UBC Social Ecological Economic Development Studies (SEEDS) Student Report

An Investigation into Implementing Induction Stovetops at the UBC Student Union Building

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ABSTRACT

This study looks into the possibility of implementing induction stovetops in the new Student Union Building at the University of British Columbia. A triple-bottom-line assessment was completed; taking into the account the economical, environmental, and social impacts of the study. The economical impacts examined the life-cycle cost of induction stovetop and compared that to gas stovetops based on current and forecasted electricity and gas rates in British Columbia; results showed that induction stovetop technology is more costly over its entire life-cycle for the costing scheme that is assumed to be implemented at the SUB. Environmental analysis showed that induction technology is preferred only if the electricity is derived from low emission energy sources; but since the new SUB is purposed to be powered by natural gas electricity generation, the difference in emissions for both technologies will be marginal at best. The social analysis showed that induction stovetops are not preferred since cooking infrastructure is already based on reliable gas technology and there is no real significant incentive to change. This study shows it is not preferable to implement induction stovetops at the SUB.

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GLOSSARY

Eddy current	An induced electric current formed within the body of a conductor when it moves through a non uniform magnetic
Ferrous	Pertaining to, or derived from, iron
Inverter topology	A type of circuit that creates an electromagnetic field
Radiofrequency	Radiation frequency between 3kHz to 300GHz
Extremely Low Frequency	Radiation frequency between 3Hz to 3kHz
Electromagnetic field	Can be thought as a combination of electric and magnetic fields produced by electrically charged objects.

LIST OF ABBREVIATIONS

DOE	Department of Energy (US)
SUB	Student Union Building
UBC	University of British Columbia
ELF	Extremely Low Frequency
WHO	World Health Organization
ICNIRP	International Commission on Non-Ionizing Radiation Protection
LEED	Leadership in Energy & Environmental Design

1.0 INTRODUCTION

The purpose of this study is to investigate the possibility of replacing gas stovetops with induction stovetops in the new SUB. This study is tied in with UBC's Campus Sustainability Office's SEEDS (Social Ecological Economic, Development Studies) Program in hopes of making the new UBC Student Union Building (SUB) more sustainable such that the building can achieve LEED Platinum building certification. This investigation will be based upon a triple-bottom-line assessment that will take into account the economical, environmental, and social impacts of the two technologies.

Induction stovetop technology has been well studied and has been available in the market for a few decades. The technology works by producing a magnetic field around a ferrous metal vessel which induces an eddy current within the metal vessel; as the eddy current dissipates due to the resistivity of the metal vessel, heat is produced (See Figure 1) (Uozumi, N., 1985, p.9).

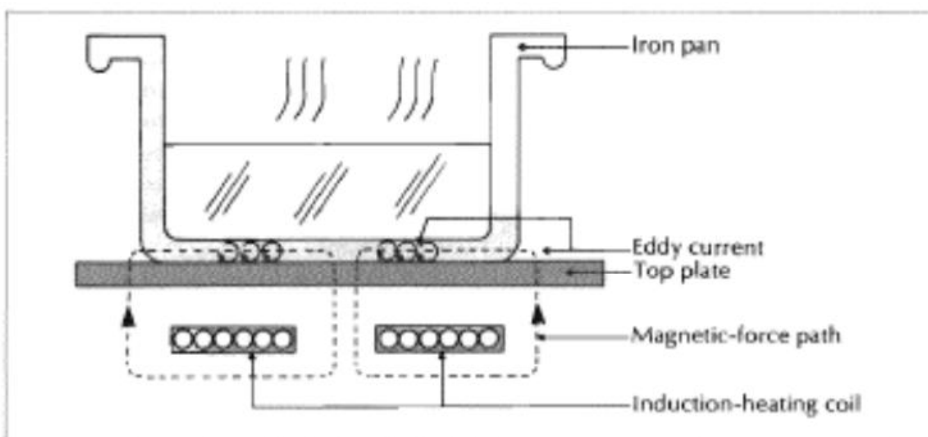

Figure 1 – Principle of operation

Gas stovetop technology, in contrast, is the preferable method of cooking in commercial kitchen. It works by combusting gas on the outside of the metal vessel. The combustion of gas produces heat that is then conducted through the metal vessel.

