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Competitive Environmental Strategy of Sundlaug Kópavogs

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HÁSKÓLI ÍSLANDS

Competitive Environmental Strategy of Sundlaug Kópavogs

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Preface

I am currently employed at Sundlaug Kópavogs - a swimming pool in the Icelandic municipality of Kópavogur and I see opportunities for improvements in environmental, social, and economic perspective in the management of the pool.

I believe that each individual bares a certain responsibility for the natural environment and the well-being of the planet. If every individual does his part, the world would become a better place. However, people, companies and organizations need an incentive to increase their environmental efficiency. One of the best incentives for companies to foster environmental protection is the potential for improvement in both company image and monetary gains. If a company succeeds in simultaneously increasing its environmental and economic efficiency, it could serve as an example to others.

We should not expect governmental decisions to change the way we behave and solve all current environmental problems in a miraculous manner. The time has come to act and each action, no matter how small, counts. It might sound naive, but I believe that I can make a difference by undertaking a few small steps such as improving my workplace. If I manage to introduce a way of thinking that links economical efficiency with the preservation of the environment, I can not only change my workplace but also set an example for swimming pools across the country.

Yes, I believe that public swimming pools can become more efficient, enjoyable and profitable if all actors from in the ‘sustainable development paradigm’ are considered and worked upon.

Abstract

This thesis is a pioneer study on competitive environmental strategy for swimming pools. The research activity is focused on a specific swimming pool - Sundlaug Kópavogs, situated in the Icelandic municipality of Kópavogur.

This thesis analyzes whether it is possible to increase the environmental and economic efficiency of Sundlaug Kópavogs by looking for actions that result in minimal tradeoffs between economic cost and environmental efficiency.

In order to understand the business implications of environmental issues, one must analyze its business drivers. This study relies on Hoffman's (2000) framework for analyzing the business drivers of environmental protection of Sundlaug Kópavogs using both quantitative and qualitative analysis tools, such as questionnaires and in-depth interviews.

The main outcome of the research is that the leading business driver of Sundlaug Kópavogs is the resource driver. Based on the prioritization of resource drivers, this thesis highlights ways of saving resources, which improve the economic efficiency of the swimming pool while reducing its negative environmental impact. Such actions involve modifying the admission system, changing the water purification system, replacing showerheads and cleaning materials, as well as introducing swimming pool covers, waste sorting and increase recycling.

Keywords: swimming pools, economic efficiency, environmental efficiency, tradeoffs.

Ágrip

Í þessari brautryðjendarannsókn á samkeppnisforskoti og stefnumótun sundlauga í umhverfismálum er sjónum sérstaklega beint að Sundlaug Kópavogs. Markmið rannsóknarinnar er að greina möguleika Sundlaugar Kópavogs á aukinni skilvirkni í rekstri og leita leiða til þess að draga bæði úr kostnaði og auka skilvirkni í umhverfismálum. Til þess að skilja til fulls þau áhrif sem umhverfisstjórnun hefur á fyrirtæki er nauðsynlegt að greina þá hagrænu hvata sem eru til staðar. Í þessari rannsókn eru hagrænir hvatar Sundlaugar Kópavogs greindir með líkani Hoffman´s (2000) þar sem notaðar eru bæði megindlegar og eigindlegar rannsóknaraðferðir, svo sem spurningalistar og djúpviðtöl. Niðurstöðurnar leiddu í ljós að auðlindahvatar eru ráðandi í rekstri Sundlaugar Kópavogs. Bent er á leiðir til þess að draga úr auðlindanotkun en það eykur efnahagslega skilvirkni sundlaugarinnar ásamt því að draga úr neikvæðum umhverfisáhrifum. Þessar aðgerðir geta til dæmis verið að endurskoða aðgöngumiðakerfi, skipta um vatnshreinsikerfi, sturtuhausa og hreinsiefni ásamt því að nota yfirbreiðslur yfir laugina og auka flokkun og endurvinnslu.

Lykilorð: Sundlaugar, efnahagsleg skilvirkni, umhverfisleg skilvirkni, málamiðlun.

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1 Introduction

Swimming pools and spas provide exercise, leisure, and pleasure for their users. However, the economic cost and the environmental impact of swimming pools should not be underestimated. In order to maintain a high level of hygiene, such facility needs to be regularly antisepticised. The corresponding sanitation often entails the use of vast amounts of chemicals, and maintaining appropriate water temperature requires large quantities of energy, and a substantial input of clean water. The environmental impact of constructing such a facility can be tremendous as well. The economic cost of running a swimming pool[1] is interconnected with its environmental impact. Furthermore, the most economically burdening inputs of the swimming pool have the greatest negative impact on the natural environment.

Generally, the main environmental impact and economic cost of maintaining a pool is linked to energy production required for heating the pool, especially if it is an outdoor pool operating all year round, and to the chemicals used for sanitation of the water as well as the facility (Harper, 2011). Additional energy demand is required to circulate, purify and pump the water and the chemicals that keep the pool clean. Pools also have both positive and negative human health impacts. For example, they can be a great source of recreation and leisure time: exercise and relaxation. However, some of the users get allergic reactions, or are sensitive to the chemicals used to sanitize the water. Furthermore, the sanitation processes of indoor swimming pools have been shown to have direct correlation with asthma incidences and other respiratory irritations (Dyck et al., 2011; Schets et al, 2011; Gomà et al, 2010).

When it comes to leisure, every nation has its traditions. Bathing has been an important part of Icelandic culture since the settlement in the 9th century AD. It is not surprising that swimming pools in Iceland are often portrayed as one of the "must-do" things in the country. As a matter of fact, the importance of swimming pools as part of the Icelandic culture is commonly remarked upon: "In our part of the world said traditions tend to

[1] This paper refers to a "swimming pool" as: the area of and around the artificial basin filled with water including (where present): the area around the swimming pool, the shower area, locker-room area, staff area and all the other infrastructure used and regarded as part of the swimming pool.

evolve around keeping warm. Finland has saunas, Russia has vodka, Iceland has swimming pools" (Rúnarsdóttir, 2013, retrieved August 18, 2013);"Visiting Iceland and not enjoying a dip in one of many swimming pools in the country is like going to Spain and keeping only in the shadows" (Total Iceland, 2012, retrieved August 18, 2013).

Iceland wants to capitalize on its clean image. Therefore, the rich cultural significance of swimming pools should be managed accordingly with the clean and pure image of the country.

1.1 Report Purpose

Swimming pools have variety of diversified problems and obstacles at their path of achieving sustainability in different areas in different countries. Making swimming pools more sustainable is a rather broad topic for a single paper. This is why the researcher will concentrate on two aspects of the sustainability paradigm, the environment and the economy (Figure 1, p.3). In addition, the focus of the research will be set on a specific country, Iceland, and a particular swimming pool, Sundlaug Kópavogs.

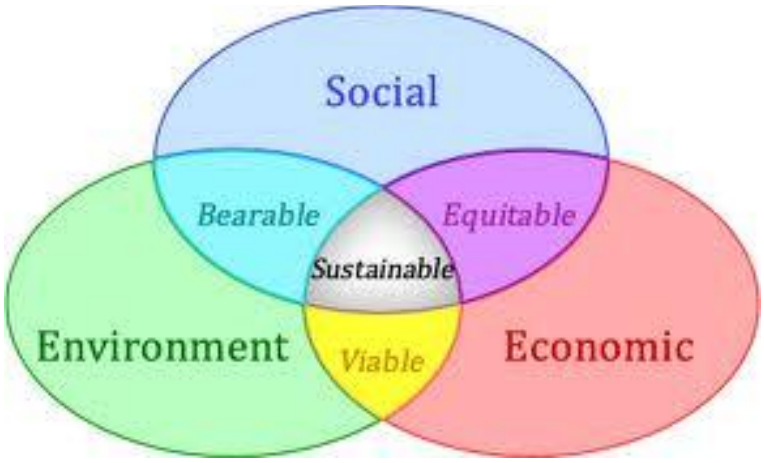


Figure 1 Sustainable Paradigm. Reference: adopted from Adams (2006).

The aim of this research is to find means to increase the environmental and economic efficiency at Sundlaug Kópavogs (hereafter SLK), and thus increase its sustainability. This paper seeks to explore the question, how can Sundlaug Kópavogs become more sustainable and efficient, with minimal tradeoffs between economic and environmental efficiency? In order to understand how this could be done, the researcher relies on Andrew Hoffman's (2000) framework for business driver analyses to assess the relevant business drivers, identify those that are most significant as well as those that are less significant, but have

potential to make a difference. Identifying the leading business drivers will pinpoint areas where improvements could lead to increase in economic efficiency of the pool while reducing its environmental impact, with minimal tradeoffs between the two.

1.2 Methods

In order to analyze and increase the environmental and economic efficiency of SLK the researcher used qualitative, quantitative and gap analyses. The only way to get the holistic and objective perspective regarding SLK's operations is to communicate with people working for the swimming pool (managers, employees, executives etc.) as well as people who are not employees of SLK (suppliers of goods and services, managers of other swimming pools etc.). In this way, the operational diversities in different swimming pools will become evident along with methods considered most effective in the context of environmental and economic efficiency.

Very few studies have focused on swimming pools and spas in the context of environmental and economic efficiency; therefore, this thesis has both academic and practical contributions. The academic contribution consists of using Andrew Hoffman's framework for analyzing business drivers for a swimming pool in a way that has not been done before as well as adding to the literature on swimming pools and spas. The practical contribution of the thesis will be to increase environmental awareness and to contribute to environmental efficiency in public swimming pools in Iceland, while maintaining or even increasing their economic efficiency.

Initially the main business drivers of SLK were identified. The analysis of the leading business drivers is the first major step in the research, since it displays the motivation behind the decision-making processes at SLK. Once the driver that has the greatest influence on decision-making processes is identified, it could be used as a "push factor" in companies that are more reluctant to accept any type of major change (Hoffman 2000).

The analyzes of the leading business drivers will be used for identifying ways of reducing the negative environmental impact of SLK with minimal tradeoffs between the environment and the economic efficiency of the swimming pool.

If the proposed suggestions for improvement prove to be successful, the managers at SLK would be more open to change, which in turn will bring SLK on the track to

sustainability. Nevertheless, one should keep in mind that the swimming pool could never become truly sustainable, because sustainability is a journey, not a destination.

In addition, this thesis may increase the interest and research activities linked to the environmental impacts of swimming pools, find new ways for sanitation and highlight the lack of Life Cycle Analysis[2] (hereafter LCA) on the user phase of swimming pools. If done properly, LCAs for swimming pools could provide critical data regarding the biggest areas of impact and improvement in all stages of the life cycle of the swimming pool (i.e. construction, use and disposal stage). This could bring benefits to the natural environment, as well as to the swimming pools (using less natural resources i.e. electricity, chemicals, water; products that are less harmful for the eco environment - certified paper, cleaning materials etc.).

There are many issues and obstacles that swimming pools need to overcome on their path to sustainability, no matter what is their location. Making swimming pools more sustainable is a rather broad topic for a single paper. As stated before, this is why this report concentrates on the economic and environmental aspects of the sustainability paradigm (Figure 1, p.2) and a particular swimming pool (SLK). This will make the research more focused and precise, since factors such as area, existing equipment and infrastructure, current use of resources and utilities are unique for different areas. The research also will consider issues of theory, methodology and policy.

1.3 Thesis overview

The researcher will provide a review on the existing literature on swimming pools and spas in the context of issues of environmental efficiency, economic efficiency and human health.

Then, information regarding Sundlaug Kópavogs and the way it operates will be presented, followed by a description of the methodology used for business driver analyses. The researcher will introduce Andrew Hoffman's (2000) framework and adopt

[2] Life-Cycle Analyses is a holistic method for assessment of environmental impacts related to all stages of a product´s lifetime from-cradle-to-grave, i.e. from the extraction of raw materials through material transportation, processing, manufacture, distribution, maintenance, and repair to disposal and recycling (ISO 14040, 2006). In the process of LCA inventory of relevant energy and material inputs and environmental releases are gathered; the potential impacts associated with the identified inputs and releases are evaluated; when this is done, the results are interpreted to help make a more informed decision (ISO 14040, 2006).

it for examining the business drivers at SLK. Finally, based on the leading business driver, the researcher will propose suggestions for improvement, which would benefit both the environment and the economy of the swimming pool.

2 Publications and research

The issues of environmental and economic efficiency are interlinked to such extent that it is hard to classify an issue in a given category. For example, is unnecessary use of resources in a given company an issue of environmental or economic consideration? The answer must involve both parts since the unnecessary use of resources has a negative impact on the environment as well as on the economy of the company.

The researcher decided to tackle this problem differently and divide the literature into two relative categories: issues of design phase and issues of the use phase of swimming pools. However, those categories are subject to interpretation depending on the viewpoints of the researcher and the reader. If a company is designed without having the concept of sustainability in mind, it may experience economic and environmental problems that could be otherwise avoided. In the same manner, some issues of the use phase could be caused by poor design.

2.1 Design phase issues

The concept of sustainability is involved in every human activity and well-being, recreational activities and sports are no exception. Throughout history, swimming pools and spas have been a health-related privilege. The acronym "S P A" originates from the Roman phrase "Sanus per Aquam" meaning health through water (Pytell, 2009, retrieved October 10, 2013). In ancient Rome and Greece, swim classes were part of the education system, yet during the Middle Ages, swimming became highly unpopular since many believed that water sped up the spread of the plague and other epidemics. Swimming pools and spas did not become popular until the middle of the 19th century, when it was realized that it is beneficial, rather than harmful for the human health (Martins, n.d.). This could be a possible explanation of why researchers' interest on the topic has started to develop only recently.

The concept of sustainability is also young. The term ‘sustainable development’ is often credited to the World Commission on Environment and Development’s so-called Brundtland Report (WCED, 1987). The origins of the term ‘sustainability’ as opposed to

'sustainable development' could be traced back to the conservation movement of the mid-nineteenth century (Stabler and Goodall, 1996).

Environmental sustainability is commonly related to concerns with management of natural resources and safeguarding ecosystems (Carew and Mitchell, 2008).

When it comes to issues of the design phase at spas and swimming pools, many scholars claim that both economic efficiency and environmental matters should be considered when designing a swimming pool with highlight on energy conservation and chemical use (Tamminen, 2007; Carew and Mitchell, 2008; Renato, n.d.; Trianti, Spyropoulou and Theofylaktos, 1998 etc.). For instance, the choice of location and the type of the swimming pool (indoor, outdoor, combined etc.) innately involve economic and environmental consideration. Furthermore, the engineers should carefully examine factors such as ground plan, slope, and geology. In addition, the weather conditions in the region should be considered since the amount of sunlight and the wind power can affect the temperature of the water and the evaporation level (i.e. energy conservation and chemical use) (Carew, and Mitchell, 2008). The number of potential users should also be taken into account, since it affects the required capacity of the swimming pool, the use of resources, the choice of equipment and other pool amenities. In order to avoid unnecessary environmental damage in future construction-related decision-making should consider quality, price, need of maintenance, durability, and the possibility of using locally available resources. Materials that last longer and/or need fewer repairs can significantly decrease the resource consumption levels as well as the amount of generated waste. In addition, local materials should be used, since they usually have a smaller environmental impact from transportation (Carew, and Mitchell, 2008).

2.2 Use phase issues

The use phase of a swimming pool consists of its entire lifecycle from the day it opens, until it ceases to exist as a swimming pool. During this phase the use of resources in pool operation produces the main economic and environmental impacts. Consequently, most of the issues in this phase are directly or indirectly connected to resource use.

Environmental issues of the use phase are categorized as follows: use of disinfection products (Cl, CO_2 and cleaning materials), disinfection-health related issues, consumption of electricity, and consumption of water.

2.2.1 Disinfection products

Many researchers have underlined the use of disinfection products in swimming pools and estimated the potential for generation of disinfection by-products (DBPs), as well as the dermal contact, inhalation and ingestion exposure doses (Dyck, Sadiq, & Rodriguez, 2011; Gomà et al., 2010; Nickmilder & Bernard 2011; Schets, Franciska, Schijven, Roda, & Maria 2011; etc.). Conclusions illustrate that there is a high potential of DBPs generation due to the high concentration of chlorine required to maintain adequate water disinfection. Dyck, Sadiq & Rodriguez (2011), presented the lack of guidelines for trihalomethanes (THMs) in swimming pool waters, created a fugacity model and estimated exposure dose limits for different chemicals and compounds (e.g. bromoform, chloroform, BDCM etc.). Others adopted a different approach to chemical consumption at swimming pools, by determining the positive effects of chemical use. Gomà (et al., 2010) used a Testo 535 device to measure air velocity and CO_2 levels. In addition, the researchers measured the Cl and pH level of the water. They concluded that using CO_2 as a pH reducer could lower the chorine consumption, diminish the formation of THMs in the water and lower the presence of oxidants in the air above the swimming pool.

