

**An Investigation into Types of Display Board and Interactive**

**Display Content for the New SUB**

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## **APSC 261 - Sustainability Project**

### **An Investigation into Types of Display Board and Interactive Display Content for the New SUB**

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## **Abstract**

This report investigates the feasibility and effects of putting in a display board in the new Student Union Building at the University of British Columbia (UBC). Through the use of articles and past surveys, this report finds that UBC needs to communicate their initiatives in a better fashion. This document also reinforces the need to have a proper marketing perspective for a positive impact of the community. A display board is the ideal way to communicate an eco-friendly lifestyle. Installing a display board is feasible if the stakeholders decide on multiple projector based displays, as this option offers the best environmental, social and economic trade-offs. The content to be displayed must be interactive and dynamic to effectively keep the community's attention. It is important to note that there is a marked reduction in a user's overall information acquisition with time. Hence, all recommendations implemented in the display board should have a positive effect on the UBC community.

Using the triple bottom line assessment, it was found that projectors are not only economically attractive due to its low cost and ease of maintenance but also environmentally- and user-friendly. The display content ought to be frequently updated to prevent losing the interest of the SUB users on campus matters and sustainability development. Energy consumption metrics and Twitter were found to be effective in increasing environmental awareness and promoting sustainable use of resources. It is recommended to set up a student committee to manage the display content to promote student involvement in UBC's sustainability efforts. All in all, the recommendations made in this report are believed to have positive economic, environmental, and social impacts on the SUB users in general and the UBC population as a whole.

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## **List of Abbreviations**

AMS:	Alma Mater Society
CSS:	Cascading Style Sheets
EKM:	Environmental Knowledge Management
GHG:	Green House Gases
HTML:	HyperText Markup Language
LCD:	Liquid Crystal Display
LED:	Light Emitting Diode
SUB:	Student Union Building
UBC:	University of British Columbia

## **1.0 Introduction**

In this report, we have investigated the use of display board(s) in the new SUB. We have examined the types of content to be displayed and the manner in which it is displayed such that, from the Triple Bottom Line, the social, environmental and economic requirements are met. This included displaying content such as the different types of energy saving metrics from around UBC and other ways that students could interact with the display and engage with it in a more social way. As well we studied the effectiveness of advertising techniques to see if that could aid in influencing the viewers of the display board. The investigation centered on these issues since it is the goal of the display board to promote awareness among the SUB's population of UBC's Green initiatives around campus. Also, the economic consideration was very important since it is not only important to be environmentally sustainable but financially stable, which meant that things like maintenance and replacement costs were factored into the choice for display board. At the end of this report, we recommended the next course of action for the SUB stakeholders to take with regards to the display board.

## 2.0 UBC's initiatives

University of British Columbia (UBC) is a leader in its initiatives for sustainable development. UBC has earned great scores from a couple of important benchmarks in sustainability. UBC has a Gold rating from the Sustainability Tracking and Rating System (STARS) and an A on its College Sustainability Report Card. Such results are not achievable without a superior focus on green technology and generating pro-environmental behavior in the university community.

UBC has a unique condition since it is a small city with its own utilities. The university has developed its campus into a living laboratory for environmental sustainability. Within The UBC Plan (UBC, 2009), UBC promises to grow a sustainable community to help promote environmental leadership. The university is a partner of change for advancing technology and social behavior in an eco-friendly mindset. Rather than only looking at the financial cost, UBC will also consider the social and environmental impacts to lead towards a sustainable future. The university's major goal is to move towards carbon neutrality.

The UBC Vancouver Campus: Climate Action Plan (UBC, 2010) documents these impressive goals of carbon neutrality and reduction of Greenhouses Gases (GHG). Three targets were made for the reduction of GHG, as seen in Table 1.