2.0 ECONOMIC IMPACTS

As part of the triple-bottom-line assessment, this section will study the economic impacts of the induction stove and determine whether the induction stove is an appropriate technology for the new SUB from an economical point of view. The economic analysis will include the following:

- Energy consumption/cost and time saved
- Cost of implementing new adaptable cookware for the induction stovetop
- Study of the life cycle financial cost between induction and gas stovetops

2.1 ENERGY CONSUMPTION AND COST

This study will compare the energy consumption of different electrical and gas-powered devices in order to gauge the efficiency and cost of each device. The estimate of cost for each device is based on local pricing of natural gas and electricity in BC. This study is based from data retrieved from the US Government Statistics where time and energy are measured for boiling 2L of water from 20°C (Control Induction Website, 1998). The pricing of the commodities used for powering or fueling the devices are based on BC hydro (electricity), Fortis BC (gas), and UBC Utilities average rates. It is expected that the new SUB will obtain its electricity from the UBC Steam Power Plant, which is powered by natural gas. It is also possible that the new SUB may obtain its electricity from the BC hydro grid, like several buildings already do on the UBC campus. In this respect, two pricing schemes have been added to this analysis to take into account the slightly different rates between the two providers. It is assumed that the UBC Utilities purchases natural gas from Fortis BC and that the UBC new SUB will receive its supply of natural gas based on Fortis BC gas rate. The analysis, shown in Table 1, clearly highlights that the induction stovetops boil water twice as fast compared to the gas stovetop. It also shows that the induction stovetop is clearly superior in efficiency rating compared over other electrical based stovetops (halogen and electric coil). The induction stovetop is significantly more efficient than the gas stove at 90% and 50% efficiency, respectively. If BC Hydro was to supply electricity to the SUB at tier 1 costing (higher rate priced under a limit specified by BC Hydro), the induction stovetop would cost slightly more to operate compared to the gas stovetop. Conversely, if BC hydro was to supply electricity at tier 2 costing (lower rate priced over a limit specified by BC Hydro) then it would cost slightly less to operate induction stovetops compared to the gas stovetops.

Table 1 – Energy Consumption for boiling water, Adapted from US Government Statistics with local costing

Boiling approximately 2 liters of water from 20° C						
Device	Time	Energy consumption		Efficiency	Costing scheme 1 ($)	Costing scheme 2 ($)
Induction hob	4 mins 46 secs	745kJ	0.207kWh	90%	0.017	0.013
Halogen hob	9mins 00 secs	1120kJ	0.3111kWh	60%	0.025	0.020
Electric Coil	9mins 50 secs	1220kJ	0.3389kWh	55%	0.027	0.022
Gas	8mins 18 secs	1340kJ	-	50%	0.011	-

Notes: Scheme 1: BC Hydro rate $0.081/kWh as of 2011
Based on Business Medium General Service rates at tier 1 costing
At tier 2 costing, there is a 50% discount
Scheme 2: UBC steam $0.0648/kWh estimated for 2012
Set rate defined by UBC Utilites. Rate derived from 2008's annual energy consumption and 2012's forecast gas price.
Fortis BC Gas rate: $7.856/GJ as of 2011

If UBC Utilities was supplying electricity accordingly to design, we see that the cost of the induction stovetop is marginally more expensive than the gas stovetop. The best case scenario for operating the induction stovetop is at BC Hydro tier 2 rating of $0.041kWh, where the induction stovetop is slightly cheaper to operate - $0.0025kWh savings. In all other cases, the gas stovetop is economically cheaper to operate. The prices of these commodities are expected to increase in the future: BC Hydro is proposing a 30% increase in electricity rates and the carbon tax will also increase the price of natural gas. Even with these increases, it is suspected that the costing difference between the induction stove and gas stove will not deviate tremendously. Fuel cost differs from region to region; in Table 2, we see that the price of gas is high in Japan, thus it would cost more to operate a gas range in this region compared to an electric induction stovetop (Uozumi, N, 1985, p. 10).

