBC. For up-to-date information, the UBC SEEDS Coordinator can be contacted mentioned in a report or about the current status of the subject matter of a project/report.

In this investigation, we operated under the accounting framework known as the Triple Bottom Line (TBL) approach. The TBL approach considers not only the economic impact, but also the social and environmental aspects of a project (Slaper and Hall, 2011). We investigated the impacts in each aspect for each of our proposed solutions, and compared them to the traditional propane patio heaters.

To conduct this investigation, both primary and secondary sources were required for our analysis. To get a sense of existing alternatives to propane heaters, we used internet search engines (google.com, etc.) to find models and manufacturers' websites of different heater heating solutions. In doing so, we familiarized ourselves with the topic and identified some of the readily available market alternatives. We also brainstormed possible questions for the Q&A session with our stakeholder, Chiyi Tam. Lastly, we gathered data on our UBC peers' thoughts on the topic by creating and distributing an online survey. This proved to be a valuable primary source of information for understanding the social aspect of our problem. The results of the survey are discussed in section 3.

After analyzing the responses we got from the survey it was clear that not extending the operation hours of the patio is another option, since the number of people who would use the patio significantly decreased when the temperature dropped past 10°C. Moreover, if there was a chance of rain, or it was raining, the number of people interested in eating on the patio also decreased. Taking this into account, along with the weather analysis we completed, there was presents a strong argument of not using patio heaters to extend the lifespan of a patio. In addition, the survey also confirmed for us that most people would prefer to be heated by an electric heater and that sustainability and safety is a key issue to potential customers.

Finally, we did a comprehensive comparison of several models of heaters with different specifications, using a TBL assessment that includes economic, social, and environmental factors that pointed towards electric (infrared) heaters being one of the best choices.

From the data collected our assessment using the TBL framework, along with all of our findings in the initial research, our final recommendation is to use freestanding electric heaters; there are several commercial models available as viable heating options and good alternatives to propane heaters. Ultimately, this is because electric heaters provide many benefits over gas and battery powered options. As showed in the analysis electric infrared heat provides a balance of flexibility, efficiency, and sustainability not offered by other models. Electric powered heaters also require less overall maintenance and setup when compared to either propane or battery powered options.

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Glossary

British Thermal Unit

A traditional unit of energy that is commonly used to grade output of heaters.

List of Abbreviations

AMS Alma Mater Society

APSC Applied Science

BTU British Thermal Units

Q&A Question and Answer

SUB Student Union Building

TBL Triple Bottom Line

UBC University of British Columbia

1.0 INTRODUCTION

This section provides an explanation of the background of the course in which this project was completed, as well as the purpose, background, and scope of the project.

1.1 Course Background

This project was designed for an Applied Science course at the University of British Columbia, APSC 261. This course deals with “the development of knowledge and abilities ... not specific to any particular engineering discipline. Rather, they relate to the interdisciplinary enquiry known as STS (Science, Technology and Society / Science and Technology Studies)” (Paterson, 2014a).

The course involves a term-long Sustainability Project, which is the subject of this project report. The project is part of UBC’s SEEDS (Social Ecological Economic Development Studies) Program. The SEEDS Program facilitates the collaboration of UBC staff, students, and faculty to “address real issues pertaining to the sustainable operation of units on the UBC campus” (Paterson, 2014a).

1.2 Project Purpose

Our group selected and completed an APSC 261 Sustainability Project called ‘Patio Heaters’ in the September 2014 term, working with the Perch Restaurant of the newly constructed Student Union Building (UBC SUB). As stated in the UBC SEEDS Project Proposal Form (Paterson, 2014b), the goal of our chosen project was to research and find a more sustainable alternative heating solution to propane heaters, for purpose of extending the months of operation of the outdoor patio for the Perch restaurant in the new SUB. During this project, our main contacts were Chiyi Tam of AMS Sustainability and David Gill, Seeds Coordinator.

1.3 Project Background

The Perch restaurant is situated on the top floor of the new SUB and has an outdoor patio that is suited for outdoor dining during the summer months. The management has changed its initial plan to only use the patio in the summer, and wants to open the patio for use during the spring and fall months, on appropriate days. This involves operating the patio in less-than-ideal conditions, such as chilly or windy weather, though not when it is raining.

The baseline heating solution that was initially considered as a heating solution were to use propane heaters. However, the unsustainable fuel source of this solution conflicts with the UBC Alma Mater Society’s green branding under which the SUB and the Perch Restaurant falls under. Furthermore, propane heaters may give off an odor of propane, which decreases user comfort, another priority of the restaurant’s stakeholders. The stakeholders stated that they would consider

any option that is presented to them, as long as it is economically, environmentally, and socially sustainable.

1.4 Scope

This project was completed over the period of about 2 months, for an undergraduate university course at the University of British Columbia. Findings from this project may be used in other campus restaurants. If the project is successful, the Perch intends on acknowledging student innovation by creating a communication piece for customers regarding sustainable heating.

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2.0 INVESTIGATION

This section deals with the details of our investigation of the topic. It includes an explanation of the TBL framework, our research methodology, and all research considerations such as building specifications, economical, environmental, and social considerations, and a weather analysis of Vancouver.