**Table 1 - UBC’s GHG Targets**

GHG Target	Key Strategies
33% below 2007 by 2015	Continuous commissioning program for core academic buildings Behaviour change initiatives Convert existing district energy system from steam to hot water Implement biomass gasification cogeneration system (UBC Bioenergy Research and Demonstration Project) Fleet management activities, including: <ul style="list-style-type: none"> <li>• Incremental costs of transitioning to a low emission fleet</li> <li>• Equipment to track vehicle usage (telematics)</li> <li>• Infrastructure for electric and natural gas powered vehicles</li> </ul> Reduce GHG intensity of electricity generation (provincial action)
66% below 2007 by 2020	Fuel switching from natural gas to renewable sources
100% below 2007 by 2050	Further fuel switching from natural gas to renewable sources Export of energy to the UBC community creates offsets and results in UBC becoming a “net exporter” of energy

The first is the reduction of GHG by 33% by 2015; this goal will be met by improving the efficiency of current buildings' energy usage, changing the campus heating system from steam-based to hot water-based, and the introduction of the UBC Bio-energy Research and Demonstration Project. UBC will aid programs and activities that promote energy-conscious behaviors. By 2020, UBC aspires to transfer over to a sustainable energy system and have less reliability on natural gas. By 2050, UBC is to be a “Net Positive Campus”, which means that there will be no GHG emissions from the consumption of natural gas, fossil fuels and electricity.

## 2.1 Community Knowledge

In a study done in 2010 by undergraduate students at UBC, it was found that students as well as faculty were ignorant of what the university and the Alma Mata Society (AMS) were doing (Baird, Chen, He, Miller, & Tso, 2010). Surveying 100 campus-goers, they found that, other than UBC’s UPASS, most of those taking the survey were unaware of the initiatives and only a small percent had ever used them, as seen in Table 2. The medium through which the knowledge of UBC’s and AMS’s initiatives are spread is by signs, posters and word of mouth. Of those surveyed, most found out about an initiative by walking through the center hub for students - the Student Union Building (SUB).

**Table 2 - 2010 Survey Results**

Relation to UBC	SURVEY 1		%						
Student	93	93%		Aware	7	7%	3-4 times	29	29%
Faculty	2	2%		Unaware	4	4%	5+ times	10	10%
Visitor	0	0%		<u>Bike Co-op</u>			0 times	8	8%
AMS F&B Staff	0	0%		<u>Used</u>	8	8%			
AMS Staff - Other	2	2%		Aware	41	41%			
Other	5	5%		Unaware	39	39%			
<b>Awareness of Sustainability Initiatives</b>				<u>Sprouts</u>			<b>Awareness of other Sustainability Organizations</b>		
Aware	37	37%		<u>Used</u>	8	8%	Aware	19	19%
Unaware	63	63%		Aware	19	19%	Unaware	81	81%
				Unaware	61	61%			
<b>Mode of hearing about initiatives</b>				<u>UBC Farm produce in F&amp;B outlets</u>					
Flyer	11	11%		<u>Used</u>	17	17%			
Online	14	14%		Aware	23	23%			
Walked by in SUB	27	27%		Unaware	49	49%			
Word of Mouth	18	18%		<u>Water Bottle Re-filler</u>					
Campus Event	5	5%		<u>Used</u>	31	31%			
AMS Staff	6	6%		Aware	29	29%			
Other	3	3%		Unaware	31	31%			
Unaware of any initiatives	49	49%		<u>LOV Menu Options</u>					
				<u>Used</u>	4	4%			
<b>Usage and awareness of AMS Sustainability Initiatives</b>				Aware	4	4%			
<u>New Sustainable SUB</u>				Unaware	80	80%			
<u>Used</u>				<u>Fair Trade Coffee</u>					
Aware	61	61%		<u>Used</u>	32	32%			
Unaware	28	28%		Aware	23	23%			
<u>SUB Waste Audit</u>				Unaware	36	36%			
<u>Used</u>				<u>Reusable Mug Discount</u>					
Aware	12	12%		<u>Used</u>	42	42%			
Unaware	53	53%		Aware	25	25%			
<u>Phase out sales of bottled water</u>				Unaware	27	27%			
<u>Used</u>				<u>Biodegradable food containers</u>					
Aware	14	14%		<u>Used</u>	29	29%			
Unaware	64	64%		Aware	16	16%			
<u>UPASS</u>				Unaware	43	43%			
<u>Used</u>				<b>Awareness of Volunteer Opportunities</b>					
				Aware	5	5%			
				Unaware	95	95%			
				<b>Frequency of Recycling</b>					
				1-2 times	53	53%			