Only a few researchers have tried to find ways of cutting off the use of chemicals altogether. Ellen Rowland (2012), for example suggests a way of creating a natural swimming pool with an area for swimming and an area for plants. The article argues that most conventional pools can be easily transformed into natural swimming pools where the plant zone will naturally purify the water at the swimming zone. The article suggests different ways of conversion with different plant combinations (Rowland 2012).

2.2.1.1 Alternative water disinfectants

The interest and research activity in swimming pools related topics in Iceland have increased during the last decade. Kristján Þór Hálfdánarson and Jóhannes Loftsson (n.d.) assessed alternative methods for water purification in swimming pools in Iceland with a focus on bromine, ozone, hydrogen peroxide, copper and ultraviolet water disinfection. The two Icelandic researchers claim that the ozone is the most potent disinfectant, yet it must be combined with other chemicals such as chlorine, since it does not dissolve easily in water. They also address water self-cleaning potential, because of chemical and

microbiological composition and mention the Icelandic Blue Lagoon in that context. They claim that topics of alternative water purification systems should be further studied (Hálfdánarson and Loftsson, n.d.).

2.2.1.2 Cleaning substances

Many of the listed articles use the word swimming pool as if the meaning includes only the artificial basin filled with water and used mostly for swimming purposes (Beleza, Santos & Pinto 2007; Johansson & Westerlund, 2001; Nickmilder & Bernard, 2011; Keswick, Gerba, & Goyal, 1981). Hence focus on the use of Cl in combination with other factors such as temperature, CO_2 etc. (see e.g. Dyck, Sadiq, & Rodriguez, 2011; Gomà et al., 2010; Nickmilder & Bernard 2011; Schets, Franciska, Schijven, Roda, & Maria 2011;). However, the use of disinfection products in buildings adjacent to the swimming pool is often neglected. The Cl might be a major part in the disinfection of a swimming pool but only presents a limited view of the cleaning substances used at the swimming pool such as in the changing rooms, hallways, staircases etc. In the swimming pool areas many different cleaning substances might be used, some presenting higher level of harmful effect for the environment and the social factors than others. This impact is largely neglected in the literature.

2.2.2 Human health issues

Nickmilder & Bernard (2011) and Keswick, Gerba, & Goyal (1981) analyze the connection between use of chemicals and possible health issues. Nickmiler and Bernard (2011) evaluated the connection between testicular hormones at adolescence and exposure to the by-products of a single chemical (chlorine). They collected data from over 360 male adolescents (aged 14-18 years) and concluded that adolescents having attended indoor chlorinated pools for more than 250 h before the age of 10 years, or for more than 125 h before the age of 7 years were about three times more likely to have an abnormally low total testosterone (<10th percentile) levels when compared to their peers who never visited this type of pool during their childhood or attended less frequently. Keswick, Gerba and Goyal (1981), investigated the occurrence of enteroviruses in community swimming pools. The results indicated a high incidence of enterovirus infection among bathers.

2.2.3 Electricity consumption

Literature found on consumption of electricity and water consumption is relatively common (Johansson & Westerlund, 2001; Lam & Chan, 2003; Lazzarin & Longo 1996; Tamminen, 2007; Trianti-Stourna et al. 1998, etc.). Jonhansson and Westerlund (2001) compare two different heat-recover techniques: the mechanical heat pump and the open absorption system with respect to electricity consumption. The researchers measured the electricity demand on an hourly basis and concluded that the open absorption system is more efficient than the mechanical pump system. The research conducted by Johansson and Westerlund (2001) strongly resembles the research of Lazzarin and Logo (1996). Both compare the same types of heat-recovering techniques and reach the same conclusions. Both illustrate technological advances with time, and show that the open absorption system was, and still is, the cheaper and more efficient option.

Lam and Chan (2003) measured the energy performance of heat pumps for hotel operations in subtropical climates. They investigated the energy performance of an air-to-water heat pump at one hotel and compared it to the performance of the water-to-water heat pump of another hotel for a period of six months. They estimated that the air-to-water pump was slightly more effective. However, both types of heat pumps operated in a COP range of 1.5-2.4 years and had a payback period of about two years, which is considered to be financially attractive.

Other studies have a more holistic approach. Trianti-Stourna et al. (1998) compared the electricity use of five swimming pools and created an energy conservation strategy for sport centers and swimming pools. The swimming pools were owned by the same company, but situated in different climatic zones. The researchers collected data on energy use by site visits, and by collecting utility bills, actual consumption of all energy sources and related cost data. In addition, the researchers performed on-site assessments, including on-site measurements of air temperature, relative humidity and daylight. Interviews were conducted with visitors and employees of the swimming pools. The conclusions showed that different strategies could be applied at different locations. However, the first step in energy conservation is the same for each case, which is to define all actions resulting in energy conservation with low initial cost. Then additional retrofit actions should be carefully examined and justified on a case-to-case basis. Nevertheless, a successful energy saving strategy depends on the construction,

installation, function and maintenance of all systems, as well as on the appropriate equipment and personnel.

2.2.4 Water conservation and waste generation

The researcher could not find any academic articles that concentrated only on water conservation at swimming pools. Saving water was mostly mentioned along with energy conservation in swimming pool guidance articles that focus on the importance of pool covers (Tamminen 2007; Beleza, Santos & Pinto, 2007). The articles suggests that swimming pool covers can be highly effective in saving makeup water (water supplied to compensate for loss by evaporation and leakages), and electricity. According to some studies, a swimming pool cover could save up to 40% of the electricity demand of a given water basin (Tamminen 2007; Beleza, Santos & Pinto, 2007). Swimming pool covers are extremely effective in lowering the amount of evaporation and preventing debris and other small particles from entering the water. This leads to decrease in the need for water heating since the water temperature is better conserved with the pool cover. The evaporation of water in swimming pools increases water consumption, as well as consumption of energy and chemicals. This is why even in indoor swimming pools heat retention covers are highly recommended (Trianti-Stourna et al., 1998; Lam and Chan, 2003; Johansson and Westerlund, 2001; etc).

In the reviewed literature, studies that concentrate solely on consumption of other resources and generation of waste, including recycling (paper, plastics, cartons, etc.) were not present.

2.2.5 Life-Cycle Assessment of swimming pools

Many scholars and researchers have tried to provide solutions for problems related to efficiency and environmental impact of swimming pools. However, the collection of Life-Cycle Assessment studies on swimming pools is very limited. The only LCA studies found were on residential swimming pools in USA (Forrest and Williams, 2010) and an LCA study for a heat pump application for hotel swimming pools (Lam and Chan, 2003). The study on residential pools shows that swimming pools predominantly use three types of natural resources: water, electricity and chemicals. The use of these resources is highly dependent on the weather conditions. Forrest and Williams, (2010) claim that

in order to be efficient in economic and environmental aspects, swimming pool executives should consider undertaking actions to use fewer resources.

The use of pool covers and reducing the work-time of the water pumps among other things (i.e. using low flow shower heads, and compact fluorescent lights) could offer potential savings exceeding that of commonly accepted household efficiency improvements (Forrest and Williams, 2010). Lam and Chan (2003) assessed heat pump applications for hotel swimming pools. The authors measured the energy required to maintain water temperatures. The swimming pool was analyzed in terms of energy loss caused by evaporation, radiation, convection and water refill. The study concludes that substantial energy savings, benefiting both the economic and environmental efficiency of the swimming pool, could be achieved by using gas fired, instead of conventional, heating boilers. Lam and Chan (2003) estimated that evaporation was the single largest heat loss factor accounting for more than 50% of the heat loss, where the heat gain due to solar radiation was considered largely inadequate.

2.3 Summary

The literature review displays that the current ways of water disinfection of swimming pools may lead to a range of environmental and health problems. There is a high potential for DBPs generation due to the high concentration of Cl required for adequate disinfection. There is a lack of guidance for prevention of trihalomethanes formation, which in combination to the high Cl concentration may lead to health issues. Nevertheless, alternative methods of disinfection are often not efficient enough to substitute chlorine completely, yet the use of Carbonic acid (H_2CO_3) could slightly lower the quantity of Cl needed for disinfection. However, decreasing economic and environmental impact of swimming pools is possible with decrease in the use of resources. Some studies (Trianti-Stourna et al. 1998; Gomà et al., 2010; Tamminen 2007) display that savings in electricity, chlorine and water consumption are possible.

2.4 Economy versus the Environment - Foes or Allies?

Companies operating with spending exceeding their revenue tend to concentrate their efforts on increasing economic efficiency while ignoring the consequences for the environment and the long-term economic cost of their decisions. Many companies in

Iceland view the environment and the economy as foes (Jóhansdóttir, 2012); one needs to prevail, while the other suffers. Nevertheless, many authors (Braungart & MCDonough 2002; Porter, 1995; Hoffman, 2000 etc.) have advocated the existence of alternative perspectives, involving decision-making strategies equally beneficial for both the environment and the economy. These two perspectives have been coined the win-lose, and the win-win perspectives, respectively. There are ways to turn the foes into allies. Different perspectives provide decision makers with alternative viewpoints.

Understanding both perspectives is important since some executives assume that the win-lose perspective is the only possibility and do not try to find solutions for existing problems that could benefit both the economic and the environmental efficiency of the company (Jóhannsdóttir, 2012).

2.4.1 The win-lose perspective

The first point of view is the win-lose framework represented by the traditional formula for developing environmental regulations. It consists of the idea that environmental and business interests are in a state of opposition, where environmental benefits can be gained only through economic trade-offs, or costs. In that way, economic and environmental efficiency are set in a narrow "cost-benefit" context, where the beneficial outcomes of pollution control policies and regulations leads to financial loss for the company because of the costs necessary for the industry to implement the regulations.

Numerous papers on the topic support this point of view. In the *Journal of Economic Perspectives,* Palmer and Portney (1995) state that the increased stringency of environmental regulations will surely lead to reduced profits for the firm. Porter and Linde (1995) in the *Harvard Business Review*, argue that trade-offs are a "necessity" when a firm strives to achieve environmental improvements. Noah Walley and Brad Whitehead (1994) also support this point of view. They pointed out, in the *Harvard Business Review,* that environmental health and safety regulations have increased from ten modest legal codes to over forty-five elaborate regulations in 1990. They also claim that when it comes to environmental regulations "Talk is cheap; environmental efforts are not" (Walley and Whitehead, 1994, p.47). Some companies lose a lot of money due to environmental regulations, while others use the opportunity to change and gain

financial profit from it. For example, a branch of the United Technologies Corporation invested $500,000 to eliminate the use of toxic solvents and clean copper and aluminum parts in the manufacture of air conditioners. The company recouped $1.2 million in reduced manufacturing cost (Hoffman, 2000 p. 3).

However, in the literature the win-lose framework is seen as incomplete, since it does not allow for scenarios that benefit both the environment and the economy of a firm (Hoffman, 2000, p.5).

2.4.2 The win-win perspective

In contrast to the win-lose perspective, the win-win framework proposes that a firm can enjoy increased profits and be environmentally responsible at the same time, with minimum trade-offs between the two.

Some claim that this may come through innovation that provides competitive benefits to the company (*Toward a new Conception,* 1995). In this case, economic gains offset economic costs. In the literature, the term "innovation" means not only technological innovation, but also innovation in the mind-set of the company. Scholars such as Harvard Business School professor Michael Porter argue that emissions are actually a sign of inefficiency (Porter and Linde, 1995). Others have taken this idea even further. In their work, "*Cradle to Cradle: Remaking the Way We Make Things*" chemist Michael Braungart and architect William MCDonough (2002) claim that waste equals food, and compare the waste at the factories to money gone to waste.

Ellen Rowland's article (2012) is a great example of how this concept can be applied in swimming pools. The plants use bacteria, debris and nutrient available in the water as food and in turn act as a natural water purification system. The swimming pool becomes a natural swimming pool with area for plants and area for swimming where chemical purification is no longer necessary.

Hoffman´s work, *Competitive Environmental Strategy* (2000), illustrates numerous examples where a possible environmental problem was used as an opportunity for innovation. In such cases, dealing with environmental problems actually brings financial gains to the company. However, such examples for spas and swimming pools are not present in Hoffman's work.

Hoffman (2000, p.6), criticizes the win-win perspective for being oversimplified and claims that it often fails to "address the inevitable distributive aspect of most negotiations". He claims that sometimes the relationship between the environment and the economics is undeniably distributive. He advocates that when it comes to dealing with environmental and economic issues simultaneously, one should not be limited by a win-lose or win-win perspectives, but rather a third, more balanced approach, called a 'strategic-perspective,' should be utilized. This approach allows the company to recognize that the relationship between the environmental and the economic interests of the company is neither purely cooperative (win-win), nor purely competitive (win-lose).

It becomes clear that in environmental management, trade-offs sometimes occur. Nevertheless, by understanding different perspectives, decision makers may better understand the possibilities, and the importance of minimizing tradeoffs between economic and environmental efficiency. It is only by viewing a problem from different perspectives that a decision maker can understand, and use methods to decrease, the negative environmental impacts of a company, while increasing its economic efficiency.

However, it is up to the company's managers to apply a sound business strategy and through new ways of thinking, or innovation in technology, to minimize trade-offs as much as possible. Sometimes a small financial gain in the short-term could cause great environmental or human health problems in the long-term. For example saving money by using less chlorine could lead to spread of harmful bacteria (Hálfdánarson and Loftsson, n.d.). This is why companies, managers and individuals should try to think ahead of time. After all, we should not forget that we live in the environment that we pollute.

3 Case description

Sundlaug Kópavogs is a swimming pools situated in and managed by the municipality of Kópavogur, Iceland. The pool first opened its doors in 1967. It contained only one water basin, which was 17 meters of length and 8-meters of width. Three hot tubs and a children's pool were built right next to the swimming pool shortly after. Another water basin was added in 1991 - a long course (50x25m) competition pool. In addition, waterslides were added to the children's pool right next to the 50-meters pool, new locker rooms were built and more hot tubs were added. On May 11 2008, SLK was changed once more. The first water basin (17x8m) was removed along with the first hot tubs. An indoor pool (25m) appeared in their place, along with a 10-meters indoor children's pool.

The swimming pool is owned by the Kópavogur municipality and is one of the biggest swimming pools in Iceland. For the last five years the swimming pool has been visited by nearly 500,000 people per year (Kópavogur accounting department, personal communication, September 12, 2013). The town of Kópavogur accepted an environmental policy in 2011. It committed the town to sustainable development taking into account the three dimensions of sustainability: environmental impact, social wellbeing and economic aspect. The policy includes minimizing negative impacts on the environment, waste and inefficient use of materials, in addition to increasing environmental awareness and encouraging eco-friendly practices in every sector of society. Kópavogur adopted Local Agenda 21 in 2003 and has strived to meet its goals ever since, in addition to encouraging sustainability in many aspects of its operations (Kópavogsbær, 2011). The environmental policy of Kópavogur is presented in Appendix II (in Icelandic). However, neither the principles of Agenda 21 nor the environmental policy of Kópavogur are implemented at Sundlaug Kópavogs.

Different groups of people visit SLK for different purposes. The building of SLK houses also the fitness center ‘GYM HEILSA.’ Gym membership cards are sold at the reception of the swimming pool. The membership cards can be used for a visit to both the gym and the swimming pool. In addition, the swimming pool is used for swimming lessons by schools, swimming teams, and private trainers.

3.1 Employees

Each employee of the swimming pool plays an integral part of the function of the pool, and is to some extent connected to the decision making process. Understanding different employee positions may display limitations and opportunities of increasing employee's efficiency, which could in turn increase the economic and environmental efficiency at SLK.

Sundlaug Kópavogs is managed by the municipality of Kópavogur. However, the sports department of the municipality and the director of the swimming pool have the most influence in decision-making processes. The technical director of the swimming pool, along with the owner of the cleaning company Þrifaspor, takes care of the maintenance of the swimming pool. The technical director monitors and repairs any malfunctioning systems, while the owner of Þrifaspor attends to minor amendments and repairs at the facility.

The employees of SLK work on shifts. Nineteen people are employed on a 100% contract (full-time) and work morning or night shift during workdays and only one shift during weekends. The personnel of the swimming pool have different work positions with different responsibilities. The responsibility of the people at the reception desk is to sell goods, entrance tickets and membership cards, to make sure that the reception desk, the cafeteria and the lobby are clean, to monitor lost and found items, and to clean the locker rooms of the gym.

The staff working at the locker-room and bathing area has to maintain high hygiene level at the indoor and outdoor changing rooms, to assist people in need of assistance, to explain the rules of the swimming pool to costumers, to supply the changing rooms with all necessities (soap, paper, plastic bags), and to supersede lifeguards when needed.

The lifeguards watch for the safety of the visitors and are able to provide first aid when needed, to maintain high hygiene at the water basins and the area around them and to explain and clarify the rules of the swimming pool. In order to work as a lifeguard one must have passed a swimming test every year, and to participate in first aid training course twice a year.

Most of the personnel of SLK rotate between different work positions during the week, depending on skills and personal preferences. However, it is forbidden to work as a lifeguard without a swimming test certificate.