2.1 Framework and Methodology

In this investigation, we operated under the accounting framework known as the Triple Bottom Line (TBL) approach. The TBL approach considers not only the economic impact, but also the social and environmental aspects of a project (Slaper and Hall, 2011). We investigated the impacts in each aspect for each of our proposed solutions, and compared them to the traditional propane patio heaters.

To conduct this investigation, both primary and secondary sources were required for our analysis. To get a sense of existing alternatives to propane heaters, we used internet search engines (google.com, etc.) to find models and manufacturers' websites of different heater heating solutions. In doing so, we familiarized ourselves with the topic and identified some of the readily available market alternatives. We also brainstormed possible questions for the Q&A session with our stakeholder, Chiyi Tam.

The detailed information on the Perch restaurant we received from the Q&A with Chiyi provided us another source of data to consider in our analysis. This information included important constraints that we were not initially indicated in the original documentation, and would later affect our decision in choosing a sustainable heating option. The details of these constraints are discussed in section 2.2.1.

Lastly, we gathered data on our UBC peers' thoughts on the topic by creating and distributing an online survey. This proved to be a valuable primary source of information for understanding the social aspect of our problem. The results of the survey are discussed in section 3.

The secondary data came from multiple sources and is where most of the information in the report is gathered from. We consulted heater manufacturers' websites, Vancouver weather data, building plans for the restaurant, and used UBC's online library catalogue and Google Scholar for our additional sources for our investigation.

2.2 Research Considerations

The following subsections deal with the variety of different considerations our project entailed, from the specifics of the patio, to weather patterns in Vancouver, to other economic, social, and environmental considerations.

2.2.1 Building Specifications

According to our initial documentation of the project provided by our stakeholder Chiyi Tam, we noted that several physical constraints of the patio area. For example, the Perch patio would not have any overhanging structures or walls to attach non-freestanding heaters on to.

2.2.2 Economic Considerations

The economic viability of each heating option was evaluated based on the total costs incurred from the time the unit was purchased to the end of its life. The analysis of this cost was broken down into four categories. The first was the initial cost, which was evaluated for both an individual unit and total cost of all the units. The next point of analysis was the operation costs of each unit type at both an hourly rate and a monthly rate. This was calculated using the current utility rates in BC at the time of this report and using the assumption that the heaters would be used for the duration of 2 meals daily. The third point of analysis was the cost of replacement of parts with a finite lifespan. Lastly, the potential for increased revenue due to extended patio hours was compared to total cost of the heater.

2.2.3 Social Considerations

To gather information in regards to the social impact of our assessment, we created our own google survey. The survey was created after we had generated a few possible alternatives for the patio heaters, keeping in mind some of the constraints we had learned from the Q&A. With this information we created a quick survey, about 4 questions primarily focussing on under which set of conditions someone would prefer to eat on a patio, and how they would prefer to be heated. The survey was answered by 63 UBC students. We aimed at UBC students because the main customers that the perch would receive would be from UBC students, so it was necessary for their involvement in this investigation. The results of the survey will be discussed in section 3.1.

Furthermore, we also analyzed other social factors that the patio would have on the customers. These included the quality of heat, direct contact with the heater, and safety factors that the heater may bring up. As well, we took into consideration of the staff's interaction with the heater and assessed this based on mobility, maintenance, and setup time. We acquired this information from the product's manufacturer website and are later discussed in section 3.2.3.

2.2.4 Environmental Considerations

The environmental impact caused by each heater would be weighed by the fuel type. The impact from the production of the heaters also cause damage towards the environment, however the impact can not be controlled. Thus, we will be evaluating the impact of the heaters based on the fuel type. In order to assess the environmental impact of the different fuel sources we need to take into account the damage caused by the production, generation, and recycling of the fuel type where applicable.

2.3 Weather Analysis

In order to gauge the scope of potential months, the heaters would be used, we gathered data from the Government of Canada on the historical and recent weather in Vancouver. Specifically, we analyzed the data from year 2013.

The average temperature of each month was used to produce the graph in figure 4. From the specification that were provide of when a heater would be used (temperatures between 5°C to 10°C) we found that the heater would only be used in five month during the year. In these five month, the heater may not be used daily, as it also depends on the conditions of the weather (i.e. raining,). With this information, calculating the cost of a heater on an annual basis could be done easily. Also, this would allow for easy estimations of the maintenance cost of the heater.