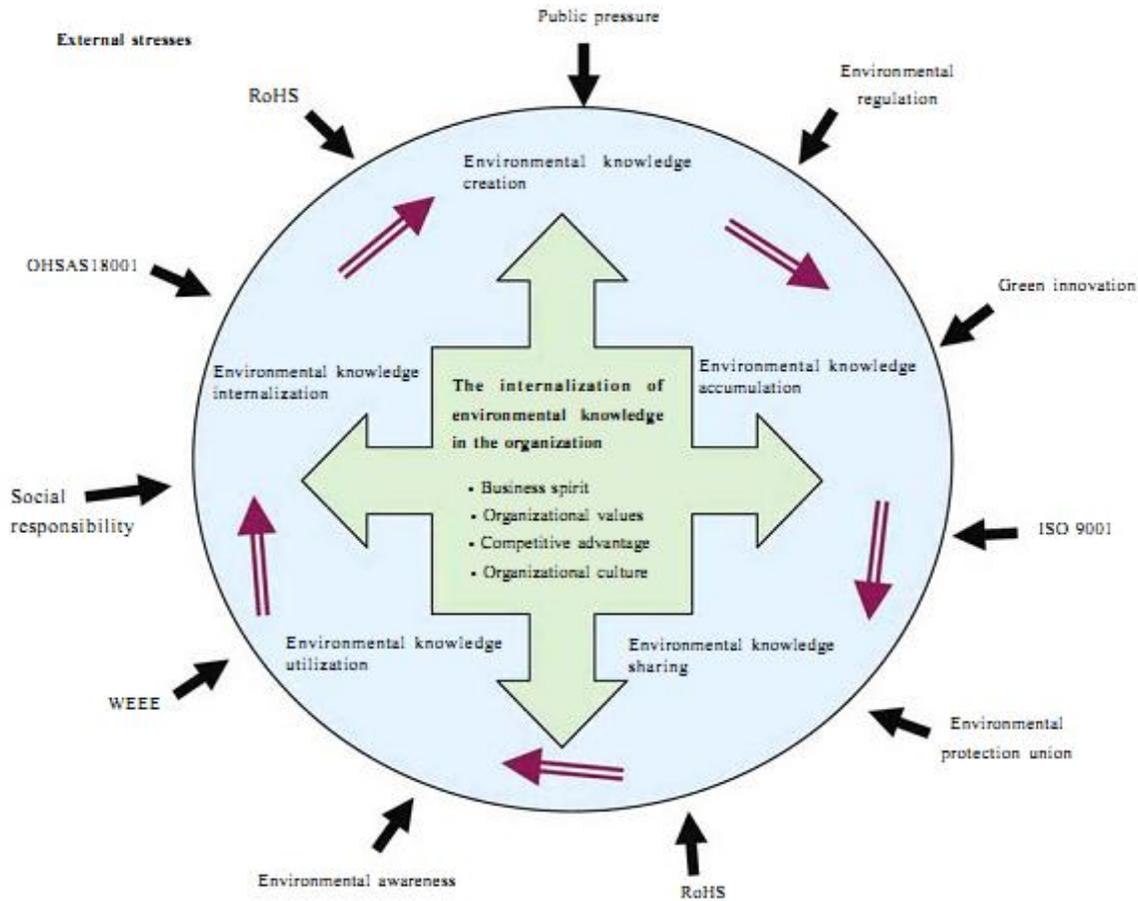
## 2.2 Increasing Awareness

The SUB is a centralized building which an average student passes through or enters with greater frequency than any other building on campus. This is due to its ideal location of being both near to classrooms and in the path of public transit. It is therefore the optimal location for UBC and AMS to foster this sustainable consciousness. The key for sustainability to be popularized is to increase the spread of environmentalism effectively (Fox, Hundley, Cowan, Tabas, & Goodman, 2009). Students and faculty need to see environmentalism as being a cornerstone principle for going forward. The community needs to recognize how sustainable awareness is important for solving problems today and in the future (Dono, 2010).

They need to start thinking about their effects on nature, such as looking at the triple bottom line. One way to remind the campus-goers of their effects on nature is a display board to capture its audience attention and guide their thoughts to a greener future. Campus goers will make the connection with what UBC is doing surrounding sustainability and their daily actions.