3.2 Operations

The activities that have impact on economic and environmental efficiency at SLK are divided into four categories; water circulation, chlorine system, cleaning operations and admission system. It is important to understand how each of those systems works in order to perform gap analysis (comparison between actual and potential performance) and suggest improvements where possible.

3.2.1 Water circulation

When considering the operations at a swimming pool, the water circulation system is at the top of the priority list, since it is connected to water level and temperature regulation, regulation of chlorine levels, and electricity consumption (pumps, motors, filtration systems and other systems related to water circulation).

The water circulation system at SLK is designed to balance water levels, to filter and purify the swimming pools' water, as well as to maintain a certain water temperature. The system consists of a series of pipes, fittings, valves, tanks, filters and heaters.

The water basins at SLK vary in size and purpose and thus the water circulation systems vary in their size and functions. In order to introduce the operation of the water systems at SLK, the researcher chose to display the water system of the outdoor swimming pool. It is the largest water basin and it gives the most complete picture of SLK´s water system operations, since it contains all filtration systems used at SLK (Figure 2, p.18).

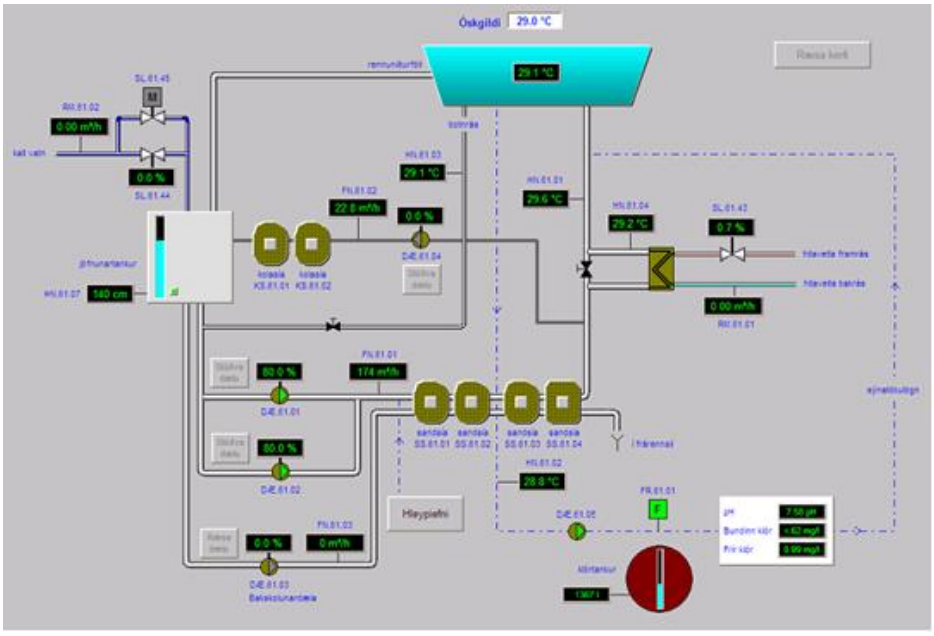


Figure 2: SLK water circulation system complete. (Retrieved from the accounting department of Kópavogur 22.03.2013).

The figure illustrates the water-circulation of the outdoor (50m) swimming pool. A simplified version of the system is presented in Figure 3.

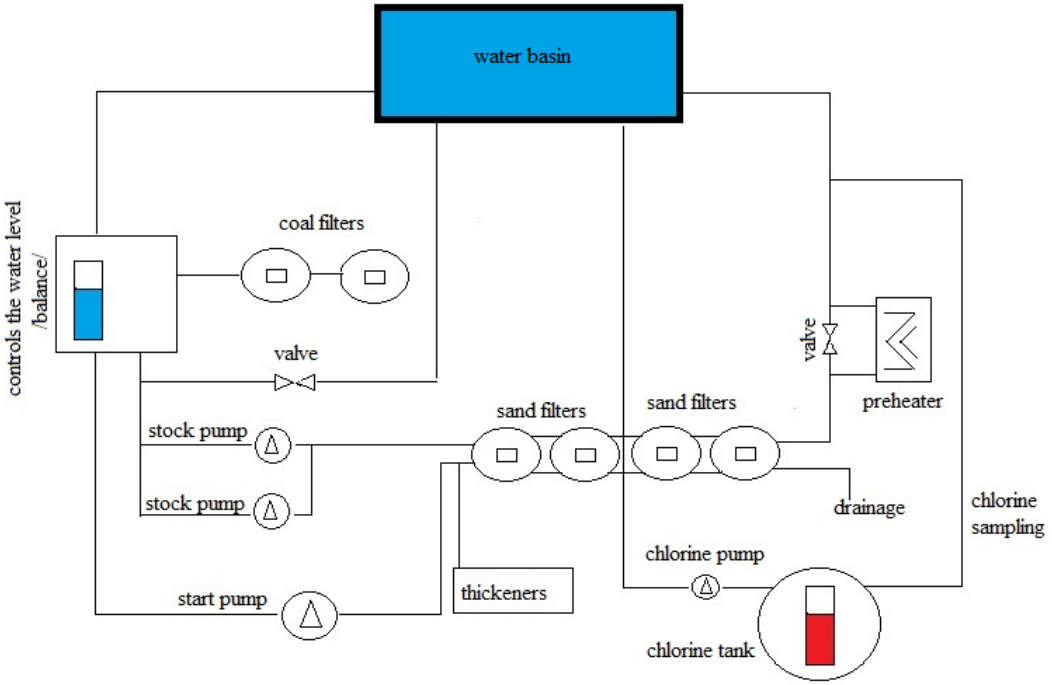


Figure 3: SLK´s 50 meters swimming pool water circulation system, simplified and translated. (Adopted and modified from the accounting department of Kópavogur 22.03.2013).

At the very top of Figure 3 is the water basin. Pumps and a balancing tank constantly balance the level of the water. If many visitors are at the pool at the same time, part of the water will be pumped out of the water basin and into the regulating tank. Once the level of the water recedes (e.g. when many people leave the basin at the same time), water is pumped from the regulating tank back to the swimming pool. A pair of coal filters purify the water in the regulating tank.

In order to maintain water quality and temperature levels during the day, the water cycles the water circulation system at the speed of 171 tons of water per hour. Two stock pumps direct the water into four sand filters. There, thickening materials are added to deposit all tiny particles of the water (dirt, sand, etc.) to the bottom of the sand filter tankers. After purification, the water goes first through a preheater, where the temperature of the water is adjusted and then the heated water enters the swimming pool again. The preheater system is composed of numerous plates. Thermal water heats one side of each plate, and cold tap water runs along the other side. The

tap water is being pumped around each of the heated plates, which increases its temperature before it enters the pool.

During the night, when the amount of the deposited material increases the start pump is switched automatically on to clean all the filters. The filtrated water enters the system again, while the dirt deposits goes to the drainage with the rest of the water used in the cleaning process.

3.2.2 Chlorine system

Chlorine is a chemical element with symbol Cl. It is yellow-green gas under standard conditions. Sundlaug Kópavogs uses chlorine compounds as a disinfectant. Chlorine kills pathogens such as bacteria and viruses by breaking the chemical bonds in their molecules. Chlorine compounds can exchange atoms with other compounds, such as enzymes in bacteria and other cells. This causes the entire molecule to either change shape or fall apart. When enzymes do not function properly, the cell or the bacterium dies (Hálfdánarson and Loftsson, n.d.).

Chlorine is currently the preferred method of water purification at SLK. The chlorine is transported to the swimming pool by a truck carrying tanks filled up with chlorine. The chlorine is then pumped into tanks situated in the basement of the swimming pool. The swimming pool has three tanks. Two of them are connected together and have a total volume of 3000 liters. The third thank is smaller in size - 500 liters. Before the renovation and the expansion of SLK, the swimming pool used the little tank as a main source of chlorine. After the expansion of SLK, the main source of chlorine was the connected tanks, and the 500-liter tank became an emergency supply of chlorine, to be used only when the amount in the other tanks could not fulfill the need for chlorine in all the water basins.

From the tanks, the chlorine is pumped into the swimming pool. However, chlorine breaks down and becomes less effective with time. Using fresh chlorine benefits both the environment and the economic efficiency of the swimming pool, since fresh chlorine is more active and less is required for the purification of the same volume of water (Haraldur Jónsson, Water Solutions representative. PowerPoint lecture presented in Sundlaug Kópavos, Borgarholtsbraut 17, Kópavogur on September 11, 2013).

At SLK, a monitoring system (Figure 4) constantly measures the amount of chlorine in all of the water basins and signals if the amount of chlorine in the water differs from the required amount.

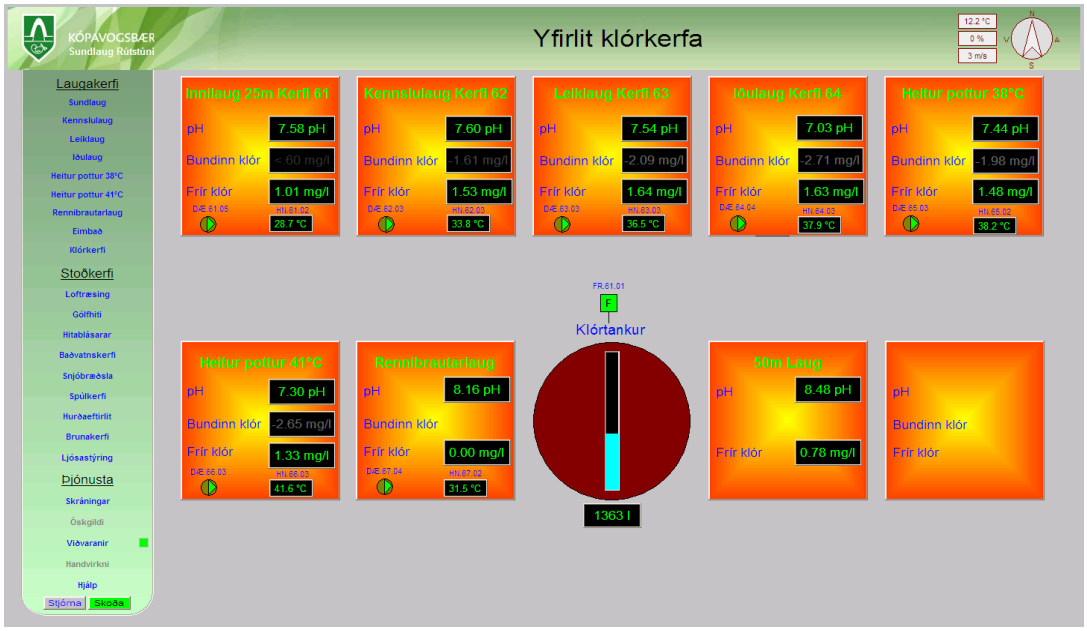


Figure 4: Chlorine monitoring system at SLK (Retrieved from the accounting department of Kópavogur. 22.03.2013).

The chlorine monitoring system displays the acidity (pH level) of the water, the free chlorine, and the combined chlorine for every water basin at SLK. In addition, it shows the amount of chlorine left in the 3000-liter tanks, visible in the red circle in the middle of Figure 4 (p. 21).

Once pumped into water, chlorine exists mainly in two forms; free and combined. The chlorine that is pumped into the water in order to purify it by killing bacteria and oxidizing contaminants, is the free chlorine. When it combines with contaminants, it becomes combined chlorine, also called chloramines.

The potency of the chlorine as a purification agent depends strongly on the pH level of the water (Figure 5). When the pH level of the water is low, the chlorine is more active. The pH level is a measurement of the basicity or the acidity of the water. Pure water has a pH value very close to 7 which is why the pH level in water is generally separated in two categories: greater than 7 (basic, or alkaline) and lower than 7 (acidic) (Covington, Bates and Durst, 1985). The water in Iceland is generally basic. Similarly, according to the water-supplying company of the municipality of Kópavogur (Ingvar

Sigurðsson, personal communication, February 17, 2013) the water at the municipality is rather basic, with values exceeding pH level of 9. In such basic water, the chlorine would be an extremely ineffective disinfectant. Figure 5 displays that in water with pH level of 8, the disinfection efficiency of chlorine is approximately 10%, and at a pH level of 6.5, the efficiency of chlorine is up to 80%. If the water at SLK were that basic (i.e. pH = 9), the swimming pool would have to use up to 10 times more chlorine in order to have the same effect of purification as when the water is with pH level equal to 7 (Ingvar Sigurðsson, personal communication, February 17, 2013).

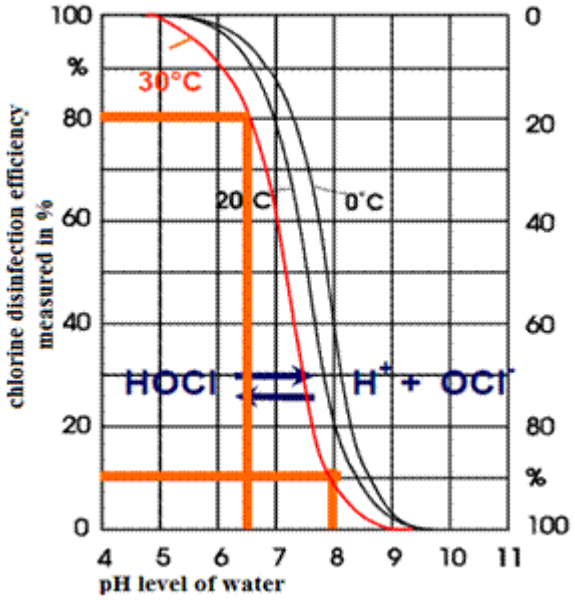


Figure 5: Connection between chlorine disinfection efficiency and pH level of water. (Retrieved from 'Water Solutions' VatnsLausnir, Haraldur Jónsson, personal communication, October 10, 2013).

In order to lower the pH level of the water, SLK uses Carbonic acid (H2CO3), which is stored in a tank situated in a storage room next to the chlorine storage, and is pumped into the water when the pH level needs to be lowered. There is a separate monitoring device that monitors the tank, adjusts the level and would set off an alarm in the case of a H2CO3 leakage.

The monitoring system that measures pH and chlorine levels needs to be reset every day and the chlorine level has to be measured every day according to the regulations of the municipality of Kópavogur (Regulation no. 814/2010). During every shift, there is a shift manager. Every day the shift manager of the morning shift resets the monitoring system and measures the chlorine in every basin. The shift manager measures the pH

level, the level of free and combined chlorine in the water and compares the measurements to the monitoring system.

3.2.3 Alternatives

Many methods exist for water purification including bromine, ozone, hydrogen peroxide, copper and ultraviolet water disinfection. However, according to Haraldur Jónsson (personal communication, September 11, 2013) "the only economically and environmentally sound water purification system that could be used as alternative to system used at SLK is the sodium chlorine electrolysis system". Haraldur argues that the electrolysis substitute uses produces fresh chlorine and sine fresh chlorine is more active the system will use less Cl and have the same disinfection effect as the currently use system. According to Haraldur Jónsson: "using less chlorine in water disinfection at the swimming pool is beneficial for the natural environment, for the human health and for the economy of Sundlaug Kópavogs" (personal communication, September 11, 2013).

However, there are two main types of salt electrolysis systems: ones that produce chlorine in an open cell, also called Hypocell (Figure 6, p. 24), and those that use a membrane cell (Figure 7, p. 25) for the production process. Both systems use salt, water and electricity to produce chlorine:

$$2NaCl + 2H_2O \xrightarrow{2e^+} Cl_2\uparrow + 2NaOH + H_2\uparrow$$

$$\text{salt} + \text{water} \xrightarrow{2e^+} \text{chlorine} + \text{caustic} + \text{hydrogen}$$

Referance: Haraldur Jónsson, (September 11, 2013). Water Solutions. PowerPoint lecture presented in Sundlaug Kópavos, Borgarholtsbraut 17, Kópavogur.

However, there are a few major differences in the way those systems work. The open cell electrolysis system (Figure 6), consists of two sides: anode side and cathode side, without any separation between the two. Because there is no separation between the anode and the cathode, sodium hypochlorite is formed. After dilution, the sodium hypochlorite will become hypochloric acid. This means that in the open cell system the formed lye stays in the solution. This creates a product that effectively raises the pH of the solution after dosing. Therefore, there is a needed for pH correction.

Figure 6 displays how salt is dissolved in water until saturation is achieved. After saturation, the solution is diluted with softened water and run through a hypocell. In the electrolysis cell three major components are formed: chlorine, lye and hydrogen

gas. Chlorine and lye are directly mixed and become sodium hypochlorite. In the electrolysis cell approximately 50% salt is converted to chlorine and 50% remains as salt (Haraldur Jónsson, personal communication, October 10, 2013). In the open cell, there is no separation and salt is allowed to enter the water circulation system. The open cell system is cheaper than the membrane cell, but it might bring some additional financial burden due to the cost of maintaining the water circulation system.