Table 2 – Energy Cost for boiling water in Japan

Table 1 A Comparison of Clean Range Cookers with Conventional Ranges

Range \ Item	Rating	Thermal efficiency	Heating time	Fuel cost
CS-150, CS-140	1,300W	Approx. 83%	7min, 40sec	4.98 yen
Conventional electromagnetic range	1,200W	Approx. 83%	8min, 19sec	4.98 yen
Electric range	1,200W	Approx. 56%	12min, 31sec	7.23 yen
Propane-gas range	0.18kg/h	Approx. 50%	7min, 12sec	5.78 yen

Conditions:

1. *Calculations were made assuming that electricity costs 30 yen/kWh and LP gas costs 249 yen/kg.*
2. *The above values are required to raise 1.5ℓ of 20° C water to 90° C.*
3. *An enameled pan with a diameter of 20cm was used.*

Source: The Japan Gas and Oil Equipment Manufacturers' Association Standards.

The results from Table 1 show that although gas stove is less efficient than the induction stove, the lower price of gas in BC allows the gas stove to be competitive in lieu of other higher efficient technologies. The prices of commodities change over time and across regions; therefore, these considerations should be taking account when deciding on which technology to implement.

2.2 COST OF IMPLEMENTING NEW ADAPTABLE COOKWARE

Mainstream induction stovetops require that the cooking vessels are composed of ferrous metals such as iron or stainless steel; non-ferrous metals such as aluminum and copper will not work as effectively (Uozumi, N, 1985, p. 9). Although it is possible to construct induction stovetops that can heat up non-ferrous metals as suggested by Tanaka from the Toshiba Corporation (1989), the technology required is not popular or available on the shelves. The cost associated with replacing cookware for induction compatibility then depends on individual restaurants' inventory of existing cookware. Since data is unavailable for the amount of compatible cookware for induction use, it is not possible to quote an exact cost. Based on market research on the internet, the price for induction compatible cookware ranges in price, but are considered affordable when compared to other non-ferrous cooking vessels. The number of cookware that will be affected at the UBC SUB is proportional to the number gas stovetops that are potentially replaceable by induction stovetops. Table 3 shows the number of units that are applicable to be replaced with induction technology in the design period; included are the type of units that may potentially be replaced in the future provided that induction ovens become main stream in the market such that it can replace convection ovens (UBC, 2010, p. 13.8).

Table 3 – Units Replaceable by Induction at UBC SUB, Sourced from 75% design SUB schematic

	Gas Stove	Electrical Requirement	Gas Requirement	Location
Applicable Replacement	Gas Wok unit - 2 burners	None	20mm gas connection 240 MB TUH	Food Leased Outlet: Noodles
	Pasta Cooker	120v/60V/1ph 12amp receptacle	25mm gas connection 77.5 MB TUH	Food Leased Outlet: Noodles
	Fryers – 2 units	120v/60V/1ph 12amp receptacle	25mm gas connection 244 MB TUH	Food Leased Outlet: Noodles/ Catering Kitchen
	Range	120v/60V/1ph 12amp receptacle	25mm gas connection 188 MB TUH	Catering Kitchen
	Fryers - 4 units	120v/60V/1ph 12amp receptacle	25mm gas connection 244 MB TUH	The Pit Pub/ The Pendulum
Potential Replacement in Future	Pizza Oven	120v/60V/1ph 12amp receptacle	20m gas connection 110 MB TUH	pie R Squared
	Double convection oven	120v/60V/1ph 10amp receptacle	20mm gas connection 80 MB TUH	Blue Chip and Bernoulli's
	Broiler	120v/60V/1ph 12amp receptacle	20mm gas connection 120 MB TUH	The Pit Pub/ The Pendulum
	Griddle	120v/60V/1ph 12amp receptacle	20mm gas connection 96 MB TUH	The Pit Pub/ The Pendulum
	Combi oven	120v/60V/3ph 22amp receptacle	20mm gas connection 190 MB TUH	The Pit Pub/ The Pendulum
	Pizza Oven	120v/60V/1ph 12amp receptacle	20m gas connection 110 MB TUH	The Pit Pub/ The Pendulum