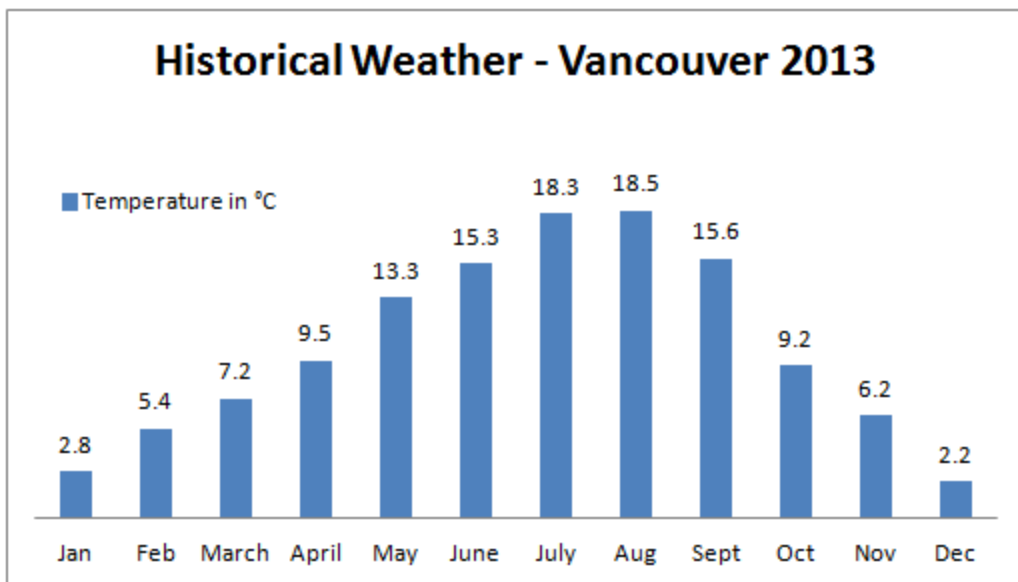


Figure 1. Historical Weather in Vancouver in 2013. Source: <http://goo.gl/RIzNb7>

With the constraint on the hours of operation for the patio during the spring and fall, we came to another consideration: that perhaps, this evaluation provides an argument, at least for economic factors, to consider scrapping the plan and not having patio heaters at all.

3.0 SURVEY RESULTS

In this section, we discuss the results and our analysis of the survey we created. The survey was conducted primarily to acquire information under which set of conditions a person would choose to eat out on a patio. We wanted to have information because the main purpose of the patio heater was to extend operational hours for the patio, outside of the normal spring and summer months. However if we found that UBC students did not want to eat out on the patio and prefer to eat indoors, this results of this survey could potentially save money for the restaurant by simply closing the patio. So by conducting this survey we were able to get a grasp on the usage the patio would receive under certain parameters. At the time of our analysis of the results, 63 UBC students had completed the essay.

A link to the original survey and the raw results data can be found in Appendix A at the end of this report. The results are available in view-only mode. Note that more respondents have submitted surveys since the time of writing.

3.1 Question 1

The first question that asked on the survey was: “Under which circumstances would you eat on the Perch’s outdoor patio?” We gave the respondents a few options of certain weather conditions and temperatures and the option to select more than one answer. This is because we were looking to see what their preferences for eating out on a patio.

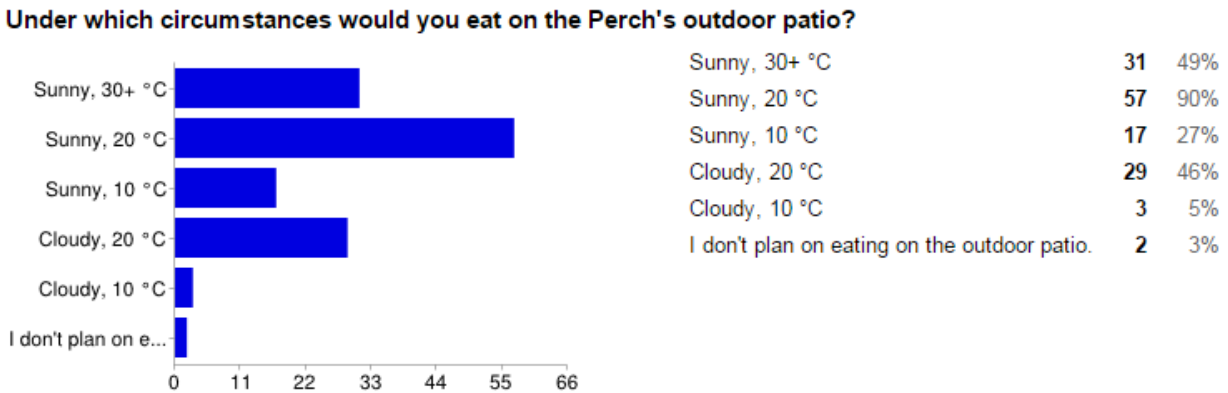


Figure 2: Survey Question 1 Responses

As you can see from the above figure, UBC students would mainly want to eat out on patio when it is sunny out and the temperature is above 20°C. It is important to note that number of people that would want to eat outdoors decreases dramatically from 90% to 46% as soon as the sky gets cloudy. As well, how the numbers dramatically drop when the temperature hits around 10°C and the differences in those numbers of when it is sunny to when it is cloudy. These results will prove to be significant when we get to the weather analysis, in section 3.3.

3.2 Question 2

The second question that we asked on the survey was: “What factors would prevent you from eating on the outdoor patio?”. We gave the respondents a few options of certain weather conditions along with some general parameters that would cover most situations that can arise. Also, we gave the respondent the option to select more than one answer; this is because we are trying to get an accurate assumption of when UBC students will not eat on the outdoor patio.