### 3.0 Effectiveness of a Display Board

#### 3.1 Comparison to EKM (Environmental Knowledge Management)



**Figure 1 - EKM system at China Steel Corporation (Huang & Shih, 2009, p. 44)**

The Design Committee of the new SUB has proposed the display of sustainability information and a running feed of energy usage for the building on the display board to create awareness on sustainable lifestyle and activities happening at UBC. This proposal is similar to the “Environmental Knowledge Management” (EKM) system implemented in the China Steel Corporation in Taiwan (Huang & Shih, 2009). As seen in Figure 1, the EKM system promotes environmental knowledge amongst the employees in their design and decision-making. The implementation of this system by the company for three decades has led to an increase in the company’s environmental and financial performance as well as a reduction in GHG emissions and total energy consumption as seen in Figure 2.

The display board can implement a system similar to the EKM model to promote awareness in the UBC community.

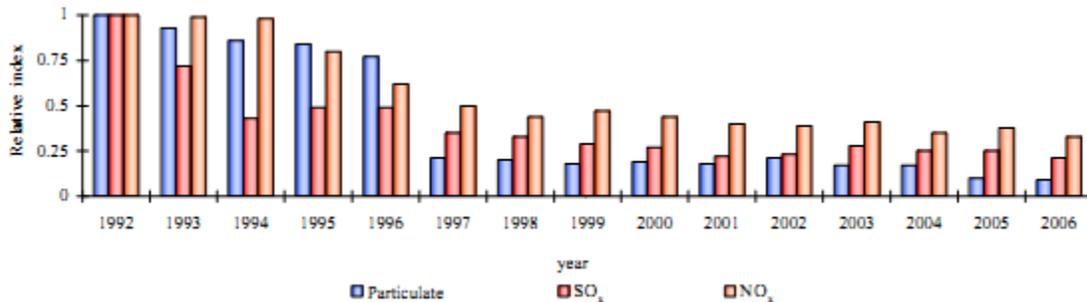


Figure 2 - Air pollution per ton of steel production (Huang & Shih, 2009, p. 45)

### 3.2 Display Features that Affect Effectiveness

For the installation of a display board in the new SUB atrium, there is a need to evaluate the social implications. The most important social aspect of using a display board is its effectiveness in conveying the message of environmental sustainability to the community. A display board is not effective if the information cannot be captured by the viewers. According to the conclusion of a case study conducted by Lehmann and Moore (1980), there is a noted reduction in the users' overall information acquisition with time, especially past information. Therefore if the information, such as the sustainable design of the new SUB, is displayed repeatedly over a period of time, the SUB users will tend to ignore the content of the display board altogether. They will become disinterested. There is consequently a need to renew the board content frequently to promote sustainable awareness among the UBC community.

The format in which the information is presented on the display board is crucial. If the display format is congruent with the users' processing method, they will be able to process the information better (Bettman & Kakkar, 1977). As the saying goes, "A picture tells a thousand words," there is a tendency to simplify the information displayed in a busy environment, such as the new SUB, by reducing it to simple graphics. Simplifying the information into simple graphics is shown to be ineffective when a time constraint is imposed on the viewers (Verplanken & Weenig, 1993). This is the case in the busy SUB

environment where the UBC community is constantly on the move. The use of graphics has proven to lower the users' ability to recall the information displayed on the board since the line drawings will distract the users from the more important information (Painton & Gentry, 1985).

## 4.0 Types of Display Board

When determining what types of display board to use, it is necessary to understand the different forms of media presentation, which include billboards, projectors and LED/LCD flat panel displays. This is quite necessary since the way in which the content is presented is often more important than the content itself. For example, a product that appears newer, such as a flat panel display, could potentially give off the impression of being new and futuristic and thus be more energy efficient. At the same time, it may not be as energy-saving or effective as a billboard. In this section, we will explore the features of these different forms of media presentation.

### 4.1 Billboards

A billboard is typically a large advertisement or poster that one would normally see along the highway or mounted against a large wall. This is an effective form of communicating information due to its size and ease of assembly. It is however generally a static form of advertisement and is not something that will meet the functional requirements of providing an interactive display as according to stakeholder Chris Karu. The estimated installation cost for a billboard, according to the Oregon State Government, is approximately \$60,000 (Oregon Dept. of Revenue, 2007).

As seen in Figure 3 below, another version of the billboard is the Tri-Vision billboard that allows up to three different advertisements to be displayed in a periodic fashion at intermittent intervals. Just like the Mono-Vision Billboard, the amount of displayed items is static and there is no way to incorporate an interactive element to this board. This would not be very effective. In addition, the typical cost of this billboard, not including installation, could be approximately \$44,000 (Oregon Dept. of Revenue, 2007).