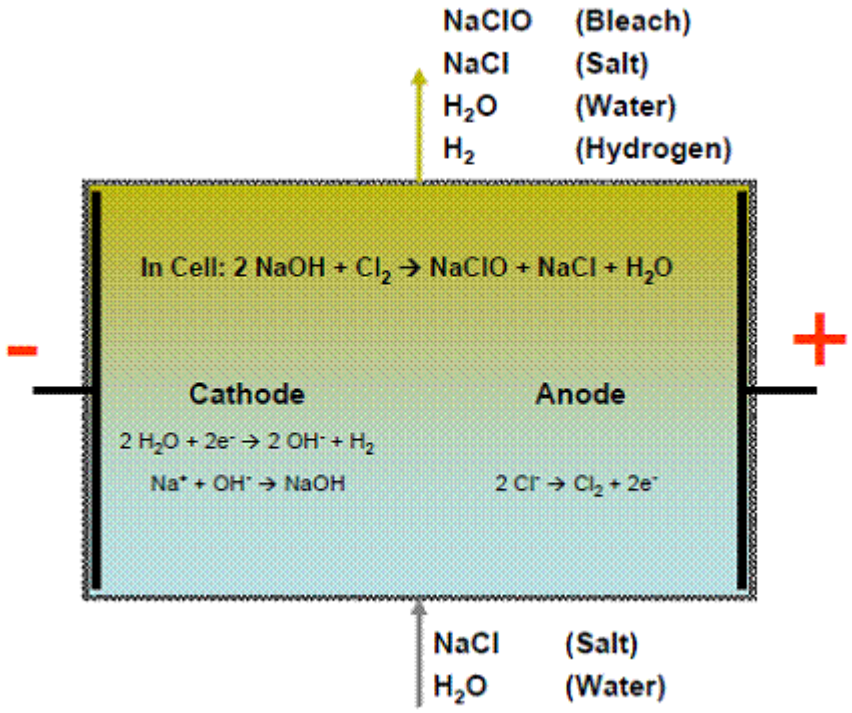


Figure 6: Open cell salt electrolysis. (Retrieved from the consultant of 'Water Solutions' Haraldur Jónsson, personal communication, October 10, 2013).

The membrane cell system (Figure 7) has a separation between the anode and the cathode side. Cathiones are transported from anode to cathode by means of electric current difference across the membrane. On the cathode side the pH rises higher and higher and on the anode side the pH becomes lower and lower. On the anode side, chlorine gas dissolves out the solution. The chlorine gas collects and is dosed directly into the circulation of the pool. The lye formed in the cathode chamber can be used for pH correction. Therefore, there is no need for additional water pH regulation.

Figure 7 displays how salt is dissolved in water until saturation is achieved in a membrane cell electrolysis system. The saturated salt solution is sucked up in the membrane cell, where three major components are formed: chlorine, lye and hydrogen gas. In the membrane cell, lye remains separated due to the membrane. The main

difference between the two systems is that in the membrane cell, approximately 100% of the salt is converted to chlorine (versus 50% in the open cell). In addition the membrane system does not allow any salt to enter the circulation system of the swimming pool.

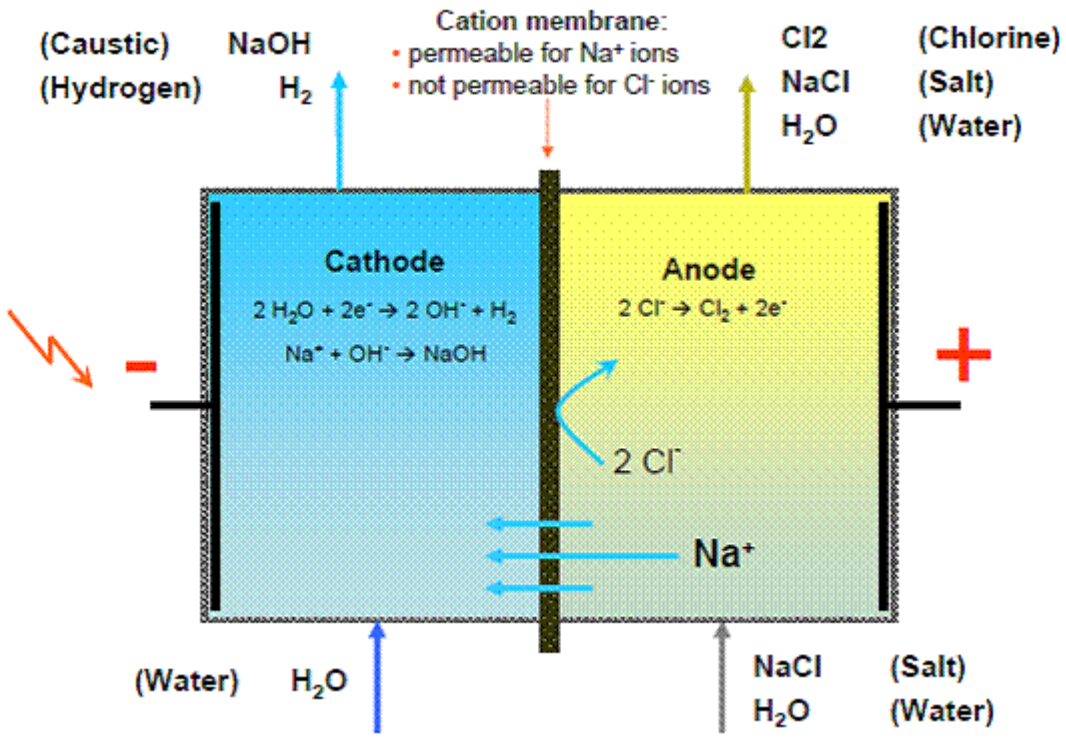


Figure 7: Membrane cell salt electrolysis. (Retrieved from the consultant of 'Water Solutions' Haraldur Jónsson, personal communication, October 10, 2013)

3.2.4 Cleaning operations

The cleaning of the swimming pool is done by employees of SLK at the end of every shift, and by the cleaning company, Þrifaspor, when the swimming pool is closed. During working days, there are two shifts, morning and night shift, while only one shift during the weekends. The aim of the morning shift is to maintain a level of hygiene for the guests and to clean the changing rooms as well as the area around the swimming pool for the guests and the night shift. The employees working during the night shift have to clean the changing rooms, the hot tubs and the children's swimming pools. The night shift uses a strong soap to spray the listed water basins. The cleaning company cleans the area around the indoor swimming pool as well as the building of the swimming pool (reception, changing rooms, corridors, staircases etc.). At SLK, Þrifaspor uses chlorine mixed with water for disinfecting dressing rooms, shower areas, areas around water basins and the steam bath. Employees of Þrifaspor disinfect the area around the indoor

swimming pools with non-certified cleaning agent that prevents falling hazards. The company uses cleaning robots with National Floor Safety Institute (NFSI) certification. The NFSI is a safety standard intended to provide preventative measures in all manner of pedestrian safety in regards to slips, trips, and falls and is titled B101 Safety Requirements for Slip, Trip and Fall Prevention.

Furthermore, in order to prevent formation and spread of algae and fungous, every week employees of SLK disinfect the area around the water basins, using chlorine mixed with water.

3.2.5 Admission system

The swimming pool currently uses one-time tickets for their 'one-time customers', and special tickets, cards and chips that allow clients with membership to visit the facility multiple times with the same card (chip).

One-time tickets are printed out at the reception. When a person pays to go once to the swimming pool he/she receives a ticket, goes to the entrance, approximately five meters from the reception desk, uses the ticket and then disposes of it. There is no difference in the appearance of the one-time and one year ticket. The membership chips, cards and tickets are valid for a given period of time, usually a year, and can be renewed.

During each purchase, regardless of the type and price of the goods or services, the system at the reception prints one receipt for the client, one for the accounting of the swimming pool and one extra. A computer system is used for the printing, accounting and monitoring of the goods and services sold at SLK.

4 Methods

The research question that this thesis seeks to answer is: Can Sundlaug Kópavogs become more sustainable and efficient with minimal tradeoffs between the environment and the economic factors? To answer this question the researcher has to gain understanding of the leading business drivers of SLK. Identifying the leading business drivers will pinpoint areas where improvements could lead to increase in the economic efficiency of the pool while decreasing its environmental impact.

Afterwards, the researcher will investigate the possibilities for improvement based on the leading driver, and finally propose suggestions for improvement with minimal creation of tradeoffs between the environment and the economy of the swimming pool.

This study relies on Hoffman's (2000) framework for analyzing the business drivers and the drivers of environmental protection of SLK. Andrew Hoffman created a tool that blends environmental, economic, and social objectives into a vision that could be translated into a corporate reality (Hoffman, 2000). He realized the simple fact that environmental strategy and economic strategy are now inextricably intertwined. Therefore, every "socially responsible business" should perceive environmental protection as a key part of their decision-making processes. Hoffman's framework is used as a tool for integration of environmental objectives into business strategy. In this way, environmentalism can alter market environments, and can lead to the creation of new types of business opportunities. According to Hoffman (2000), in order to understand the business implications of environmental issues or the environmental implication of the business issues in a company, one must analyze its business drivers.

A business driver is a resource, process or condition vital for the success and growth of a business. Identifying the leading business drivers of a company displays, among other things, the business and environmental pressures exerted on a company and the limitation and opportunities that these pressures create. Understanding the business drivers of the swimming pool can present ways of improvement with minimal creation of tradeoffs between the environment and the economic efficiency of the swimming pool.

In order to gain understanding about the business drivers of the swimming pool, the researcher chose to use quantitative and qualitative forms of research.

4.1 Quantitative research

The preferred form of quantitative research was an individual questionnaire, as it gives certain advantages. One such advantage is that it allows the empirical investigation of several employees simultaneously. In addition, similarly to individual interviews, if the meaning of a question in the survey is not clear to the participants, they could ask for clarification. The survey was conducted in the period from the 20th of September to the 20th of October 2013. All permanent employees of SLK participated in the survey. In total 19 employees, 10 men and 9 women.

The questionnaire was anonymous. It was distributed to SLK´s personnel during their regular shifts. Some employees took the survey home in order to have more time to fill it out, since they were unsure about many of the answers.

The participants were told that there is not a right or wrong answer to the questions and that the survey should reflect only their own opinion on the matters.

The survey was in Icelandic, since most employees of SLK are Icelanders or fluent Icelandic speakers. The topic of the survey was 'Umhverfismál í Sundlaug Kópavogs' ['Environmental issues in Sundlaug Kópavogs"] (see Appendix I). Most questions regarded the participants' attitude towards the environment, their general environmental awareness and level of concern about the environment, inside and outside their working place, in addition to their views on external business drivers such as clients. The survey also contained questions regarding the environmental and economic efficiency of SLK and the attitude of the employees towards participating in additional activities in order to decrease negative environmental impact of the swimming pool. The survey consists mostly of close-ended questions. However, it also includes dichotomous questions, multiple-choice questions and several open-ended questions, in which each participant could further elaborate on his/her opinion. The researcher provided an additional empty field for participants who want to express an opinion not incorporated in the possible answers sets. Furthermore, the survey contained an additional section regarding participants' background information.

The computer program Excel was used for collection, interpretation and graphical representation of the data.

4.2 Qualitative research

It is often difficult to use an individual questionnaire to receive more in-depth information and personal views on a specific topic. The researcher used a qualitative form of research, in-depth interviews, to gather information from managers, directors and other high-level executives, who have access to information that is not publically available. By conducting qualitative interviews with the people in charge of SLK (directors, managers, policymakers etc.), the researcher gained understanding on topics regarding most of the problems related to economic efficiency and negative environmental impact as well as most of the factors that could make this swimming pool a more sustainable and environmentally friendly place.

4.2.1 Interviews

The interviews were semi-structured, which allowed the interviewer to elicit information from the interviewee through a series of open-ended questions derived from a specific framework of questions.

This form of interview was chosen because it allows the interviewer to ask questions prepared ahead of time, to be competent on the topic and, if needed, to add additional questions during the interview. In addition, semi-structured interviews allow informants the freedom to express their views using their own terms. All of the interview sessions were recorded with the permission of the interviewee. The researcher made notes and indexed all the information that was important for the research. Sometimes secondary interviews were conducted, since the interviewee wanted to share more information or gather more data after the initial interview.

A computer software, Silverlight, was used during the analyses of the interview to enhance the quality of the sound, slow the speech pace and remove sounds of disturbances or long pauses.

The following people were interviewed[3]:

- representative of the department of sports of the municipality of Kópavogur;
- representatives of Sundlaug Kópavogs;
- representative of the cleaning company, Þrifaspor;
- Icelandic representative of 'Water Solutions' (Vatnslausnir, a company that sales water treatment systems); and
- representatives of swimming pools that use water treatment systems, alternative to the one used at SLK (Sundhöll Reykjavíkur and Laugardalslaug).

A large amount of quantitative data was obtained through e-mails and other forms of personal communications (phone conversations, presentations etc.) subsequent to the qualitative interview sessions, since most of the interviewees had access to, and were willing to share, data of great importance for this report.

4.2.2 Interview questions

During the in-depth interviews the researcher asked questions regarding the systems at SLK, how they work, how are they maintained, specifics, etc. The researcher also asked about environmental and economic efficiency through questions such as:

- Was environmental and economic efficiency considered during the design and the construction of SLK?
- Where does SLK disposes of its water, and is that harmful for the environment?
- How often are the chlorine tanks cleaned?

The researcher was also interested in whether the managers of SLK have considered options for water purification, and facility sanitation, other than those that are currently used. Of great interest for the research, was the question: what would make the managers of SLK consider the use of alternative options? In addition, SLK

[3] *(Author) Note: In order to protect the interviewees' confidentiality, the researcher changed the names of all participants in the qualitative forms of research. Therefore, the names cited in this work will not be the actual names of the interviewees. For citation purposes, the researcher will use the word "representative" instead of job-titles. The position of the people interviewed will not be represented and their names will be fabricated.*

representatives were asked questions regarding the accounting and the monitoring of resources at SLK (i.e. where most of the spending of SLK goes), and if there is some kind of monitoring system for expenses and use of resources.

All swimming pool representatives were asked:

- whether they think that swimming pools have negative environmental impact and what in their opinion has the greatest negative effect on the natural environment;
- whether they try to reduce the negative environmental impact of the swimming pool they manage.

The researcher also asked questions about economic efficiency. For example, whether current operation and management techniques are considered to be efficient, and whether or not the techniques could be improved upon (if so, how?). The researcher also asked about the main factors that influenced directors of swimming pools to change their sanitation system with a new one (i.e. was it some kind of pressure [social, regulations, etc.] the environment or economics, or a combination of some [or all] of the above?).

4.2.3 Personal communication

Personal communication was conducted with the following people:

- representative from SLK
- representative from Kopavogur municipality
- representative from the waste collection company that serves SLK (Íslenska Gámafélagið);
- the head managers of some of the companies that sell food to SLK: Saffran, and Domino's;
- representatives of SLK´s suppliers (paper and cleaning materials); representative of the water supply company for the municipality of Kópavogur;
- representative of the printing service company "Strikamerki"; and
- representative from Sundlaugin Blönduósi (a swimming pool that uses alternative water treatment systems than the ones used at SLK).

Through personal communication, the companies that provide SLK with resources (i.e. paper, soup, cleaning materials, food) were also asked about their environmental concerns. In the case when suppliers had recently changed their ways, such as becoming more environmentally conscious or getting green certificates, they were asked what their motives were. Using personal communication, the researcher gained understanding about the water quality at the municipality of Kópavogur, and the recycling options that were available to SLK.

The researcher gained permission to use the accounting database of SLK in order to extract some to the information that was too time-consuming to be extracted by the managers, since the database is not optimized for monitoring purposes.

The researcher is currently employee of SLK. This allows the use of personal knowledge and experience in addition to available literature. The researcher gained understanding on alternative chlorine producing systems, their pros, cons and differences by interviewing consultants, and researching companies that sell such equipment and swimming pools that use it.

The researcher drew conclusion from the findings using computer programs such as Microsoft Excel for calculations and graphs, and Silverlight for processing the data obtained during the interviews and the analyses.