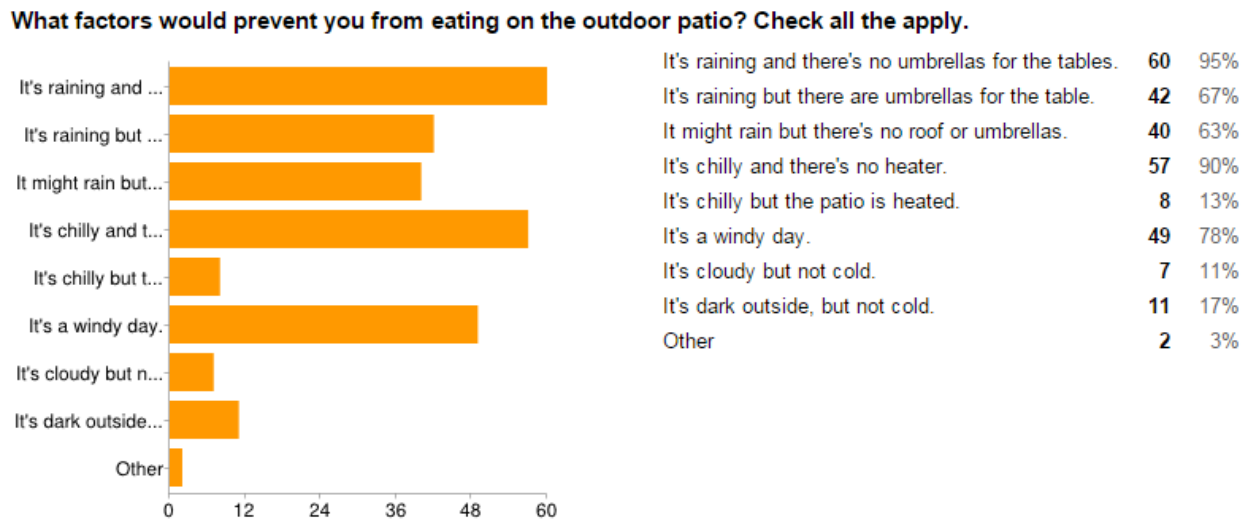


Figure 3 Survey Question 2 Response

From the above figure and the data seen, the most critical piece of information we obtained is that at least 2/3 of the students surveyed said they would not eat outside if it was raining. Furthermore, this value held true even if there were umbrellas for the tables, to cover the customer from the rain, and when it was just a chance for it to rain that day. As well, a significant amount of people would avoid eating outdoors on a windy day. However, it is important to note that people are opened to the idea of eating outside when it is past sunset as well when it's a little chilly, as long as the patio is heated.

3.3 Questions 3 & 4

The last two questions we asked on the survey were: “Which heating solution would you prefer?”, and a follow up question: “Please explain what factors affected your previous answer”.

We gave the respondents a few options on how they would like to stay warm on the patio and the opportunity to explain their choice. We wanted to know if people cared about how they were being heated and their mindset towards that particular method.

Which heating solution would you prefer? If you choose "Other", please



Figure 4: Survey Question 3 Response

From the above figure, it is clear that most people would prefer electric heaters and that there is a significant percentage that doesn't mind how they are kept warm. At the same time, they are very few people, who would prefer to be kept warm by a propane heater, warm cloths, or other methods of heating. Therefore it would be safe to assume that most people would prefer to be kept warm by an electric heater.

In the follow up question, we asked why they made that particular choice in heater. The general consensus for the people who choose electric heaters as their heater picked it based on sustainability. Most of them cared that the electric heater was better for our environment and safer compared to the propane counterpart. For the people who selected the "don't care" option, the general consensus for them was if they were kept warm they didn't care about how they were being heated, or how sustainable the method is. As long as they were kept warm and comfortable they were fine with whatever means was used to do so.

3.4 Survey Results Analysis

After analyzing the responses we got from the survey it was clear that not extending the operation hours of the patio could be a possibility. Since the number of people who would use the patio significantly decreased when the temperature came around 10°C. Moreover, if there was a chance of rain, or it was raining, the number of people interested in eating on the patio also decreased. Taking this into account, along with the weather analysis done in section 3.3, it presents a strong argument of not using patio heaters to extend the lifespan of a patio. In addition, the survey also confirmed for us that most people would prefer to be heated by an electric heater and that sustainability and safety is a key issue to potential customers. These results will prove to be vital in our final recommendations, which will be discussed in sections 4 and 5.

4.0 ASSESSMENT

This section deals with our assessment based on our findings from Section 2 and 3 of this report., and includes side-by-side comparisons of the heating alternatives we considered.

Moreover, to provide an alternative solution to the propane heater, our initial research had a large range of heaters. However, due to the structural constraints we disregarded any heaters that would require structural change or installation into the patio structure. The remaining options were freestanding or individual. When evaluating the heaters, we looked into the economic, social, and environmental impacts of the options.

In the initial investigation for heating alternatives a number of options were considered. Of the options considered many options were ruled out in this initial phase mainly due to constraints arising from the construction of the patio. Hanging heaters of any power source were ruled out due to lack of suitable structure to secure the heaters. Radiant floor heating was also ruled out due to construction deadlines. The concrete floors have been poured and cannot be altered. Fixed floor heaters were also ruled out in favour of freestanding models. This was to meet the requirement for a flexible floor space. After the initial investigation four heating options remained viable; radiant electric, propane, natural gas, and battery powered seat warmers.