**Figure 3 - Tri-Vision Billboard Display (Oregon Dept. of Revenue, 2007)**

In the past few years, advertising agencies have been under scrutiny to become more eco-friendly since billboards and signed advertisements are seen all over the city. Companies like JC Decaux “replaced all of its paper-and-paste billboards with high quality, environmentally friendly, one-piece posters. Companies are implementing “High Definition (HD) billboards – a premium-quality, glue-less, recyclable, vinyl poster that can be clipped in and out of frame and reused” (Gray, 2008). These HD billboard displays are said to be more vibrant in colour and an improvement on quality.

This is a big consideration since the social aspect of the Triple Bottom Line is a major concern. We need to display something that will not only catch people’s eyes but will also have enough high fidelity that people will pay attention to it. If this can be marketed as a viable green solution, it can definitely touch upon the environmental impact. The only downside is that due to its static nature, any “wow” factor from a billboard is likely to taper off not long after its premiere, which does not initiate a social interaction and communication with the population in the SUB (Gray, 2008).

## 4.2 Digital Display

Unlike the static and fixed billboard, the content is designed and pushed onto the digital display from a remote location. This type of display, as seen in Figure 4, typically showcases a computer-generated advertisement. This results in easily manipulated content to display whatever that is viewed as important.



**Figure 4 - Digital Billboard Display (Oregon Dept. of Revenue, 2007)**

The digital displays use LED bulbs which are deemed one of the most energy-efficient forms of lighting today. The LEDs have an average useful life of approximately 100,000 hours, which works out to 11.4 years of continuous operation. The brightness of each LED diminishes by about 30% to 50% of its original illumination over its product lifespan. Due to a lack of fidelity, the bulbs will have to eventually be replaced, with some degrading sooner and others lasting much longer than its rated life. The amount of circuitry and bulbs required to operate a digital display requires large structural members to support the weight. Unlike the average weight of a static billboard being 500 lbs, the average weight of a digital display is in the range of 2000 to 6000 lbs. (Oregon Dept. of Revenue, 2007).

These displays typically come as large as 14x48 feet or smaller, which is a suitable size for the new SUB atrium. As such the cost of a square foot of display board is between \$450 and \$485. Thus for a 14x48 ft display, which is 672 ft<sup>2</sup>, the cost ranges from \$302,400 to \$325,920 (Oregon Dept. of Revenue, 2007).

These displays are not appealing from an economic perspective. But from a social perspective, seeing a large display in the SUB atrium will draw attention to the Green initiatives and other news on the display. This could be a much more effective means of influencing social change than any of the other types of displays listed in this section. A large digital display will be the best choice to educate the community in the new SUB atrium.

### **4.3 Projectors**

Projectors are another form of digital display since their content can easily be manipulated on a computer. They are typically used in classrooms and work best in low lighting environments. It is a different environment in the new SUB atrium. It is much larger with more ambient light than a typical classroom. Higher-end projectors, such as the one in Figure 5 below, come with a high lumen count, which make for a good viewing experience even in ambient lighting conditions (Branzburg, 2006). The cost of projectors ranges from \$800 to \$10,000. As well, replacement bulbs cost between \$300 and \$500 and are rated at 1,000 hours of life, which equates to 41.7 days of continuous use. Since the SUB is primarily in use for approximately 12 hours in a day, you can double the life to approximately 82 days of continuous use (Everson, 2003).



**Figure 5 - Suggested Projector to use (Epson, 2009)**

One key advantage for projectors is their mobility, replaceability, and maintainability. This is ideal since UBC would not have to hire offsite workers who specialize in large digital display installation and maintenance. UBC can just utilize the current Plant-Ops employees to maintain the well-being of the projectors. Thus the projectors are an extremely viable from an economic standpoint.

## **5.0 Interactive Features of a Display Board**

This section analyzes several types of interactive content that are to engage the public audience on sustainability.

### **5.1 Twitter**

With the improvement in technology, social media is rapidly shaping the way information is communicated. Twitter is an influential and free social media platform. It is a real-time information network, which provides the public with the most up-to-date information (Twitter, n.d.). Twitter can be used as a way to promote campus events and volunteering opportunities (Heiberger, 2011, p. 122). It can also provide a low-stress way for students to ask questions in a public forum anonymously (Heiberger, 2011, p. 122).