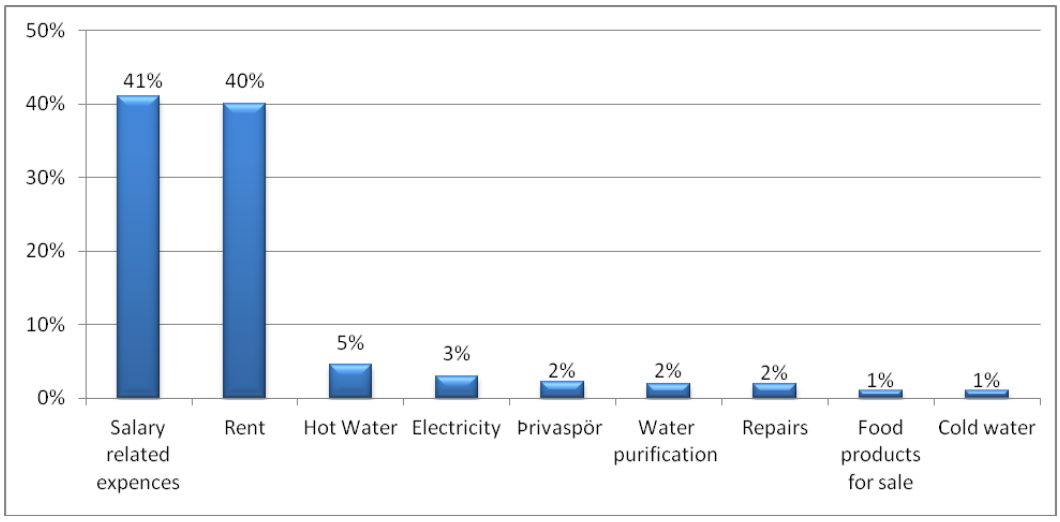
Afterwards, specific solutions and suggestions for improvement will be provided for each of the factors. Some of them will be drawn from the literature, while others come from gap analyses, personal experience and communication with consultants and owners of other swimming pools. Finally, results of the research and possible improvements will be presented.

5 Results

5.1 Economics

In order to assess the economics of the swimming pool, the researcher studied SLK's accounting data for one complete year (2012) and estimated the difference between the expenses and the income of the company. Furthermore, putting cost information into an environmental context contributed to insights for actions that could simultaneously improve economic and environmental efficiency.

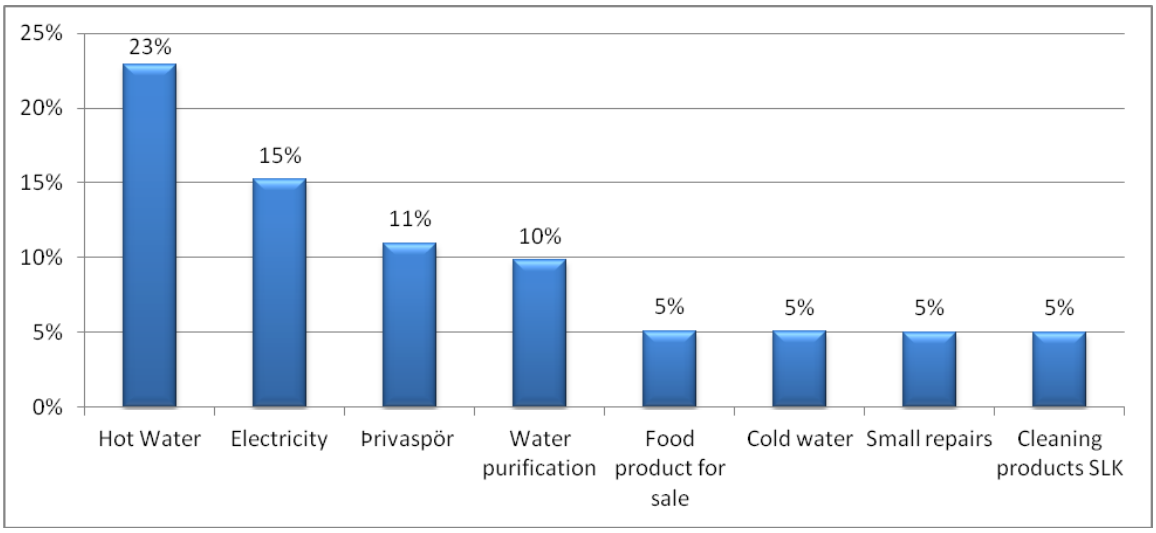
Sundlaug Kópavogs is a publicly owned company, yet it pays rent to the Kópavogur municipality. According to the accounting department of Kópavogur (personal communication, September 16, 2013), rent and salary-related expenses accounted for 81% (Graph 1) of SLK´s total operational cost for 2012. The combined monetary value of those two categories for 2012 was 293.3 million ISK. For the same year, the total income of the swimming pool was estimated at 173.2 million ISK and the total operation cost was 365.4 million ISK (constant 2012 ISK, accounting department of Kópavogur, personal communication, September 16, 2013). Therefore, in the year 2012 SLK operated at a loss greater than 120 million ISK before it paid operational bills (water, electricity, cleaning, water purification etc.). With all expenditures accounted, SLK operated at a loss exceeding 190 million ISK.



Graph 1: SLK's operational cost segments I. Reference - data obtained from the accounting department of Kópavogur, personal communication, September 16, 2013).

Having such excess of expenditures over revenue could be viewed as a disadvantage or an opportunity for improvement, depending on the respective manager's viewpoint. The researcher can do very little to decrease SLK spending on rent and wages (fixed expenses). Therefore, the researcher will concentrate on increasing the economic efficiency of the swimming pool by limiting the use of resources (variable expenses).

Although it is included in the list of SLK´s expenses, employees' salaries are paid by the municipality of Kópavogur. In order to get a clearer picture of the actual operational cost of the swimming pool, the researcher excluded the employees' wages and the rent of the building from SLK´s expenses (Graph 2).



Graph 2: SLK operational segments II. Reference - data obtained from the accounting department of Kópavogur, personal communication, September 16, 2013)

The operational cost of the swimming pool for 2012 was 72,1 million ISK (rent and wages excluded). Graph 2 displays eight of the most economically burdening items. The excluded variables (Figure 8, p. 35) are over twenty, seventeen of which account for less than 1% of the total spending. Nevertheless, the combined cost of the excluded variables equates for 21% of the total operational cost of the swimming pool. The variables are excluded from Graph 2, since it shows only the-most economy burdening assets. However, the omitted variables are not excluded from the gap analyses and the improvement suggestions.

1. Hot Water	22,9%
2. Electricity	15,2%
3. Þrivaspör	11,0%
4. Water purification	9,8%
5. Food product for sale	5,1%
6. Cold water	5,0%
7. Small repairs	5,0%
8. Cleaning products SLK	5,0%
9. Contract services	2,5%
10. Technical repairs	2,3%
11. Purchased products for resale	1,9%
12. Other purchased products	1,8%
13. Computer services	1,7%
14. Work Clothes	1,4%
15. Internet service	0,9%
16. Trash service	0,8%
17. Travel expenses	0,7%
18. Other costs	0,7%
19. Bathing suits and towels	0,7%
20. Building maintenance	0,7%
21. Advertising	0,7%
22. Phone service	0,7%
23. Regulatory fees	0,7%
24. Various equipment	0,7%
25. Lager	0,5%
26. Printing and scanning	0,5%
27. Courses and tuition	0,4%
28. Health inspection fee	0,3%
29. Coffee expenses	0,3%
30. Paper and stationery	0,3%
31. First aid materials	0,3%
32. Machinery	0,1%
33. Municipality contracts	0,1%
34. Other	0,0%

Figure 8: SLK's complete operational cost segments. Reference - data obtained from the accounting department of Kópavogur, personal communication, September 16, 2013).

5.2 Hoffman's framework

In his work, *Competitive Environmental Strategy* Andrew J. Hoffman (2000) argues that the twentieth-century brought unprecedented economic growth and human prosperity, as displayed by the increase of the global per capita income, the average life expectancy and the number of literate and educated people. According to Hoffman, many of these improvements are driven by industrial accomplishments, but those accomplishments

have tended to come hand-in-hand with serious environmental implications. The environment has often been viewed as an endless source of resources and a limitless sink for wastes. At present times, political economic, market and social systems are adjusting to change these beliefs. Hoffman claims that these adjustments enter the corporate consciousness through the various drivers of competitive environmental strategy. Hoffman categorized those drivers into four categories: regulatory and international, market, resource and social.

Identifying the leading business driver of a company is essential for changing its management system. Once determined, the leading business driver of Sundlaug Kópavogs could be used as a tool to show the company that reducing its environmental impact might be highly beneficial for both the environment and the economic efficiency of the company.

5.3 Regulatory Drivers

It is a common belief that without government regulation, corporations would not attend to environmental issues (Hoffman, 2000). However, government pressures take many forms and the complexity with which they presently drive corporate strategy is sometimes overlooked.

In the Icelandic regulatory system on swimming pools, great emphasis is set on visitor safety and strict rules are in place for safe demeanor in and around the pools as well as hygiene, health and safety. Laws and regulations are unavoidable. It is important to identify them in order to ensure that the environmental management system is according to the relevant requirements. The following regulations focus mostly on safety and hygiene in the pools and in their vicinity:

- Regulation 840/2010; hygiene at swimming pools (Reglugerð um hollustuhætti á sund -og baðstöðum) (Regulation no. 840/2010).
- Regulation made by the Ministry of Education with reference to 14th article, Law of Sports no. 64/1998: Rules for safety around swimming pools and pools for teaching (Reglur um öryggi á sundstöðum og við kennslulaugar) (Samband íslenskra sveitarfélaga etc., 1999).
- Law 1998 nr. 7 12; health, hygiene and pollution control (Lög um hollustuhætti og mengunarvarnir) (Law no. 7/1998).

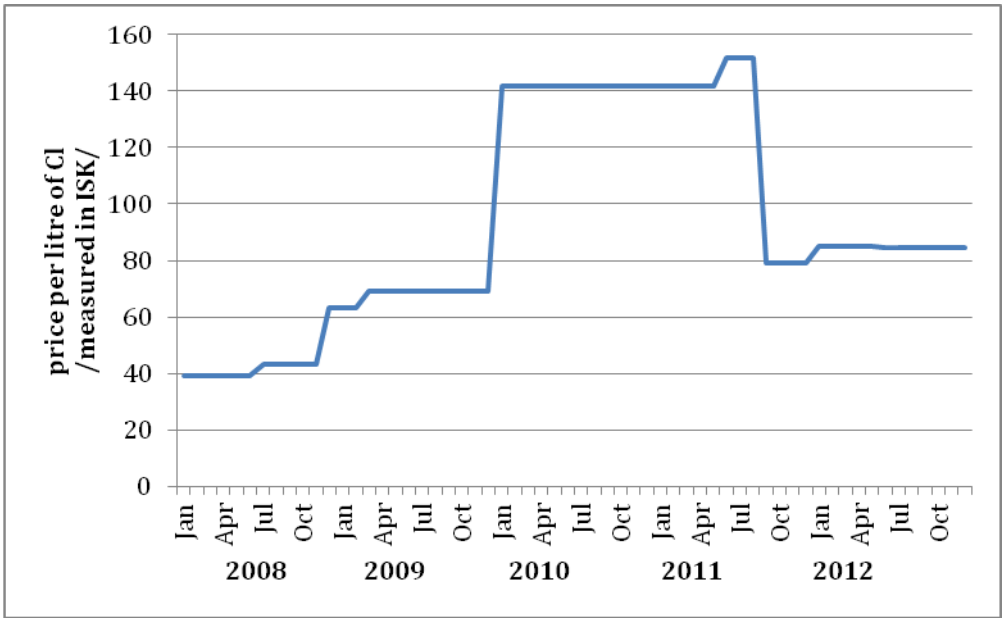
Swimming pools also strictly adhered to regulations regarding monitoring and operation. The most recent regulations set were implemented in 2010, and Sundlaug Kópavogs is currently in full compliance. However, the focus of the most recent regulation set is mainly on hygiene and chlorine use.

5.3.1 Chlorine

There are three main types of pools in Iceland: swimming pools, thermal pools and shallow tepid pools for sitting. Different rules apply to these three different pools. However, water in public swimming pools should be cleaned and disinfected.

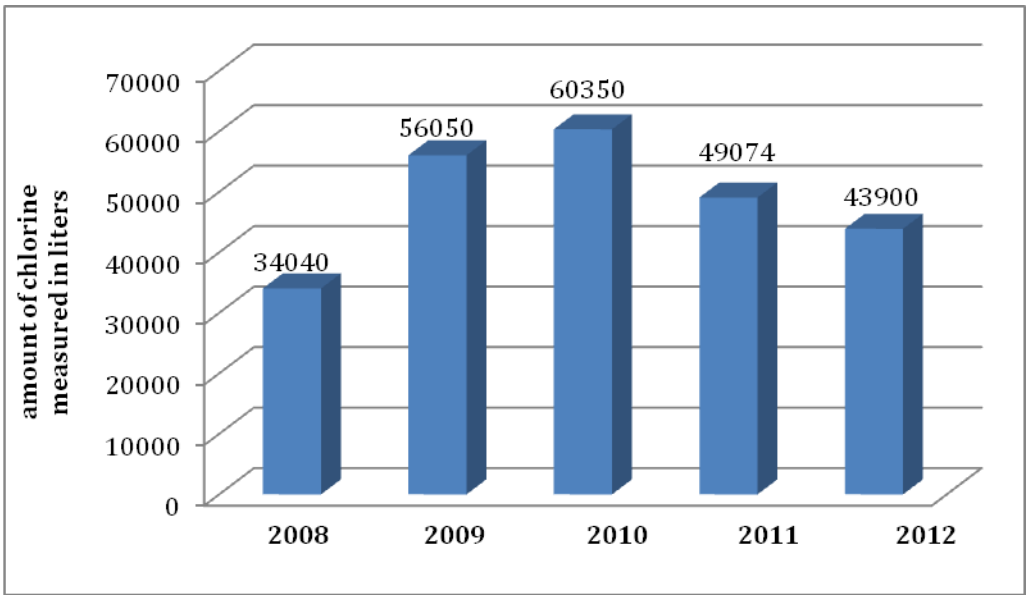
The Local Health Committee can allow other methods, or substances other than chlorine for disinfection of pool water (Regulation no. 814/2010). Chlorine and other disinfecting chemicals kill dangerous bacteria in the water such as E.coli in addition to killing beneficial bacteria, which keep us from getting sick (Green life smart life, 2012). However, chlorine is dangerous for the environment, so it is forbidden to release chlorine into rivers, lakes and areas where it can damage drinking water or biota (Regulation no. 814/2010).

Changing the current disinfection system could benefit the economic efficiency of the swimming pool as well, since the prices of chlorine are not very stable (Graph 3, p. 37). The total cost of chlorine can amount to over 10% of SLK´s operating costs (Graph 2, p.34 - water purification). As a result, regulatory and economic drivers at SLK are closely interconnected.



Graph 3: Fluctuation of chlorine prices over time. (Data obtained from the accounting department of Kópavogur, personal communication, September 10, 2013).

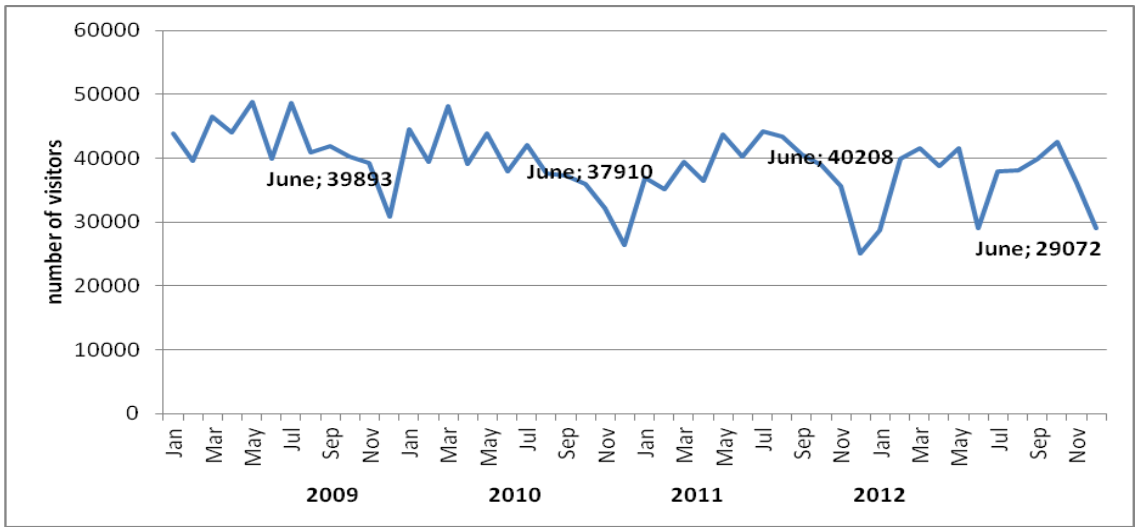
The chlorine prices differ not only between months, but also vary between swimming pools. Currently SLK receives chlorine that is more expensive than other swimming pools; a difference of nearly 20 ISK per liter (Magnús Kristinsson, supplier - personal communication, November 4, 2013). During the hottest months in 2012 up to 8000 liters of chlorine per month (85 ISK per liter) were consumed at SLK, accounting for up to 680,000 ISK in a single month. The total amount of chlorine used per year at SLK can exceed 40,000 liters (Graph 4, p. 38), on average more than 3,300 liters per month (accounting department of Kópavogur, personal communication, September 21, 2013).



Graph 4: Annual chlorine usage at SLK from 2008 to 2012. (Data obtained from the accounting department of Kópavogur, personal communication, September 10, 2013).