Table 1: Operating Cost at 90% Capacity for 5 Hours Daily Use

| | Electric | Propane | Natural Gas | Heated Seats |
|-------------------|--------------|--------------|--------------|--------------|
| Cost Per Unit | \$350 | \$500 | \$700 | \$100 |
| Units Required | 15 | 3 | 3 | 100 |
| Total Cost | \$5250 | \$1500 | \$2100 | \$10000 |
| Cost Per Hour | \$2.25 | \$4.59 | \$0.51 | \$0.80 |
| Cost Per Month | \$337.50 | \$688.50 | \$211.16 | \$23.98 |
| Fuel Type | Electric | Propane | Natural Gas | Battery |
| Heat Output (BTU) | 5100 | 40000 | 40000 | NA |
| Type | Freestanding | Freestanding | Freestanding | Individual |
| Replacement Rate | 5000 Hr. | 10 Hr. | NA | 2500 Hr. |
| Replacement Cost | \$30 | \$18 | NA | \$100 |

Source: Woodland Direct, <http://www.woodlanddirect.com/Outdoor/Patio-Heaters>

4.1 Economic Factors

The economic viability of each heater type detailed in both Table 1 and Table 2 were evaluated based off an average heater in each category when used as the sole heating method for the patio. The cost efficiency was evaluated with the assumption that a temperature of 20 degrees Celsius was maintained for a period of 5 hours per day. A period of 5 hours was based off of the span of two average meal times. The data in Table 1 shows that both electric and battery powered options have a high initial cost when compared to either propane or natural gas heaters when required to heat the entire space. This is because both electric and battery options require more units to provide the same amount of heat as either gas option. Table 2 shows that as the capacity of the patio drops the cost of the electric and battery options become more cost effective. The operation cost for these methods can be reduced further as these heaters can be positioned to reduce wasted heat. In contrast Propane and natural gas heaters incur a lower initial cost as fewer units are required to heat the entire space. However the lead time to heat the space with gas heaters is much greater than that of either the electric or battery option. Also neither gas option can provide directed heat so heat loss cannot be easily reduced. As a result the operation cost of both gas heaters remain relatively static as the capacity drops. Table 1 also takes the replacement costs of each heater type. The refueling costs for the propane and natural gas heaters are included in the operation cost. For electric heaters the heating element costs \$30 to replace and needs to be replaced after 5000 hours of use. The batteries used in the heated seats are built into the unit and will need replacement after 2500 hours of use.

Table 2: Operation Cost at 50% Capacity for 5 Hours Daily Use

| | Electric | Propane | Natural Gas | Heated Seats |
|----------------|----------|---------|-------------|--------------|
| Cost Per Unit | \$350 | \$500 | \$700 | \$100 |
| Units Required | 7 | 2 | 2 | 50 |
| Total Cost | \$2450 | \$1000 | \$1400 | \$5000 |
| Cost Per Hour | \$1.05 | \$3.06 | \$0.34 | \$0.40 |
| Cost Per Month | \$157.50 | \$459 | \$140.77 | \$11.98 |

Source: Woodland Direct, <http://www.woodlanddirect.com/Outdoor/Patio-Heaters>

4.2 Environmental Factors

The environmental impact of the different heating methods were evaluated based on the fuel type. Assessing the electrical fuel source we need to look at the production and generation methods. Electricity has zero emissions into the atmosphere, however, due to electricity being a generated energy source the production method may create emissions. In British Columbia, most of our electricity is generated through hydroelectricity; the impact from producing energy is negligible, however the environmental impact from the construction to build the dam, as well as, the effect on wildlife habitat, which is immensely difficult to place a dollar value.

When comparing the impact to the environments of propane versus natural gas, propane was found to be more environmentally friendly. As propane emits fewer greenhouse gases, lowering the number of air toxins, that may affect the quality of the air. One may assume that propane causes a similar impact to the air quality as there is a odor when operating the heater, but this odor is added in to allow the user to be aware that the device is running.

From recent studies, it has shown rechargeable lithium-ion and lithium-polymer batteries have a large impact to the environment. As the recycling process of the chemicals and metals create hazardous waste. As battery technology is improving daily, this option would not be the most sustainable.

In summary, the most environmentally friendly option would be electric, as the energy source has zero emissions. The environmental impact from the construction of the dam can be compared to the impact when harvesting the natural gas or propane. The impact from only the recycling of the battery fuel cells is large enough to not consider this option sustainable.

4.3 Social Factors

After analyzing the results of the survey, it was evident that the majority of the prospective customers of the Perch would prefer the use of electric heaters, as sustainability and safety were a concern. Also, from the weather analysis in section 3.3, and the condition of the patio operating in the fall and spring with certain weather settings, it would not be ideal to use patio heaters to extend use of the patio in the autumn and spring.

The social impact for each heating method was evaluated based on how customers and staff interact with the product. With respects to the customer three main characteristics were evaluated; the quality of heat, direct contact with the product, and the safety of the product. Both the heated seats and electric heaters provide heat that is focused on the individual. This allows for more flexibility and variability based on customer preference. The gas powered heaters provide an uneven heated area with little control over where the heat is focused. The direct contact between the customer and each heating method was also evaluated. In the case of the heated seat direct use will cause wear and decreased the lifespan of this product.

With all freestanding models there is a concern that the customers may knock over the heater. In this scenario the electric heaters pose the least risk as there is no gas that may ignite. The staff interaction with the heaters were evaluated based on mobility, maintenance, and setup time.