There are many key benefits to including Twitter on the new public display boards. Firstly, Twitter has shown to be very effective in distributing information to large groups. This is largely due to the ease of accessibility by way of mobile devices. Moreover, it has the ability to deliver updates instantly, eliminating the use of printed materials. This provides both economic benefit (i.e. no money wasted to print flyers or pamphlets) and environmental benefit (i.e. no paper consumed). For these reasons, Twitter is a powerful tool that provides environmental, social, and economic benefits.

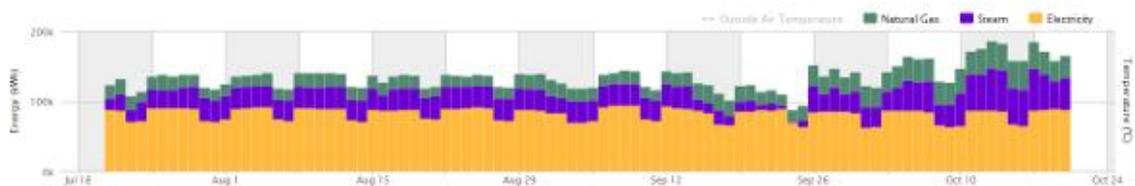
### **5.2 Sustainability tips and reminders**

Sustainability tips and reminders can educate the public with different ways on how to be more sustainable. The large display board can incorporate sustainability tips and reminders to promote the use of green technology. To increase the effectiveness of the sustainability tips and reminders of green technology, consumer behavior researchers have found that exposure to guilt appeals more in green advertisement. This can lead to a higher positive response rate. An article from the "Journal of creative communications" titled "How guilt level affects green advertising effectiveness" analyzed consumers' response on guilt appeals in advertisements.

Their experiment demonstrates an "inverse relationship between the guilt level and the consumers' attitude towards the advertisement and brand" (Jiménez, 2008, p. 247). The study's findings show that consumers react positively to small amount of guilt appeals in green advertising. An example of a low amount of guilt can be a poster reminding a person to place paper towels in a paper recycling bin. If the person chooses not to recycle the paper towel, the poster can convey a message of guilt that many trees will end up in landfills due to his/her action. These levels of guilt appeals will induce self-conscious emotions (Jiménez, 2008, p. 247). However, higher levels of guilt appeals will cause the viewer to react negatively. The hypothesis is that the viewer would feel that the advertisement is artificial and is trying to force a response from them. The effect of the public would "feel intimidated and respond unfavorably due to their perceived deprivation of freedom" (Jiménez, 2008, p. 234).

### 5.3 Resource Consumption Statistics

To raise social awareness on resource consumption in the new SUB building, a resource consumption metrics should be incorporated in the large display board. The resource consumption metrics is recommended because it has positive social, environmental, and economic impacts. The resource consumption metrics can provide the audience with a graphical representation of how close the university is to reaching the GHG reduction targets. These charts raise social awareness on sustainability and can influence the public to be more conscious on their energy usage. Pulse Energy's web-based energy tracking software is proven to "influence behavioral change and raise energy awareness" (Pulse Energy, n.d.). The following figure is Pulse Energy's web-based visual representation of the power consumption used in a building.



**Figure 6 - Pulse Energy's power consumption level per day (Pulse Energy, n.d.)**

## **6.0 Methods of interacting with the public display board**

This section compares several popular technologies that can be used to interact with the public display board.

### **6.1 i>Clicker**

The i>Clicker is an audience response system that is used in many courses at the University of British Columbia. It is an option to incorporate this system with the large display board to collect feedback and engage the public. Smith and Rosenkoetter (2009) found that the audience response system has demonstrated "an increased involvement of students, learning engagement, and increased attention in classrooms" (p. 156).

The system is used across "1000 institution and by nearly 2 million students" and is able to receive up to 750 responses per second using the iClicker device and webClicker application (iClicker, n.d.). The web>Clicker allows the audience to submit their response from their laptops or mobile phone (iClicker, n.d.). The drawback to this technology is that it requires the public to have purchased an iClicker or a webClicker license in order to be able to participate.