For the year 2012, the swimming pool used 43,900 liters of chlorine. It must be noted that the amount of chlorine used in 2012 is lower than it should actually be. The reason is that during 2012 the swimming pool went through maintenance. The outdoor swimming pool was closed during the entire summer and several of the smaller water basins were closed for several weeks during the month of June. Much noise was involved in the maintenance project, which additionally resulted in a lower number of visitors (Graph 5). As a result, the amount of chlorine needed also decreased (Graph 4).

Graph 5 (p. 39) displays a great decrease in visitors during the summer of 2012 and most notably during June, when the number of visitors decreased to 29,072, which compared to previous years (i.e. the month June) sets an average decrease of visitors to more than ten thousand visitors for that month alone.



Graph 5: Number of visitors per month for the period 2009-2012. (Data obtained from the accounting department of Kópavogur, personal communication, September 10, 2013)

5.3.2 Surface

Regulations for swimming pools are very strict and there is little room for exceptions. The disabled should have access to swimming pools, and locker rooms according to applicable laws and regulations. That means that the surface around the swimming pool area should be even and easily accessed, which can lead to little water drainage if the (outdoor) surface is completely concrete (Regulation no. 814/2010). Therefore, due to regulations, swimming pools should invest in additional infrastructure (elevating platforms, auxiliary equipment, etc.) in order to ensure access for disabled people.

5.3.3 Indirect municipal drivers

Regulatory pressures do not stop at national borders. In the last decades, information flow is faster than ever and environmental concerns are transferring increasingly along international borders (Hoffman, 2000). Kópavogur municipality has an environmental policy and adopted Agenda 21, but currently these strategies are not affecting the actions of SLK. The municipality is also doing green accounting but SLK does not undertake any similar activities. SLK itself does not have any quality system (Jón Jónsson, personal communication, September 28, 2012). The swimming pool is not trying to limit its environmental impact, nor does it follow the environmental policy or strategies of the municipality of Kópavogur (Jón Jónsson, personal communication, September 28, 2012).

5.4 Resource Drivers

A representative from SLK claims that "the resource driver is most definitely the leading business driver of SLK´s operations" (Jón Jónsson, personal communication, January 15, 2013). Economic value and profit are often the focus of policy makers and managers. Sundlaug Kópavogs is not an exception, "if an option is both profitable and environmentally friendly, it will be taken into consideration, yet if an option is economically beneficial it will be preferred" (Guðleifur Leifsson, personal communication, September 10, 2013).

"At present, the level of environmental concern among Sundlaug Kópavogs' executives is increasing. Alternatives to the current water disinfection methods are to be considered" (Jón Jónsson, personal communication, September 28, 2012). However, in order to be considered as an option, the alternative needs to be economically viable first (Jón Jónsson, Guðleifur Leifsson, personal communication). Some of SLK´s executives (Jón Jónsson, Guðleifur Leifsson, personal communication, September 2012) claim that new environmentally friendly cleaning techniques have been tested and considered for adoption. Yet, no actual changes were done until the researcher started to ask questions about the level of environmental concern of the SLK´s managers. After conducting several interviews with the head director and sport representative of Kópavogur as well as the director and the deputy director of SLK, some noticeable changes occurred. The cleaning materials used by the employees of the swimming pool were changed with Nordic Swan certified ones and the plastic bags used by the visitors were changed with thinner and smaller ones.

The managers and the director of SLK are going to consider adopting a computer program that will monitor the electricity use in the building, cut off any overuse and point out equipment that is not efficient enough (Jón Jónsson, personal communication, September 28, 2012). The use of chlorine is reduced by the use of Carbonic acid H_2CO_3. The Carbonic acid lowers the hydrogen ion concentration of the water (pH), which increases the disinfection potential of the chlorine (Jón Jónsson, personal communication, September 28, 2012).

At SLK, most of the resources that have the greatest impact on the environment are chemicals used for water purification, soap, cleaning materials, electricity use, and use of cartons and paper. As it happens, those resources are also the most expensive

resources used at SLK (see Figure 8, p.35). The operational cost of the swimming pool for the last five years (2008-2012) averages approximately 316,443,200 ISK per year (the accounting department of Kópavogur, personal communication, March 22, 2013). According to the director of the swimming pool, the most expensive resources are electricity, hot water and chlorine, followed by paper, cleaning materials and soap.

The following sections concentrate on those resources since reduction in resource use could benefit both the natural environment and the economic wellbeing of SLK.

5.4.1 Buyers and Suppliers

According to Hoffman (2000), organizations that control the acquisition of raw materials and the consumption of products can increase or decrease the level of environmentalism in a company. Sundlaug Kópavogs enjoys the so-called 'free-rider benefit'. The swimming pool in Kópavogur does not demand environmental awareness from its suppliers (Magnús Kristinsson, Adam Ólafsson, Davíð Þór Jónsson, personal communication, October, 2013), yet some of the suppliers have acquired eco labels, eco certificates or have simply become 'greener.' The supplier of paper for instance obtained the EU Ecolabel also known as the 'European flower' label, and some of the companies, which provide food for the staff, are increasing the use of recyclable and recycled materials in food packaging (Jón Jónsson, personal communication, September 28, 2012).

The researcher contacted some of the food companies with most notable changes in their packaging. The head manager of Saffran, Adam Ólafsson, shared that the company tries to minimize the use of plastics by using recyclable carton packaging instead. However, he claims that "the changes in the company were not due to pressure from SLK, or any kind of social pressure for that matter" (personal communication, October 22, 2012). The company just became more environmentally aware and decided to try their best to limit their negative environmental impact according to Adam Ólafsson. Another food supplier for SLK, the pizza company Domino's, has also changed their packaging. They use recycled cardboard boxes that are environmentally friendlier, and try to limit the use of plastics. "The decision to implement the new packaging came from Domino's Board of Directors and was the result of both environmental and economic consideration" (Davíð Þór Jónsson, October 23, 2012). The head managers of both companies declared that they have never received any kind of market pressure

from SLK. The same statement was repeated by a representative of the company that supplies SLK with paper and plastic bags Magnús Kristinsson (personal communication, September 28, 2012). Magnús claims: "the company's paper products became eco certified due to changes in governmental regulations and partly due to market pressure from clients in Reykjavik" (personal communication, September 28, 2012).

5.5 Market Drivers

The customer base of SLK is wide with customers from different ages and social classes as well as nationalities. This gives challenges to the management; the variety of customers brings many different needs and expectations for the SLK utilities to satisfy. For example, youngsters are looking for a place to play and have fun while recreational swimmers and pensioners generally prefer relaxing moments in hot tubs and swimming in peace. In addition, many people, especially babies and smaller kids, are more sensitive to chemicals, or prefer warmer water temperature. This sets pressure for the swimming pools to develop methods that would decrease the need for chemicals. Nevertheless, this combination is difficult to sustain, since chlorine is evaporating from the water faster with higher water temperatures (Magnús Ólafsson, personal communication, June 13, 2013).

5.5.1 School Children and Athletes

Schools are an important customer group for SLK. Every school is required to offer swimming lessons to every student and there are four schools using SLK regularly (Guðleifur Leifsson, personal communication, September 10, 2013). They are expecting facilities that can be used for teaching and are suitable for different age groups. Swimming is also a very popular sport in Iceland and athletes expect a high quality facility for effective training in every possible type of weather. Currently there is no inside pool that would fulfill the requirements of a competition swimming track in Kópavogur (Einarsson, 2006). As a result, some athletes may be driven to use other swimming pools nearby, or to limit competitions to the warmer summer months. There are two public swimming pools in Kópavogur and many others within a short distance in Reykjavík. Many private companies also offer similar services such as gyms and wellness centers. Compared to the private companies, Sundlaug Kópavogs is relatively advantageous in terms of price and versatility (Jón Jónsson, personal communication, September 28, 2012). The swimming pool must be able to handle large numbers of

customers with different facility requirements. If customers are not happy, they may choose to attend an alternative swimming pool nearby. As such, SLK could stand to benefit from a unique quality that differentiates it from its competition. One such quality could be reduced chemical usage in the pools.

5.5.2 Tourists

Iceland has been long marketed as a 'clean' country with close ties to untouched nature. In recent years, the tourism industry has increasingly emphasized Iceland as a spa destination, strengthening health-based tourism (Ministry of transport, 2000). Currently in Iceland, more than 120 thermal swimming pools welcome visitors all year-round (Thermal pools, 2013). Advertising them would be a good way to bring in more tourists. Should municipal swimming pools show interest in participating in this type of marketing, they must take into account the influence foreign customers, as individuals and as groups, can have on their peers. However, currently the head executives of SLK do not express interest in such marketing strategies (Guðleifur Leifsson, Jón Jónsson, and Magnús Ólafsson personal communication).

5.6 Social Drivers

There are numerous social groups with interests that need to be considered, and these same groups can put direct and/or indirect pressure on firms and governments alike to take responsibility for their impact on the environment. It is important for managers to recognize and appreciate the ability of constituents in the social system to influence and alter public opinion, accepted norms and people's expectations toward corporations and institutions in environmental protection (Hoffman, 2000).

5.6.1 Community

Activism at the community level can be effective at influencing corporate and government action. In recent years, Iceland has not seen much social and community activism, except concerning the financial crisis of 2008 and the banking crash. Customer groups can be extremely influential; however, one must not underestimate the influence of the individual customer. A considerable proportion of the SLK's customers are residents of Kópavogur and therefore part of the community. Nevertheless, according to the survey for the personnel of SLK, the visitors of the swimming pool show little interest in environmental matters at SLK and in Iceland. Only a few customers have made remarks regarding the waste of paper for

one-time admission tickets (disposable, neither reused nor recycled) (Jón Jónsson, personal communication, September 28, 2012).

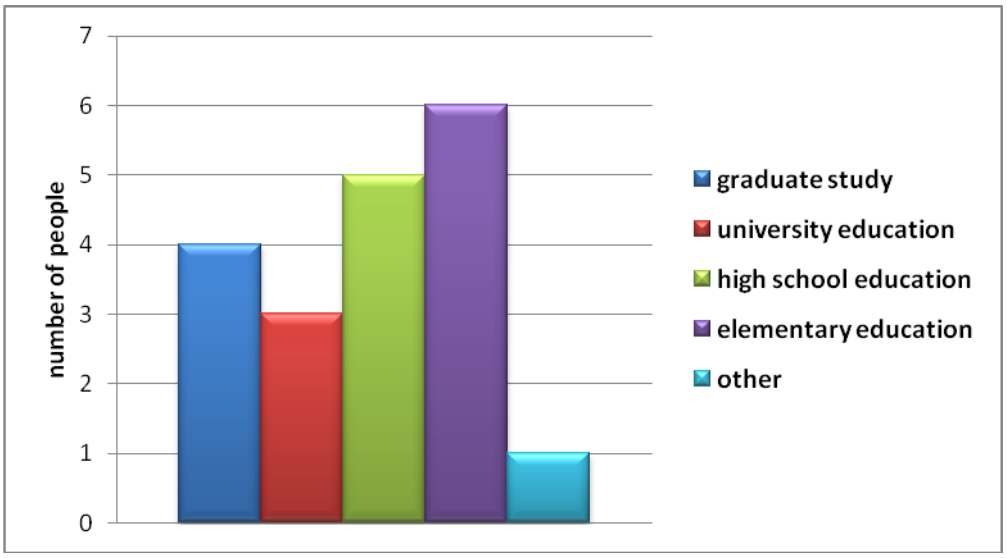
It seems that the environmental strategy of the municipality of Kópavogur is not closely followed at SLK. It is important that private companies and government-run institutions alike demonstrate to the public that they are being environmentally responsible and that economic and environmental efficiency is a task that is important to them and one they take seriously.

5.6.2 Employees

The researcher composed a survey in order to find out i) whether the employees of Sundlaug Kópavogs could be a pressure group willing to decrease the negative environmental impact of the swimming pools' operations and ii) what actions they would focus on in such effort. The survey also assessed if other social groups could be considered drivers for action at SLK.

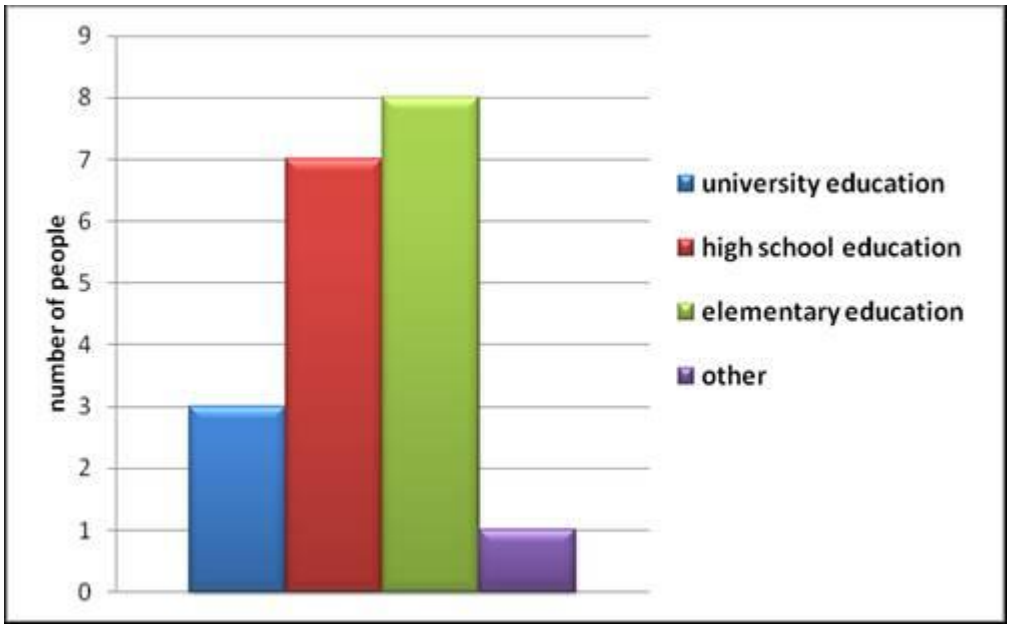
5.6.3 Background information of SLK's employees

All employees currently employed on a 100% (full-time) work position participated in the survey. The participants were 19 in total, 10 male and 9 female. According to the survey, four people have a graduate level of education (Masters or Doctors degree), three people have a university degree, five have completed high school and six have completed elementary education (see Graph 6),



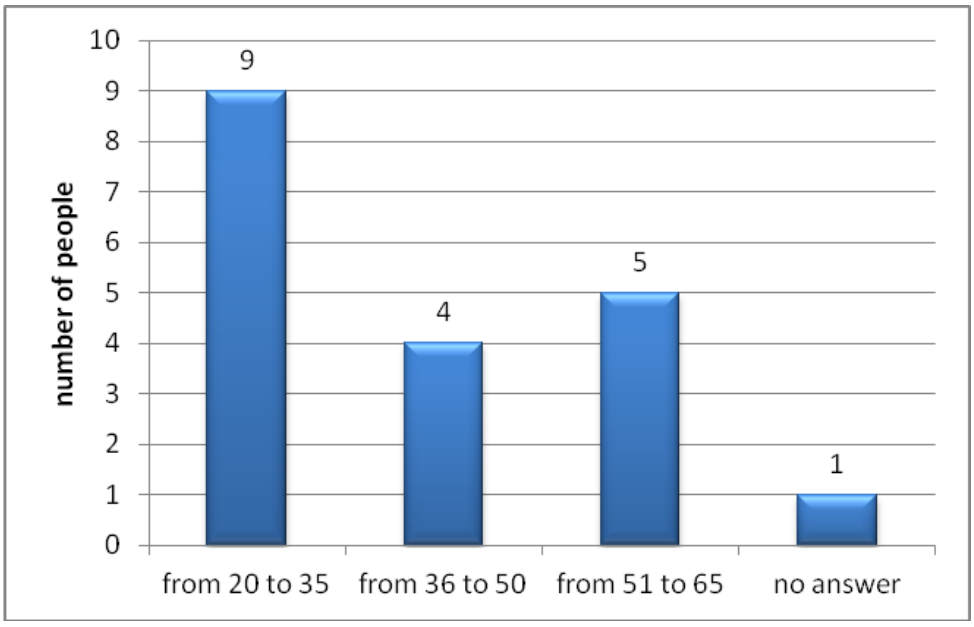
Graph 6:Employees' education according to the survey.

However, the reality is slightly different (see Graph 7). Eight employees at SLK have an elementary education, seven have a high school education, and three have a university education. It turned out that some of the employees misunderstood the question. All four employees who misunderstood the question are male. The confusion came, because the researcher used the Icelandic word "framhaldsnám" which according to most dictionaries (e.g. snara.is) translates to 'graduate study'. According to the official website of the University of Iceland, the word means education that is M.A M.S or PhD i.e. education that is Masters level or higher. Some of the participants thought that the meaning is “education that continues,” and therefore marked the Icelandic equivalent for graduate education if they had elementary education and some self-improvement classes (e.g. swimming lessons). Therefore, the researcher should have used "Masters or Doctors (PhD) level of education" instead of "graduate study" Only one of the participants marked only the field "other" without further specifying his education.