The main limiting factors for mobility were the weight and the cord length. The freestanding heaters range in weight from 40 lbs to 120 lbs, with the electric being the lightest and propane the heaviest. The electric or gas line length is only a concern for the electric and natural gas models. Both of these options are limited by the construction of the space as a limited number of electrical and gas outlets are available in close proximity to the patio. Due to this constraint the number of units for either of these options will be limited by the outlets available. For both these the lines will have to be secured on the floor to reduce tripping hazards for servers with food trays.

Propane and battery powered heating options both require the most maintenance. For propane heaters, the 20 lb tank will need to be refueled after approximately 10 hours of use. For the heated seat option the battery will provide 2 to 4 hours of operation and will require 6 to 8 hours to recharge fully. The heated seat options can only be washed by hand. In comparison the electric heaters only require that the heating element is replaced after 5000 hours of use. Both gas options require the least set up consideration and are only hindered by the time required to heat the area. The added flexibility of the electric and battery option also adds to the setup time and consideration. The directed heat of electric heaters will require staff to position the heaters based on the distribution of customers. Similarly, the heated seat option required servers to address the individual needs of each customer.

5.0 CONCLUSION

From the data collected our assessment using the TBL framework, we recommend freestanding electric heaters as the most viable heating option as an alternative to propane heaters.

Electric heaters provide many benefits over gas and battery powered options. As showed in the analysis electric infrared heat provides a balance of flexibility, efficiency, and sustainability not offered by other models. Electric powered heaters also require less overall maintenance and setup when compared to either propane or battery powered options.

A comparison of top models of different styles is provided in Table 3. The Fire Sense Pole Mounted Infrared Electric model detailed in Table 3 offers a number of benefit over other models of the same type. All the heaters compared offer competitive heating ability but the Fire Sense Pole Mounted Infrared offers a number of features that make it much more mobile, including wheels on the base and a telescoping stand.

Table 3: Comparison of Freestanding Electric Heater Models

| | Fire Sense Round Infrared | Lava Heat Italia Cylindrical | Fire Sense Pole Mounted Infrared | Aura Patio Plus Stainless Steel |
|--------------------|---------------------------|------------------------------|----------------------------------|---------------------------------|
| Cost Per Unit | \$240 | \$600 | \$350 | \$380 |
| Units Required | 7 | 5 | 7 | 7 |
| Total Cost | \$1680 | \$3000 | \$2450 | \$2660 |
| Heat Output (BTU) | 5100 | 5100 | 5100 | 5100 |
| Type | Radial | Radial | Directed | Directed |
| Finish | Stainless Steel | Stainless Steel | Stainless Steel | Stainless Steel |
| Base Diameter (in) | 18 | 20 | 18 | 20 |
| Height (in) | 83 | 72 | 87 | 79 |
| Weight (lbs) | 32 | 34 | 53 | 50 |
| Mobility | Light | Light | Wheels / Telescoping | NA |
| Item # | 1551096 | 47900053 | 1551040 | 2330033 |

Source: Woodland Direct, <http://www.woodlanddirect.com/Outdoor/Patio-Heaters>

References:

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Appendix A: Survey Responses (63)

Link to the original survey:

<https://docs.google.com/forms/d/1L7lKmt8zYX2j4BieQT8ROz0defYE-79tGt6d9J3lQfU/viewform>

Link to the raw survey results data (view only)

https://docs.google.com/spreadsheets/d/1B83uZn-QxOTl_3f84GE1MvsV9gYOqtuzW8aXeH1p0X0/edit?pli=1#gid=1556614428

| Timestamp | Under which circumstances would you eat on the Perch's outdoor patio? | What factors would prevent you from eating on the outdoor patio? Check all the apply. | Which heating solution would you prefer? If you choose "Other", please | Please explain what factors affected your previous answer. |
|------------------------|---|---|--|--|
| 11/15/2014 21:44:06 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater. | Electric heater | Heaters would make it much more comfortable |
| 11/15/2014 21:44:43 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day., rain | Electric heater | I don't like being cold |
| 11/15/2014 21:46:18 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's chilly but the patio is heated., It's a windy day., It's cloudy but not cold. | FIRE | fire is sustainable and warm |
| 11/15/2014 21:48:38 | Sunny, 30+ °C, Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Don't care | What's the practical difference between electric and propane heaters? |
| 11/15/2014 21:49:07 | Sunny, 30+ °C, Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's chilly and there's no heater., It's a windy day. | Electric heater | I am so cold right now - the building I am studying in is freezing. Right now, heat is a priority. |
| 11/15/2014 21:54:13 | Sunny, 30+ °C | It's raining and there's no umbrellas for the tables. | Electric heater | no. |
| 11/15/2014 21:54:48 | Sunny, 30+ °C, Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Electric heater | Electric heating can be applied effectively, efficiently, and subtly in various designs. |
| 11/15/2014 21:54:53 | I don't plan on eating on the outdoor patio. | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Don't care | I want to be able to enjoy myself while eating outside. Going when weather isn't friendly won't make it enjoyable. |
| 11/15/2014 21:55:43 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no | No heater (dress | Why use energy, when you can put on a coat? |