### **6.2 Mobile Text Messaging**

A significant amount of users have access to a mobile phone on campus. It would be useful to integrate mobile interaction with the public display board. A study was conducted at UBC that investigated the feasibility of using mobile text messaging with a public display board (Blackstock et al., 2008). The researchers created a mobile text messaging system that collected feedback from the public. The results from their study suggest that users are more likely to engage the public display board if they feel less pressured. The mobile text messaging system gives the audience the flexibility to text feedback to a phone number. Blackstock et al. (2008) found that users are less embarrassed if they have more time to compose a response compared to providing feedback immediately in a kiosk or around the large display board (p.5).

However, the drawback to this technology is text messaging service may cost the university for incoming text messages and user's money for outgoing text messages. It also takes time to develop an application to parse the text messages to produce meaningful results. The economic cost of this technology may not be the best option.

### **6.3 Mobile Application and Website**

With the growing number of users having access to mobile devices and laptops, a simple application or webpage can be used to spread awareness and collect public feedback. The university can set up a team to volunteer in managing the content for the large display board. A webpage will allow the public to submit text-related feedback through a web browser on a mobile device or a computer. The results from the webpage can be incorporated into the large display board. A polling and form feedback webpage can be implemented using simple HTML forms or radio buttons, CSS, and a database (w3schools, n.d.). Ruan et al. (2010) highlights various techniques that a mobile phone can interact with a large display. The research team demonstrated the ability to use mobile phones to send input event streams to interact with the large display board through an application (Ruan et al., 2010, p.262). The drawbacks to designing a mobile application is that it is more complex to develop compared to creating a webpage. A website is much easier to implement and it can be accessed through a browser. The webpage has both social and economic benefits.

## 7.0 Conclusion and Recommendations

The stakeholders had a variety of suggested options for implementing the display board. What we believe to be the best arrangement is “Option B” from the “New Student Union Display Board Options Proposal” provided by Chris Karu. This option implements multiple display boards around the new SUB with a centralized component in the SUB atrium. In implementing this option we recommend that projectors be used to display all information since they provide good picture quality and are easily replaceable and cheap to maintain. As well, we do not recommend implementing way-finding terminals but instead recommend that maps be displayed on boards, similar to those in a shopping mall. There is no positive social or environmental impact since most people who come to the SUB are students who know their way around UBC. From an economic standpoint, the cost of developing such software would be too expensive. This program would appear appealing at first but become unimportant with time since people will eventually know their way around.

We recommend developing a simple webpage using HTML and CSS to collect feedback from the public. A student committee should manage the content for the display board. The student committee can create polls on the website to collect feedback as well as to provide frequent content updates for the display board.

Finally, we recommend having a Twitter feed integrated with the large display board to provide students with the latest sustainability tips and reminders. Twitter will be able to promote social awareness on sustainability to a large group of audience without the use of printed materials. We recommend integrating energy consumption metrics into the display board as energy tracking software is proven to increase environmental consciousness. Twitter and resource consumption metrics have positive social, economic, and environmental benefits.

## 8.0 References

- Baird C., Chen A., He C., Miller A., & Tso E. (2010). Proposal for Strategies to Improve Awareness and Participation of the Alma Mater Society's Sustainability Initiatives at the University of British Columbia. UBC SEEDS.
- Bettman, J. R., & Kakkar, P. (1977). Effects of Information Presentation Format on Consumer Information Acquisition Strategies. *Journal of Consumer Research*, 3(4), 233-240. doi:10.1086/208672
- Bill Board Cost Factors: Off-premise Outdoor Advertising, (Property Tax Division Report 05.07)*. Retrieved from Oregon State Government website:  
[www.oregon.gov/DOR/PTD/docs/303-418.pdf](http://www.oregon.gov/DOR/PTD/docs/303-418.pdf)
- Blackstock, M., Deutscher, M., Finke, M., Giesbrecht, C., Tang, A., Leung, R., & Tain, G. (2008). Designing for Bystanders: Reflections on Building a Public Digital Forum. Retrieved from <http://www.magic.ubc.ca/wiki/pmwiki.php/Projects/MAGICBoard>
- Branzburg, J. (2006). Effectively use an LCD projector -- share your multimedia riches with the entire class. *Technology & Learning*, 27(1), 38.
- Dono, J. (2010). The Relationship between environmental activism, pro-environmental behaviour and social identity. *Journal of Environmental Psychology*, 30(2), 178-186.
- Epson PowerLite 410W Short-Throw Projector*. (2009). Epson. Retrieved November 22, 2011 from <http://www.epson.com/cgi-bin/Store/jsp/Product.do?sku=V11H330020>
- Everson, F. P. (2003). Buying an LCD projector for emergency nursing continuing education: One ENA state council's experience. *Journal of Emergency Nursing: JEN : Official Publication of the Emergency Department Nurses Association*, 29(2), 168-170. doi:10.1067/men.2003.64
- Fox, P., Hundley S., Cowan, D.J., Tabas, J., & Goodman, D. (2009) Teaching sustainability: Course, program and degree considerations. *Management of Engineering & Technology*, 2240-2245. doi:10.1109/PICMET.2009.5261847