Table 3 shows a total of 10 units that are applicable to be replaced by induction stovetop technology. The food leased outlet most affected by this implementation would be the "Noodles" vendor (most likely Manchu Wok or other Asian cuisines that mainly use gas ranges to prepare their food). As a result, we will see only a few food outlets that may have to replace their cookware if this technology is implemented. There is no data available for whether induction-compatible cooking vessels have nearly the same life time as traditional cooking vessels. The cost of replacing worn vessels should be taken into account if future studies show that induction-compatible cooking vessels tend to fail earlier compared to their counterparts. This paper will give induction-compatible vessels benefit of the doubt and assume their lifetime is similar to traditional cooking vessels. Cooking vendors that are affected will then experience a moderate upfront cost in the investment of new cookware but that will be comparable to traditional cookware in the long term.

2.3 LIFE CYCLE FINANCIAL COST

Induction stovetops are significant investments that cost more than gas stovetops. This part of the study will focus on the total life-cycle cost between the two technologies. Since available data for the amount of gas currently used at the old SUB for the gas burner does not exist, the following assumptions are made:

- It is assumed that each gas stove including fryer, burner, pasta cooker, and range uses an equivalent energy equal to boiling 2L of water from 20°C seven times per hour (the seven multiplier is derived from Table 1 by utilizing the time needed for a gas stove to boil water over a whole hour – 60minutes/8minutes 18secs = 7x)
- It is assumed that each gas stove operates on average for 6 hours a day, 5 days a week with a total annual use of 1560 hours

The life-cycle analysis compares the total cost of both technologies such that they are standardized to produce the same result – boiling 2L of water from 20^{o}C, 7 times an hour or cumulatively boiling 14L of water in one hour. The results of the analysis are shown in Table 4. Note that these estimates of the total life-cycle cost for both technologies are not an estimate of how much it will cost for these stoves to operate at the SUB since the actual consumption of energy is unknown. Table 4 shows that the induction stove will cost 45% more to operate compared to the gas stovetop in order to yield the same result.

Table 4 - Total life cycle cost based on standardized energy consumption - boiling 2L of water 7 times per hour from 20°C

Device	Retail Price ($)	Installation Cost ($)	Annual Maintenance ($)	Annual Energy Use	Annual Energy Expense ($)	Total Life Cycle Cost ($)
Induction	1057	0	0	2260 kWh	146.45	3839.55
Gas	300	23	7	14.6GJ	114.96	2640.24

Notes:
Electricity cost based on UBC utilities rate for 2012 defined in Table 1
Gas price based on fixed rate of 2011 (Fortis BC)
Lifetime of both devices limited to 19 years, sourced from US DOE
Retail price, installation cost, and annual maintenance cost sourced from US Department of Energy valued in 1990
Assume US dollars on par with CND

In this respect, the induction stovetop is at a disadvantage economically, even though it is far more efficient. If the price of electricity was to drop or the price of natural gas was to increase such that the life-cycle cost would significantly benefit the induction stovetop, then implementation of the induction stove would be lucrative. In addition, the price of induction stovetop is expected to come down in the future but this will range depending on its model which may make it competitive with gas stovetop.

3.0 ENVIRONMENTAL IMPACTS

As associated with any technology, there are certain risks and hazards one must analyze when considering acquisition and usage of the chosen product. For this section of the project, the environmental analyses between gas stovetops and induction stovetops is compared in order to determine which, possibly neither or even a combination of the two, would be the better alternative as the future technology to be implemented in the new SUB building. Induction heating stovetops require a finite amount of electricity to be used. Gas stovetops require pipeline connection to natural gas. With regards to the current infrastructure of the SUB, either technology can be installed. This section will compare and contrast the differences between the two technologies as well as analyze the type of fuel upon which these technologies are based.