| | | | | |
|------------------------|--|--|---------------------------------------|---|
| | | heater., It's chilly but the patio is heated., It's a windy day., It's cloudy but not cold., It's dark outside, but not cold. | warmly!) | |
| 11/15/2014 22:00:37 | Sunny, 30+ °C, Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day., It's dark outside, but not cold. | Electric heater | I feel like electric heaters are more environmentally friendly and potentially safer. I don't know too much about heating, but it feels like electric heaters may also be easier to control (ie. turn on and off, adjust temperatures). |
| 11/15/2014 22:00:51 | Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Electric heater | Electric heater over propane heater due to any gas leak possibilities. Electric heater probably safer. |
| 11/15/2014 22:05:50 | Sunny, 20 °C | It might rain but there's no roof or umbrellas. | whichever will satisfy customers more | Either electric or propane heater would work with me as long as it keeps people warm. I do not know much about the effects of electric and propane heaters on the environment so that is why I prefer the heater that will keep customers consistently warm |
| 11/15/2014 22:10:04 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Don't care | Anything that heats at a comfortable temperature with a consistently large region (I don't want my face to be warm while my feet freeze). Is a patio heater sustainable to begin with? Perhaps only when there is a need for overflow seating should this be implemented? Why not only have patio seating when the weather permits? |
| 11/15/2014 22:18:40 | Sunny, 30+ °C, Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Don't care | which ever is more cost efficient and energy efficient as well which ever one would radiate the furthest and have easier controls for how hot the heater is |
| 11/15/2014 22:19:06 | Sunny, 30+ °C, Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day., It's dark outside, but not cold. | Electric heater | electricity can be generated, less consumption of resources |
| 11/15/2014 22:21:49 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day., It's dark outside, but not cold. | No heater | If its cold outside I would rather eat indoors. Also, there wouldn't be a need to heat the patio, and the restaurant could focus on being more sustainable instead. |
| 11/15/2014 22:59:48 | I don't plan on eating on the outdoor patio. | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day., It's cloudy but not cold. | Don't care | I enjoy eating indoors |
| 11/15/2014 23:04:37 | Sunny, 20 °C | It's raining but there are umbrellas for the table., It's chilly and there's no heater. | Don't care | I don't mind electric or propane heating. Both do the trick but i'd prefer electric, even though they're less efficient.. |
| 11/15/2014 23:05:09 | Sunny, 30+ °C, Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's chilly and there's no heater., It's a windy day. | Electric heater | Electric heater for sustainability!! I tend not to eat outside unless it's summer. |
| 11/15/2014 23:05:28 | Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater., It's a windy day. | Electric heater | 30+ degrees is usually too hot/humid for patios, making it inconvenient to sit and eat on the patio |

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|------------------------|---|---|-----------------|--|
| 11/15/2014 23:05:47 | Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Don't care | Not enough experience with the different kind of heaters. I would prefer it to be sustainable and to not feel drying and too overwhelming. Something that creates a warm environment and not just a warm head or seat. |
| 11/15/2014 23:07:41 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Electric heater | Propane smells |
| 11/15/2014 23:09:32 | Sunny, 10 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater., It's a windy day. | Electric heater | I want to be warm, electric heaters can work effectively and efficiently. |
| 11/15/2014 23:14:29 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's chilly but the patio is heated., It's a windy day., It's cloudy but not cold. | Don't care | I am happy as long as I'm warm |
| 11/15/2014 23:14:38 | Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater., It's a windy day. | Propane heater | There's no way I'd sit outside if it was cold and there were no heaters. I've seen propane heaters at many restaurants and they seem to work well. |
| 11/15/2014 23:15:29 | Sunny, 30+ °C, Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining but there are umbrellas for the table., It's chilly and there's no heater., It's a windy day. | Don't care | If the Perch has a cozy atmosphere, sitting on the patio is just fine! All that is required is a break from the wind, a couch and maybe a heater. If you look at Koerners, people still sit outside when it's chilly because its cozy and warm. Rain is another factor though, as usually the humidity makes outside cold no matter what. Good Luck! |
| 11/15/2014 23:16:07 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Electric heater | propane pollutes the planet electricity does not. |
| 11/15/2014 23:16:07 | Sunny, 10 °C, Cloudy, 20 °C, Cloudy, 10 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater., It's a windy day. | Electric heater | I prefer electric heaters... Just because that option is the most sustainable other than just dressing warmly. However, that's not always a viable option. |
| 11/15/2014 23:17:09 | Sunny, 30+ °C, Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater. | Propane heater | Propane heating is usually more cost effective than electric heating. |
| 11/15/2014 23:19:35 | Sunny, 30+ °C, Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C, Cloudy, 10 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater. | Electric heater | Dressing warmly isn't that fun, propane is inherently non-sustainable, electric heaters still warm. |
| 11/15/2014 23:32:02 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater., It's a windy day. | Don't care | Just needs to be warm |
| 11/15/2014 23:33:37 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Don't care | Personally I prefer to eat inside a restaurant so I don't think the patio will have a great impact in whether or not I will eat the restaurant |