Graph 7: Employees' education according to the researcher.

Most of the employees at SLK fall in the age group 'from 20 to 35' (Graph 8, p.46). This could be due to the fact that there is an annual swim test and unless the person works only at the reception desk, he/she must be able to cover the test with ease. Only one of the participants did not want to share information regarding his age.



Graph 8: Age of the employees of SLK.

5.6.4 Environmental awareness of SLK´s employees

In recent years, terms like 'going green,' 'environmentally-friendly' and 'eco-friendly' have become buzzwords on the media, product packaging, marketing strategies etc. The term 'eco-friendly' or 'environmentally-friendly' has been used for so many different products and practices, that its meaning is often misinterpreted and misused. The term environmentally friendly is often used to describe products, goods, services, regulations, guidelines or laws aiming to reduce, minimize or bring no harm at all to the ecosystems and the natural environment (nature-friendly, n.d.; Merriam-Webster, 2013; Idoceonline, n.d.; Hearst Communicatoins Inc, 2013).

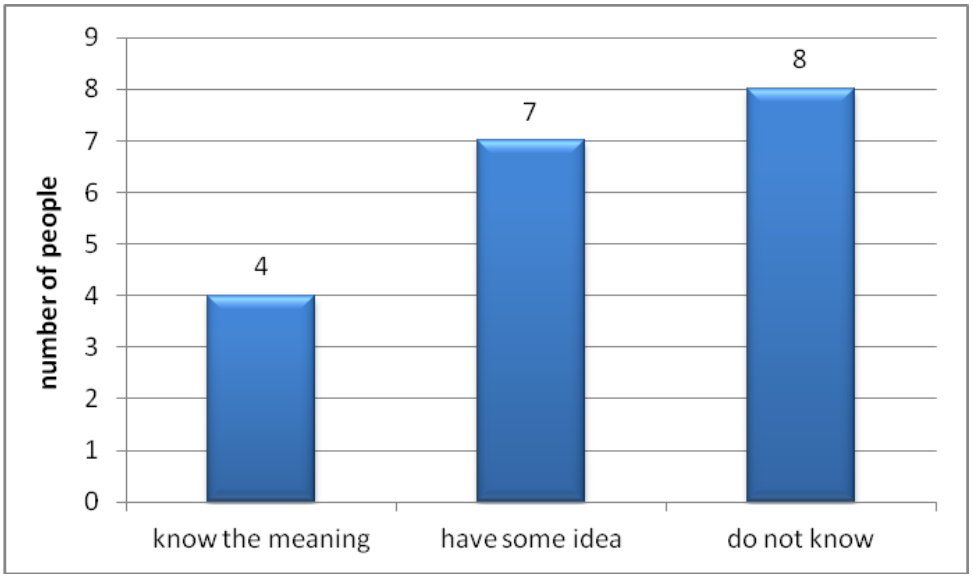
Four participants in the survey, or 21%, knew the meaning of the term (Graph 9 p. 47). Some of the participants in this group define an environmentally friendly company as a company that tries to have as little negative impact to the environment as possible, not only by its actions (i.e. selling of goods and services) but also by its interactions with other companies (e.g. demanding suppliers to be environmentally friendlier or to get certified products). Others had similar definitions and added the use of green energy, reasonable use of resources, recycling, using eco-certified products etc.

Participants who defined an environmentally friendly company as a company that has adopted several of the mentioned practices, without mentioning environmental concerns or adding any additional information, were regarded as people who have some idea, but do

not fully understand the meaning of the term. Seven participants, accounting for 37%, had some idea of what is an environmentally friendly company (Graph 9Graph 9).

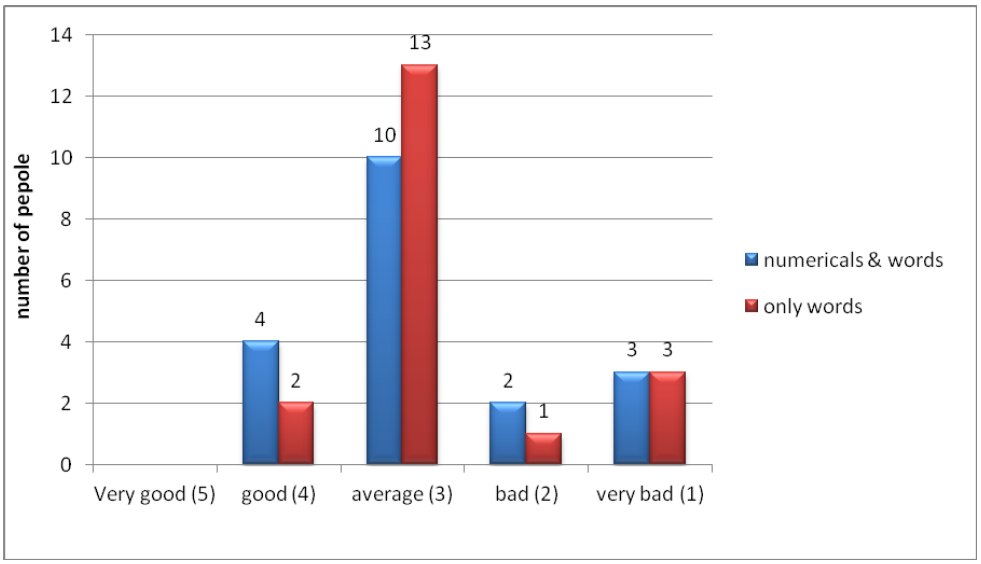
Employees of SLK, whose definition involved only one resource (e.g. company that uses less paper) without any additional clarification, and employees who did not answer the question at all were classified in the group 'did not know the meaning.' This group of participants is the largest, accounting for 42% (eight people), of the total number of employees.

Recycling was the most commonly mentioned practice when defining 'environmentally-friendly' company. In total 68% (13 people) of the participants mentioned recycling. Apparently, most employees of SLK consider recycling to be one of the key practices defining an 'environmentally-friendly' company.



Graph 9: Employees' awareness of the term 'environmentally-friendly' company.

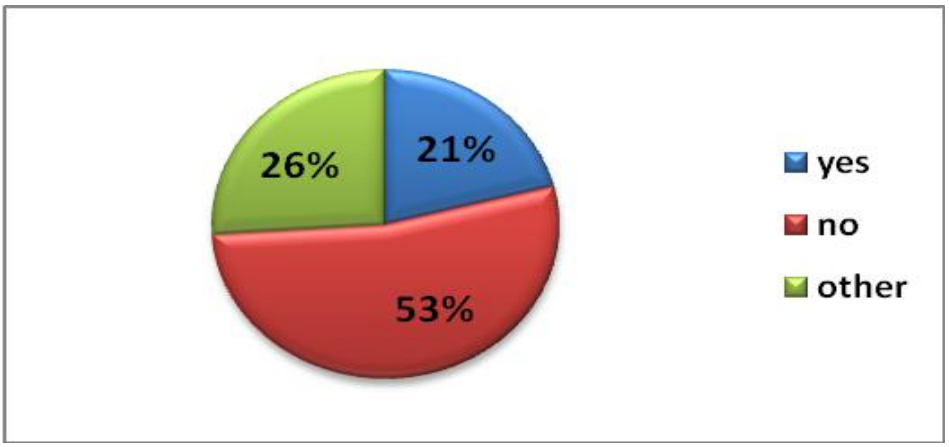
The employees of SLK were asked twice the same multiple-choice question: "How, in your opinion is the state of the environmental problems in Iceland?" There were five possibilities to choose from varying from "very good" to "very bad" (Graph 10). The first time the question was asked the participants had to evaluate the state of the environmental problems in Iceland with a mark from 1 to 5, where "very good" was the equivalent of 5 and "very bad" was the equivalent of 1. The second time there were no marks - just the possibilities from "very good" to "very bad". The employees of the swimming pool evaluated the state of the environment with a mark of 2.8 (on average).



Graph 10: Participants evaluating the state of environmental problems in Iceland using numerical values and words versus using only words for evaluation.

The participants answered the same question differently when it was introduced in a slightly different manner. Only seven of the participants gave the same answer to both the questions. The employees of SLK rated the environmental states slightly higher when using numerical values along with words for evaluation.

According to the survey, most of the participants do not consider SLK to be an environmentally friendly company (Graph 11). Most of SLK's personnel believe that the swimming pool can put more effort into recycling and resource management. Most participants name paper and cartons as resources that SLK could and should start recycling. Nearly all employees who do not consider SLK to be an environmentally friendly company share the belief that the swimming pool does not put enough effort into limiting their use of paper and plastics.

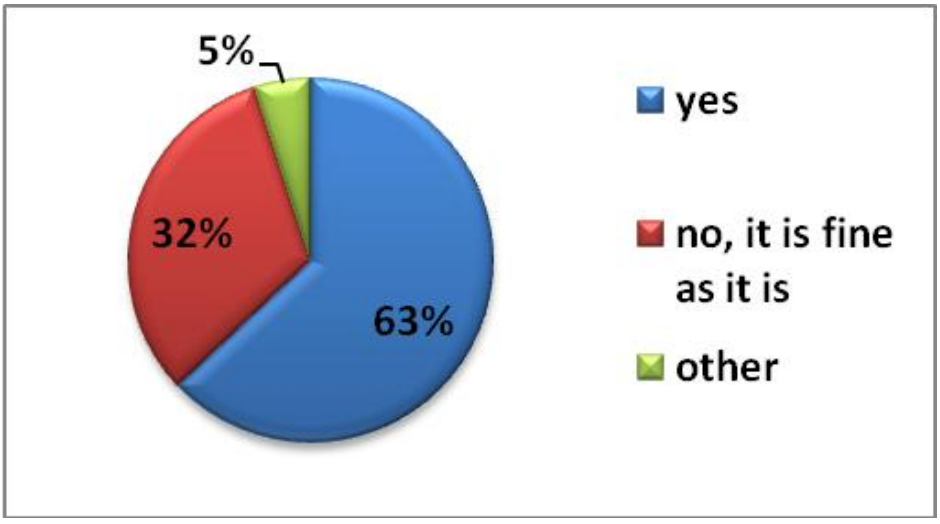


Graph 11: Is SLK an environmentally friendly company /according to the employees/?

Some of the participants consider SLK to be an environmentally friendly company. They set SLK in this category because the swimming pool uses eco-certified paper; has new equipment; strictly follows the levels of chlorine or because the environment around the swimming pool is clean.

Two employees of SLK chose to skip this question and three participants considered SLK be both environmentally friendly and not environmentally friendly company. They marked both the "yes" and the "no" fields and gave arguments for both opinions. Some of the participants in this group argued that SLK was environmentally friendly company because it follows health regulations of water Cl levels. Others stated the use of eco-certified paper makes SLK an environmentally friendly company. Yet others stated that in their opinion SLK is an environmentally friendly company because some of the products that are used at SLK do not degrade in the environment. The same group of people claimed that SLK is not an environmentally friendly company because it uses resources in a careless manner. The most commonly mentioned resources that were considered to be carelessly used were paper plastic and Styrofoam coffee cups.

When asked whether something should be changed at SLK in order to become an environmentally friendly company, most participants gave a positive answer (Graph 12). Even employees who claimed that SLK is an environmentally friendly company shared the opinion that changes are needed and gave suggestions for improvement.

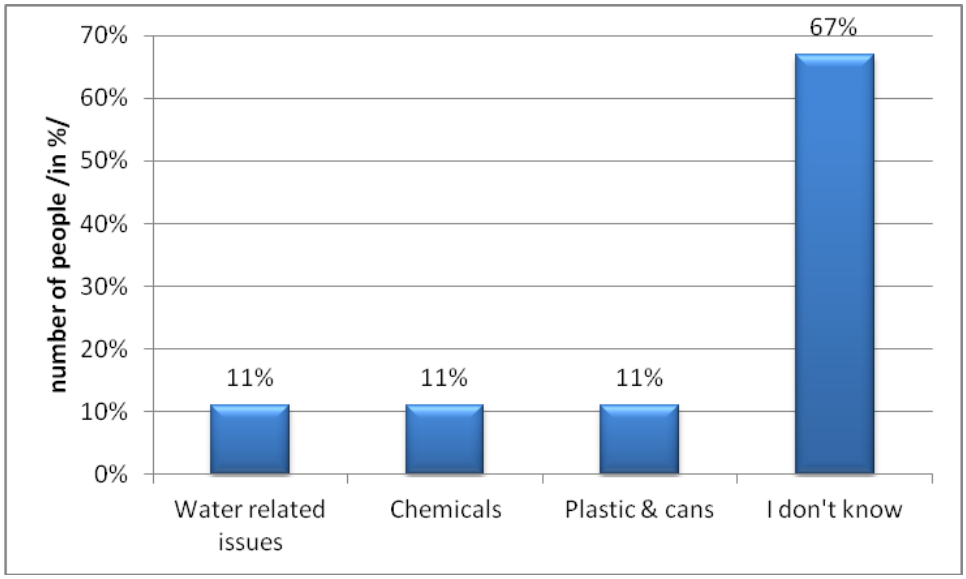


Graph 12: Should the managers of SLK change something in order to make SLK an environmentally friendly company?

The most common suggestion was regarding recycling practices. Most employees argued that the swimming pool should definitely start to recycle paper and obtain a special trash bin for papers and cartons. They claimed that there are rather large quantities of paper at SLK that can and should be recycled. Other suggestions for making SLK an environmentally friendly company included the use of alternative methods for water purification instead of the currently used ones. Others suggested that the staff should change their ways of thinking and doing things. They advocated the idea that a lot of resources, especially electricity, could be saved by using occupancy light sensors or by increasing the environmental awareness of SLK's employees.

Most of the participants, who claimed that SLK does not need any changes, did not provide any reasoning for their answer. However, some of the employees in this group admitted that they are not really environmentally aware or concerned with such topics, while others challenged the researcher with questions such as, "Could anything be done in a better way?" and "Do you think that something can be changed for the better?"

Only one participant decided not to give an opinion on this question.



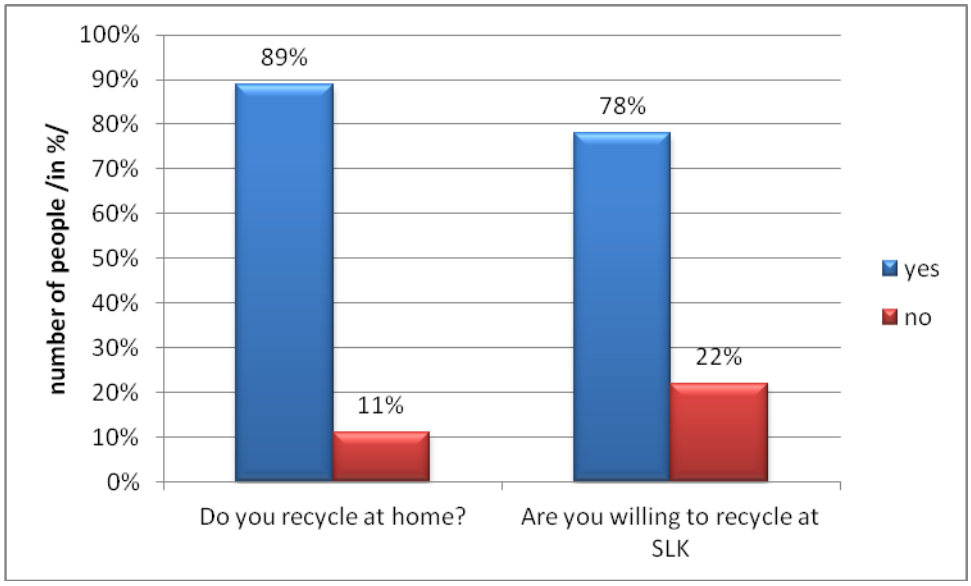
Graph 13: What do you think are the major environmental impacts associated with the activities of SLK?

The personnel of SLK were asked to point out the major environmental impacts associated with the activities of the swimming pool (Graph 13, p.50). Some participants pointed out the use of chemicals and cleaning materials. Others claimed that the negative environmental impact of SLK is mostly due to water-related issues such as

chlorinated water and gray water (wastewater generated from wash hand basins, showers baths etc.). Yet, others believe that SLK does not recycle enough cans and plastics. However, most employees could not name any major environmental impact of the swimming pool or were not aware that SLK has a negative environmental impact. In addition, the director of the swimming pool claims that SLK's personnel have never raised any issues regarding the environmental impact of the swimming pool during staff meetings (personal communication, September 3, 2013).