For induction stovetops, only certain kitchen appliances can be used in the process. Cookware appliances made from ferromagnetic materials are better suited for the induction stovetops when cooking, as appliances made from higher conductivity metals such as aluminum and copper will be unable to generate the necessary resistance and friction that generates heat, and consequently unable to heat the food (U.S. Department of Energy, 1994, p. 40). A similar effect is associated with ceramic and glass materials as well. As a result, if the SUB were to implement induction stovetops for several new cookware appliances, replacement and purchases in additional cookware would be required for those induction stovetop units and will render incompatible cookware obsolete which may be dispose of before they reached their service lifetime.

For gas stovetops, gas connections to the new SUB are already planned since the gas is also used for other appliances in the building such as for other kitchen appliances, backup gas fired hydronic boiler plant, and for the barbeque area ("My New SUB", 2010, section 4.3, p. 53). Since a gas supply is already being diverted to the planned SUB building, and plans to provide gas supplies to kitchen appliances is already implemented, the introduction of new induction stovetops may not be necessary. The amount of electricity that a gas stovetop uses is negligible in comparison to the induction stovetop, since this electricity would be used to power most pilot lights and a glow bar in the gas stove to keep the flames ignited. In addition, the cost of replacing the cookware used on conventional gas stoves would have to be replaced over time, due to the repeated thermal expansion and cooling of the cookware material. Also, despite the burning of natural gas having the least amount of CO_2 released (in comparison with other hydrocarbon fuels), the amount of overall CO_2 emissions worldwide is a contributing factor to global warming (IPCC 2007, Section 4.3.1, p. 15).

In a qualitative analysis of the gas stovetops, potential electricity supplication for the new SUB may be provided either by the UBC Steam Plant, BC Hydro, or a combination of the two. The UBC Steam Plant produces an annual of approximately 48,000 tonnes of CO_2 from burning natural gas, and the electricity produced from the steam generated is then used to power most of the buildings in the Vancouver campus (UBC Climate Action Plan, 2009, p. 10). BC Hydro, as their company name suggests, produces their electricity by hydroelectric means. Hydroelectric power is considered one of the safest and virtually emission free sources of electricity generation (Whittington & Gundry, 1998, p. 31). Now, considering the possible combinations of power sources and stovetop technology, the most efficient and emission-free combination would be to employ the use of hydroelectric power from BC Hydro and the use of induction stovetops. While a gas supply will still be provided to the new SUB, it is within the best interests to keep the greenhouse gas emissions low whenever possible; this may involve switching the campus electricity entirely from the UBC Steam Plant to hydroelectric power.

To conclude this section of the report, both technologies have different strengths and weaknesses in their implementation. Gas stovetops can offer a wider range of cooking activities and are compatible with all existing cooking appliances in the current SUB. Gas connections are already planned to be implemented at the new SUB, so the ease of transitioning would be simpler. Induction stovetops are more efficient in terms of usage and only require a connection to electricity. However, induction stovetops have fewer cookware appliances that can be used due to the current limitations in the technology. Ferromagnetic cookware will be required in order to properly use the induction stovetop; any other conductive cookware will either have to be modified or replaced entirely just to work with these stovetops. Induction stovetops are the more environmentally viable option of the two, provided that the electricity supply is drawn from hydroelectric generation at BC Hydro or any other electricity supply that has minimal greenhouse gas emissions.

4.0 SOCIAL IMPACTS

Understanding the social complications of induction stovetops is ambiguous, debatable, and usually contains misconceptions. This section discusses the possibility of induction stovetops as an appropriate choice for the new SUB from a social standpoint.

Induction stovetops are steadily rising in popularity in North America but are not used to the same extent as other countries, such as Japan. When comparing the selection of models of induction stovetops which are available in Japan and North America, one can clearly see the much larger demand in Japan. Induction stovetops are known to be more efficient, but what is the reason why the induction stovetop is lacking in popularity in North America (Stuchly et al., 1987, 67)? In order to answer this question, the following social related questions must be answered first.