| | | | | |
|------------------------|---|--|---------------------------|---|
| 11/15/2014 23:39:44 | Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C, Cloudy, 10 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater., It's a windy day. | Electric heater | I don't like to freeze when sitting outside. I would most preferably eat inside but if a heated patio is available, I will use it. That being said, heated patios are an incredible waste of energy so I would just a LITTLE guilty about sitting in one. Still nicer than freezing my ass off though. |
| 11/15/2014 23:55:16 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's a windy day. | Electric heater | I just prefer electric heaters more...no particular reason. |
| 11/15/2014 23:55:22 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's a windy day. | Electric heater | I just prefer electric heaters more...no particular reason. |
| 11/16/2014 0:01:39 | Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater. | Don't care | have no preference |
| 11/16/2014 0:03:58 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater. | Electric heater | Propane is not renewable whereas electricity is |
| 11/16/2014 0:12:56 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | No heater (dress warmly!) | I feel like it would be a waste of energy. |
| 11/16/2014 0:20:43 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's chilly and there's no heater. | Electric heater | Less pollution. |
| 11/16/2014 0:23:51 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's chilly and there's no heater., It's a windy day. | Electric heater | i would love to eat on the roof on the patio of any building as long as it is warm during cold days. Electric heating seems reasonable since it should only be turned on during the odd cold day in the summer. I dont think people would be eating on the patio in the winter. |
| 11/16/2014 0:43:21 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's chilly but the patio is heated., It's a windy day. | Electric heater | More sustainable and safer solution |
| 11/16/2014 0:45:36 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's chilly and there's no heater., It's a windy day., It's dark outside, but not cold. | Electric heater | I chose the electric heater because a heater is usually needed since dressing warmly is not always enough, and the electric heater seems like a more reliable and efficient option |
| 11/16/2014 0:56:04 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day., It's cloudy but not cold. | Electric heater | No knowledge of alternatives. |
| 11/16/2014 1:27:04 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's chilly and there's no heater. | Don't care | I just want to be warm, dont care how. |
| 11/16/2014 1:32:22 | Sunny, 30+ °C, Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Don't care | I don't notice what type of heating solution unless if it stands out (decoration). |

| | | | | |
|---------------------|--|--|----------------------------|---|
| 11/16/2014 1:35:09 | Sunny, 30+ °C, Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Don't care | I don't really care for the type of heating solution but as long as it keeps me warm when the weather is chilly, then i'm fine. |
| 11/16/2014 2:14:14 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's chilly and there's no heater., It's chilly but the patio is heated., It's a windy day. | Electric heater | I find electric heaters to be more reliable. |
| 11/16/2014 8:13:17 | Sunny, 30+ °C, Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's chilly but the patio is heated., It's a windy day. | Don't care | as long as it's warm I don't care. But if it's cold enough to need heaters I probably won't eat outside |
| 11/16/2014 8:38:43 | Sunny, 30+ °C, Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater. | Don't care | Previous experience |
| 11/16/2014 8:50:16 | Sunny, 30+ °C, Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater. | Electric heater | I think it makes more sense to use an electric heater rather than use gas due to ease of maintenance? |
| 11/16/2014 10:23:36 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's chilly and there's no heater., It's a windy day. | Don't care | As long as it is heated, it doesn't make much of a difference how it gets heated. |
| 11/16/2014 11:20:02 | Sunny, 30+ °C, Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's chilly but the patio is heated., It's a windy day. | No heater (dress warmly!) | Even if there are heaters outdoors, they only really provide little spots of warmth and so you'd either need a lot of them (which isn't environmentally friendly) or you should just focus on indoor seating. |
| 11/16/2014 12:41:25 | Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Don't care | I don't know enough about heaters to have a preference about the type. |
| 11/16/2014 14:24:29 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day., It's cloudy but not cold., It's dark outside, but not cold., evil weather in general | Electric heater | propane - might smell no heater - wearing 10 layers have a tendency to restrict movement don't care - i am a cold-blooded reptile. i will DIE in the cold. |
| 11/16/2014 15:00:51 | Sunny, 30+ °C, Sunny, 20 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day., It's dark outside, but not cold. | Electric heater | seem more modern |
| 11/16/2014 15:23:33 | Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day., It's dark outside, but not cold. | Propane heater | From personal experience propane works better for heating. Electric would be fine if it heated well enough, and would likely be more sustainable long-term. |
| 11/16/2014 15:59:25 | Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | Propane heater | Provides a nicer look and feel than an electric heater. I don't know enough about the sustainability of propane however; I would be happy with whichever option is more environmental. |
| 11/16/2014 17:15:20 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's a windy day. | No heater (dress warmly!) | A heater is a dumb idea |

| | | | | |
|------------------------|--|---|-----------------|--|
| 11/16/2014 18:27:50 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas., It's chilly and there's no heater., It's chilly but the patio is heated., It's a windy day., It's cloudy but not cold., It's dark outside, but not cold. | Electric heater | i don't know but i'm guessing electric is better for the environment? |
| 11/17/2014 14:48:55 | Sunny, 30+ °C, Sunny, 20 °C, Sunny, 10 °C, Cloudy, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater., It's dark outside, but not cold. | Electric heater | Electric because I prefer non-propane heat. This is not necessary though |
| 11/17/2014 21:25:20 | Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It's chilly and there's no heater., It's a windy day., It's dark outside, but not cold. | Propane heater | Because I'm Hank Hill and sell propane and propane accessories. |
| 11/21/2014 19:24:14 | Sunny, 30+ °C, Sunny, 20 °C | It's raining and there's no umbrellas for the tables., It's raining but there are umbrellas for the table., It might rain but there's no roof or umbrellas. | Electric heater | more environmentally healthy than propane |