- Gray, R. (2008). Green credentials on display. *Marketing*, 33.
- Heiberger, G. (2011). The Effect of Twitter on College Student Engagement and Grades. *Journal of computer assisted learning*. Vol. 27., no. 2., pp. 119, doi:10.1111/j.1365-2729.2010.00387.x
- Huang, P. S., & Shih, L. H. (2009). Effective environmental management through environmental knowledge management. *International Journal of Environmental Science and Technology*, 6(1), 35-50. Retrieved from <http://www.ceers.org/ijest/issues/full/v6/n1/601004.pdf>
- iClicker (n.d.). In *i>clicker*. Retrieved November 19, 2011 from <http://www.iclicker.com/Products/iclicker>
- iClicker (n.d.). In *web>clicker*. Retrieved November 19, 2011 from <http://www.iclicker.com/Products/webclicker>
- Jiménez, M. (2008). How Guilt Level Affects Green Advertising Effectiveness? *Journal of creative communications*, 3(3), 231. doi:10.1177/097325861000300301
- Lehmann, D. R., & Moore, W. L. (1980). Validity of Information Display Boards: An Assessment Using Longitudinal Data. *Journal of Marketing Research*, 17(4), 450-459. Retrieved from <http://www.jstor.org/stable/pdfplus/3150498.pdf?acceptTC=true>
- Middlemiss, L. (2011) The Power of Community: How Community-Based Organizations Stimulate Sustainable Lifestyles Among Participants. *Society & Natural Resources*, 24 (11) 1157-1173.
- Painton, S., & Gentry J. W. (1985). Another Look at the Impact of Information Presentation Format. *Journal of Consumer Research*, 12(2), 240-244. doi:10.1086/208512
- Pulse Energy (n.d.). In *Improving Energy Efficiency*. Retrieved November 19, 2011 from <http://www.pulseenergy.com/site/utilities/energy-efficiency>
- Pulse Energy (n.d.). In *Pulse Check*. Retrieved November 19, 2011 from <http://www.pulseenergy.com/site/pulse-platform/pulse-check/>

- Ruan, H., Qian Y., Zhang, Y., & Zhou, M. (2010). TouchInteract: An Interaction Technique with Large Displays Using Touchscreen-Phone. *Ubiquitous Intelligence & Computing and 7th International Conference on Autonomic & Trusted Computing (UIC/ATC), 2010*, 26-29, 262-265. doi:10.1109/UIC-ATC.2010.36.
- Smith, D., & Rosenkoetter, M. (2009). Effectiveness, Challenges, and Perceptions of Classroom Participation Systems. *Nurse Educator*, 34(4), 156-161.  
doi:10.1097/NNE.0b013e3181aab7e3
- Twitter (n.d.). In *Twitter is the best way to discover what's new in your world*. Retrieved November 19, 2011 from <http://twitter.com/about>
- UBC (2009). Place and Promise: The UBC Plan Retrieved November 6, 2011 from <http://www.sustain.ubc.ca/about-us/plans-reports>
- UBC (2010). UBC Vancouver Campus: Climate Action Plan. Retrieved November 6, 2011 from <http://www.sustain.ubc.ca/about-us/plans-reports>
- Verplanken, B., & Weenig, M. W. H. (1993). Graphical energy labels and consumers' decisions about home appliances - A process tracing approach. *Journal of Economic Psychology*, 14(4), 739-752. doi:10.1016/0167-4870(93)90019-H
- w3schools (n.d.). In *HTML Forms and Input*. Retrieved November 19, 2011 from [http://www.w3schools.com/html/html\\_forms.asp](http://www.w3schools.com/html/html_forms.asp)