- Is it because of the psychological trait of North Americans?
- Is it because of the expensive price of induction stoves?
- Is it because of the temperature controlling scheme?
- Is it because of the reaction time of heat when the intensity is changed?
- Is it because of the work environment related to induction stoves?
- Is it because of the many health issues related to radiation?
- Is it because magnetism poses a health risk to pacemaker users?
- Is there a common misconception with induction stoves?

Human insight is advancing into making people lives easier, but it is hard to convince humans into trying something new when they are already comfortable in their routines. North Americans have the tendency to only change their attitude towards ideas and products when what they are currently engaged in is “wrong”, or when a paradigm shift occurs. Like the old saying goes “if it ain’t broke, don’t fix it.” Other countries have a different standpoint when it comes to using new technologies. Japan proudly displays new technologies-which may or may not have the potential in making one’s life simpler; this may be part of the reasons why Japan has so readily accepted induction stovetops.

There are possibly many reasons not considered by this paper that may play a role in modernizing Japan as a technologically advanced superpower; for example, the differing mindsets of Japanese people compared to North Americans. Looking at consumer reports, there are several integral roles which are common amongst all of them. The determining roles for induction stovetops are the following: the convenience, the price, and the safety of the product.

Induction stovetops are scarce in variety and significantly priced more than other conventional stovetops (Sadhu et al., 2010, p. 652). Electrical stovetops, which are less efficient and cheaper than induction stovetops, have a larger consumer base since electrical energy is relatively cheap; North Americans do not look for long term savings as it may take a long time to start seeing any savings. Gas stoves are also very popular as well because of their attractive price and the price of gas is relatively low. In Japan, the energy cost is several times greater; therefore the Japanese are inclined to search for alternative stovetops for efficiency reasons in order to save money. In Japan, electricity cost above 20 cents/kWh U.S. while in British Columbia electricity costs a little above 6 cents/kWh U.S. (U.S. Energy Information Administration, 2010). Convenience can potentially overpower cost (i.e. cars versus bicycles) but is there greater convenience with induction stovetops?

Another annoyance consumers may have about induction stovetops is they do not have direct control of the cooking temperature. Commercial induction stovetops use a temperature level scheme instead of an adjustable dial. In gas or electric stovetops there is usually several dials in which the consumers are able to choose a custom temperature, enabling users with more control over how hot the stove may be. Chefs like to have full control of the temperature of their cooking apparatus. There is technology currently in development for the induction stovetops to enable the consumer direct access to temperature controls (Paesa et al., 2009, p. 1124). The reason full control is not currently implemented is because of the simplicity of current switch designs (the inverter topology). The inverter topology provides a smaller manufacturing cost when compared to the use of complex algorithms which also require sensors to determine the temperature.

There is a problem with the dial system in electric and gas stovetops. There is a slow response time when switching the dial to a lower or higher heat concentration. This problem is not related to the dial control, but how the heat is produced by the gas and electric stovetops. When it comes to response time of induction stovetops and how fast the hobs can change in temperature, induction stovetops have an advantage. Induction stovetops have a fast temperature response time; when the temperature level switch is changed to a different setting the induction stovetop will respond faster than gas and electric stovetops (Nicoll, 2007). Chefs may enjoy the faster response time, but this may potentially require chefs to cook at a faster rate.

Working in a kitchen can be tough due to the stressful and excessively warm working environment. Since kitchen labour is a demanding occupation, workers usually work in an overall negative environment. To improve the happiness of workers, businesses could switch to different stovetop technology. There is proof of workers being more psychologically stable in a kitchen which uses induction stovetops versus gas stovetops (Matsuzuki et al., 2008, p. 363). With gas stovetops, the kitchen had an overall higher radiant heat index and global temperatures when compared to induction stovetop only kitchen. Not only was the temperature lower for the induction stovetop kitchen, it was also shown that workers generally had a lower heart rate, lower blood pressure, lower oxygen intake, and overall the workers had lower amounts of work (in a physical context). For gas stovetops, workers would be required to move in awkward positions in order to avoid the gas burner.

Safety is the last on the list of topics this section discusses about consumer needs. There are many misconceptions about the safety of induction stovetops. Induction stovetops are known to have an extremely low frequency (ELF) and a radiofrequency associated with them. According to the World Health Organization (WHO), there is no substantial evidence suggesting any long term health effects from ELF (World Health Organization, 2007, p. 355). WHO determined there is very little evidence surrounding ELF long term health effects. Even with the lack of evidence WHO still recommends people still lower there ELF exposure. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) makes recommended exposure thresholds, which all electrical equipment (in certain countries) should comply with (International Commission on Non-Ionizing Radiation Protection, 1998, p. 10).

Radiofrequency is the other known radiation produced by induction stovetops. This type of radiation is known for multiple negative effects (Occupational Safety & Health Administration, 2005). There is a misconception with how radiofrequency works. The range of radiofrequency is extremely short, and the amount of radiation coming from an induction stovetop that can interact with a person is well below the limit recommended by ICNIRP. There is also shielding within the induction stovetop to help prevent the leakage of radiofrequency (Miyoshi et al., 1983, p. 496). In everyday operations, many North Americans interact with radiofrequencies from cell phones to microwaves. The consumers' perception of induction stovetop radiofrequency should be identical to that of those devices since they function similarly.

People with pacemakers have a different level of tolerance of radiation or electric fields than those thresholds values created by ICNIRP. Consumers with pacemakers are more at risk due to electromagnetic fields which can disrupt the pacemaker from working properly. The electric fields from induction stovetops do affect pacemakers, but only at minimal ranges. An induction stovetop with a pan cannot be placed correctly over the hob which has the largest electromagnetic field the stove can produce; this field can cause interference to a pacemaker at most 34 cm away (Hirose et al., 2005, p. 543). This distance is relatively small and it is unlikely that a person with a pacemaker would be that close to an induction hob. Furthermore, if a pot was placed correctly on top of the hob, the electromagnetic field would decrease significantly, reassuring the likelihood of a pacemaker not retrieving any interference (Stuchly et al., 1987, p. 67). There is a risk for one group of pacemaker individuals though; non-dependent unipolar pacemaker users are at risk if the pot is not concentric and if the person stands as close as possible (Irnich et al., 2006, p. 381).

Induction stovetops are quite safe for the average consumer. Induction stovetops can provide convenience to some and annoyance to others. Induction stovetops cost more than their electric or gas counterparts. Induction stovetops however have a higher efficiency compared to gas stovetops.

So, are induction stovetops socially acceptable for the new SUB? When analyzing the social aspect of the triple-bottom line assessment, the conclusion reached is that the induction stovetop is not necessarily a better choice, but an equivalent one. Based on social impacts, implementation of gas stovetops over induction stovetops is better since the current SUB is already using gas stovetops. Reasons for choosing gas stovetops are that that maintenance infrastructure for gas stovetops is already known, and many commercial kitchens in North America already use gas stovetops. Since kitchen labour is already familiar with gas stovetops, why change? (See the irony?)

5.0 CONCLUSION

The triple bottom line assessment in this study shows that economically, the induction stovetop is not preferable unless electricity rate goes down or/and gas rate goes up in the future; environmentally, the induction stovetop is preferred only if the electricity is derived from low emission sources such as hydro; and socially, the gas stovetop is preferred because changes in stovetop is only warranted when there is need for change and since the kitchen infrastructure and cooking environment are already built around gas stove technology which has already proven itself reliable, there is no need for a change. This study concludes that it is not advisable to implement the induction stoves into the new SUB. Further studies would need to be carried out when induction technology in oven becomes more main stream in order to see if it's viable to eliminate gas all together from the kitchen and to see whether the electricity market allows induction technology to be competitive compared to gas.

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