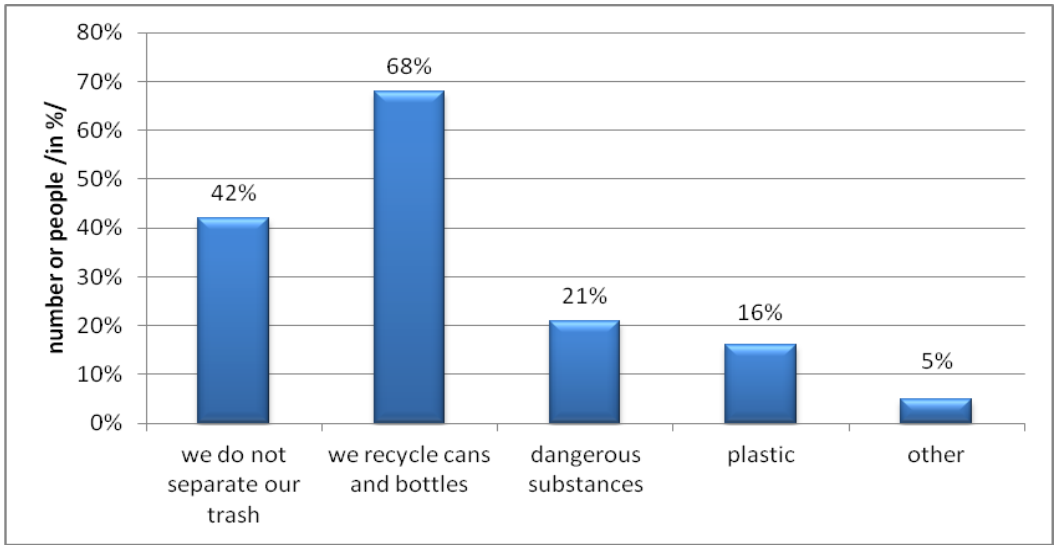
According to the survey (Graph 14, p.51), 89% of the employees of SLK recycle at their homes. Yet, 22% of the people who recycle at their home are not willing to recycle at their current workplace. Half of the people who do not want to recycle at SLK (11%) gave no explanation as to why they were against recycling at their workplace. The other half (11%) however claimed that they were not willing to pick up trash from garbage bins and manually separate it into different categories. Nevertheless, this group of people was willing to recycle at SLK if there were garbage bins for different types of trash with clear labels and instructions.

All of the employees who do not recycle at home (11%) (Graph 14, p. 51) are willing to recycle at their work place if SLK provides proper basis for recycling. The group of people who do not recycle at home shared the exact same opinion regarding recycling at their work place. Those employees demonstrated willingness to recycle with instructions on how to do it and with different garbage bins for the different categories of trash.



Graph 14: Employees' recycling habits and willingness to recycle.

At SLK the trash is currently not separated in different categories. The only specialized trash bins are for recycling cans and bottles. Most of those trash bins lack labels and recycling instructions. According to the survey (Graph 15) 68% of SLK´s personnel are aware that cans and bottles are being recycled at the swimming pool. Only 42% of the staff is aware that trash is currently not separated. Some of the employees claim that the swimming pool recycles plastics (16%) and dangerous substances (21%). However, this is not the case. One person marked the field other and explained that presently the recycling at SLK is limited to only cans and bottles. The person claimed that something should be done to increase the recycling awareness, since the misuse of resources (e.g. Styrofoam cups and paper) was unacceptable.



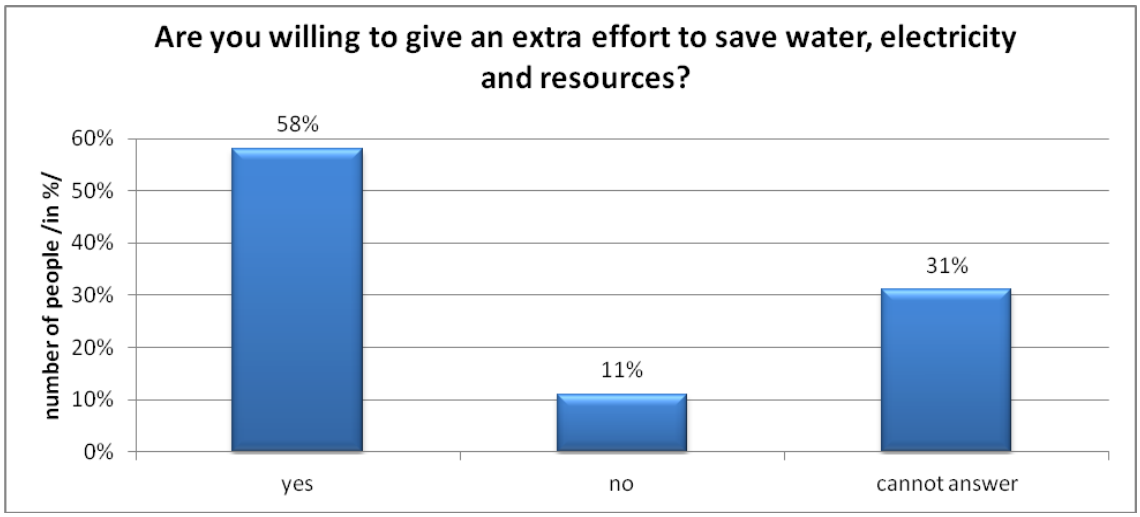
Graph 15: Recycling at SLK according to the personnel.

According to SLK representative, employees of SLK are willing to put extra efforts in saving energy, electricity and other resources at SLK (Jón Jónsso, personal communication, January 9, 2013). More than half of the employees (11 people) at SLK claim to be willing to put an extra effort into saving resources at work. Only one participant of this group shared that she is willing to save resources only if it does not involve labor outside her usual working hours.

The employees, who marked the field "I cannot answer," did not explain why they were unsure or why could they not provide an answer to that question.

Only two employees (11%) are not willing to save resources at SLK (Graph 16). One of them explained that the electricity in Iceland could be considered ‘green energy,’ the

water is more than enough and the other materials will simply degrade in the nature as part of the normal biological processes in life.

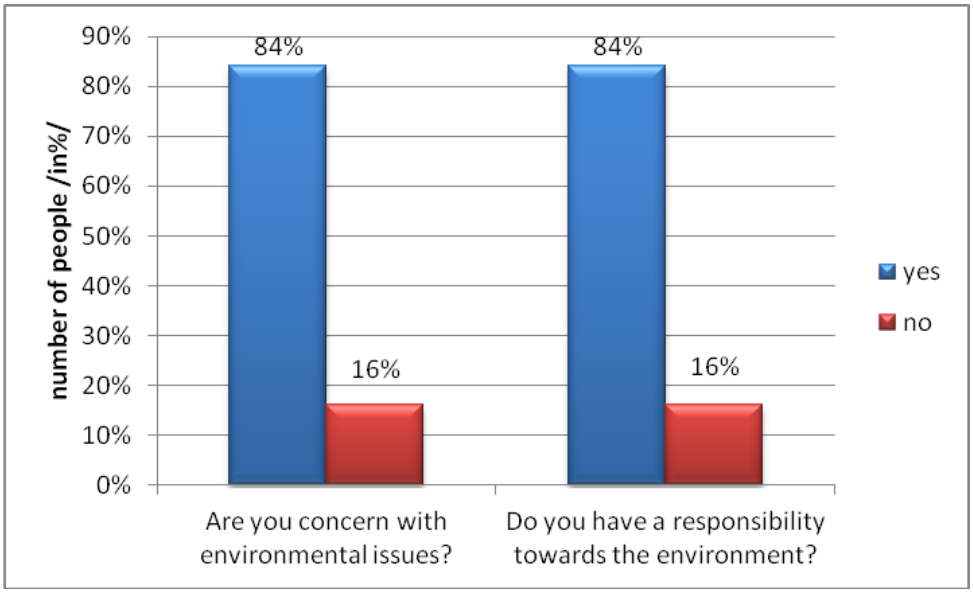


Graph 16: Employees' willingness to save water, electricity and resources.

Most of the employees at SLK claim to be concerned about the environment in general and feel that they have responsibilities towards the environment (Graph 17, p.54). Many participants explained that they were concerned with different environmental issues (i.e. CO_2 emissions, increasing acidity levels in oceans, climate change etc.). Others stated that we should think about the next generations, and we should preserve and even improve the natural environment because is not ours to destroy, it is only borrowed for a given time period. Others explained that if we are not concerned with environmental issues we should still try to limit our negative environmental impact, since when we pollute the environment we damage our health and decrease our wellbeing. A few participants were concerned about the environment from intrinsic and aesthetic perspective. They claim that a polluted environment is simply not beautiful and pleasant to live in. They state that there is nothing delightful in ocean view full of plastics and trash.

When it comes to personal responsibility, most participants claim that they should recycle their garbage, preserve the environment and think of future generations. There are participants who argue that we all have the same personal responsibilities toward the environment regardless of whether we admit it or not.

The percentages in Graph 17 are an exact match, yet people who claim to be concerned with environmental issues did not always feel that they have responsibility towards the environment and vice versa. Some participants claimed to be concerned with environmental issues, yet when asked about personal responsibilities, they deny having such, others claimed that they are not concerned with environmental issues, but argued that they had responsibility towards the environment.



Graph 17: Employees' concern towards the environment.

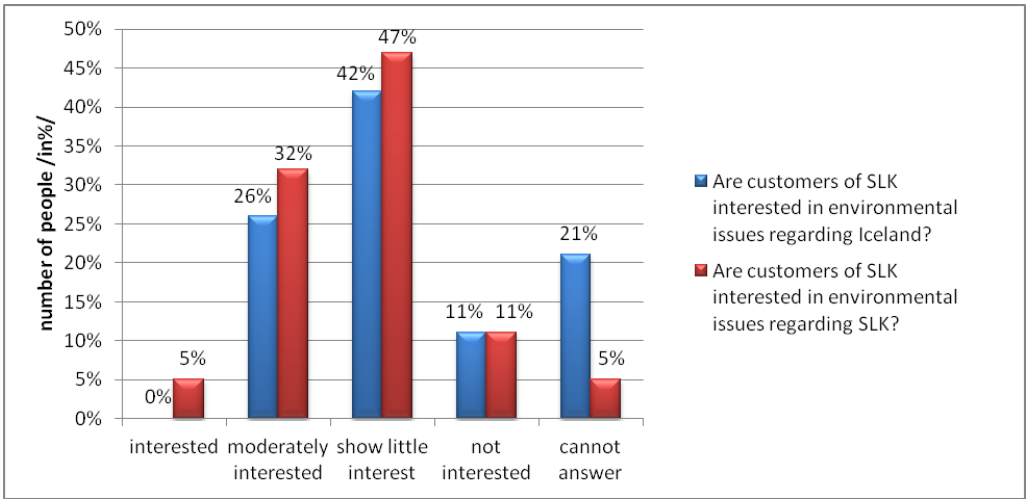
From the group of employees who are not concerned with environmental issues, only one chose to give an explanation. The participant admitted that she simply lacks interest in environmental issues, and added that where infrastructure for recycling existed she recycled. However, if such was not available the person would not be concerned where that trash is going to end or how would it affect other people.

5.6.5 Visitors

The next part of the survey contained questions regarding the level of environmental concern of the visitors at SLK. SLK´s employees consider the customers of the swimming pool to show rather little interest in environmental issues, both regarding Iceland and regarding the swimming pool (Graph 18).

This does not mean that the customers of SLK are not environmentally conscious. It shows however, that visitors of the swimming pool have rarely expressed environmental concerns when visiting SLK.

The employees of SLK mention that guests have sometimes expressed concerned regarding the Styrofoam coffee cups used only once, and the admission system, claiming that the swimming pool uses too much paper.



Graph 18: Level of environmental awareness of SLK´s customers (according to the employees).

5.6.6 Summary of the survey

According to the survey, most of SLK´s employees (84%) are concerned with environmental issues and more than half of the personnel (58%) are willing to participate in additional activities in order to decrease the negative environmental impact of the swimming pool. Nevertheless, only four (21%) out of 19 employees could define the term 'environmentally friendly company' and 89% could not mention any environmental impact of the swimming pool.

Almost all employees (89%) of SLK recycle at home and most of them (78%) are willing to start recycling at their workplace. However, the personnel are generally not informed about what is being recycled at the facility.

Currently SLK's personnel are not acting as a pressure group for increasing the environmental and economic efficiency at SLK. Nevertheless, most of the employees of the swimming pool have suggestions for improving SLK´s efficiency and are willing to participate in additional activities in order to decrease the negative environmental impact of the swimming pool.

According to the employees of SLK, the majority of the visitors rarely express any environmental concern. Therefore, the social and market business drivers are not active

in the context of decreasing the negative environmental impact of the swimming pool. However, those drivers could become more active once the environmental awareness of visitors and employees increases.

5.7 Leading Business Driver

According to the analyses of the business drivers, no pressure groups are currently altering the decision-making processes at the swimming pool. Within the potential group of influencers, the buyers, the suppliers, the community and the personnel of SLK, none of these groups seem to set any noticeable pressure regarding environmental or economic efficiency at SLK.

Nevertheless, SLK should comply with the regulations of Kópavogur. The main municipal regulations in regard to swimming pools are focused on safety and hygiene in the water basins, changing rooms and their vicinity, and not on environmental and economic efficiency. The municipality of Kópavogur has an environmental policy. Unfortunately, the swimming pool does not comply with the environmental policy or strategies of the municipality of Kópavogur and is not very active in trying to limit its environmental impact beyond what is legally required.

The only business driver that alter the decision-making processes at SLK is the resource driver as stated by executives and decision makers at SLK. At SLK, changes in operations are considered only if they can save financial resources. Environmental concerns remain somehow in the background and are dealt with only due to regulatory requirements. It is appreciated when suppliers acquire eco-labels. If they do not however, the swimming pool does not raise any questions or demands regarding the matter.

Since the resource driver is the leading influencer in the SLK operations, suggestions for improvement must be based on resources in a way that minimizes the creation of tradeoffs between the environmental and economic efficiency of the pool.

6 Suggestions for improvement

6.1 Water purification system alternative

Many alternatives to chlorine exist for water purification, such as bromine, ozone, hydrogen peroxide, copper and ultraviolet water disinfection. Although recognized, those water purification methods are either far too expensive to be applied at SLK, or should be used in combination with each other, or with other water purification methods, since they are not efficient enough on their own (Jón Jónsson, and Guðleifur Leifsson personal communication). According to several directors and head executives of swimming pools in Iceland the only alternative to current ways of water purification that can actually benefit both the economic and the environmental efficiency of swimming pools in Iceland is sodium chlorine electrolysis system (Hördur Már, Björn Ólafsson and Þór Níelsen, and Pétur Helgason, personal communications).

The researcher contacted the consultant of a distributor company, Water Solutions, that sells such systems. Together both parties estimated whether it is economically and environmentally efficient for SLK to purchase such equipment. The operation price of the current chlorine system was taken into account and compared to the operational price of an electrolysis system, if it were to operate at SLK. Factors such as price of the resource (chlorine or salt), number of visitors, amount of electricity needed and maintenance and reparation cost of both systems were taken in to account. In order to make approximate calculations of the possible operational cost of the electrolysis system, the researcher and the Water Solutions' consultant used three years of data from the electrolysis system's operational cost at another swimming pool. The electrolysis system had a relatively high capital cost of 30 million ISK. According to the consultant of Water Solutions, the equipment's pay-off period would be approximately 6-8 years, with variations depending on the usage. Estimated total savings were calculated to be between 3,75 and 5 million ISK per year (Haraldur Jónsson personal communication, September 25, 2013).

The conclusion of the calculations illustrated that a substitution of the current disinfection system with electrolysis system is definitely worth considering, due to possible economic and environmental benefits.[4]

However, the membrane cell electrolysis system (Figure 7, p. 25) is the better system and the better option, since it transfers nearly 100% of the salt into chlorine. In contrast, the open cell system transfers only 50% of the salt. In the open cell system, the salt enters the circulation system, which will increase the reparation cost of the water circulation system.

The membrane electrolysis system is better than both the open cell electrolysis system and the currently-used chlorine system. It could potentially eliminate the financial burden of the current chlorine system, since SLK would no longer have to pay for chlorine, carbonic acid, or for renting the carbonic acid tank.

The amount of chlorine used at SLK would decrease, since the chlorine produced by the electrolysis system would be fresh and therefore a more potent disinfectant. The membrane cell system produces chlorine gas. The gas could be used for pH regulation instead of the carbonic acid. Therefore, there would no longer be a need for transporting dangerous substances such as carbonic acid and chlorine to SLK.

6.2 Water

6.2.1 Showers and faucets

Water is one of the most abundant resources in Iceland. Many people do not consider saving water to be a priority because of the abundance and the low price of the resource. However, for the year 2012, SLK's hot water bill accounted for more than 16.5 million ISK. Among all resources used at SLK, hot water was at the top of the expenditure list and cold water was among the top five (Figure 8, p. 36).

It is evident that the managers of SLK need to increase the environmental awareness of customers and employees and consider ways of saving water. Currently SLK uses showerheads that have a flow rate of 18 liters of water per minute (personal communication, November 22, 2013). In contrast, the low flow showerheads available on the market have a flow rate between 7.5 and 10 liters (depending on the type). Therefore if installed, low-flow showerheads would save between 8 and 10.5 liters of

[4] Exact estimates could not be shown due to confidentiality issues.

water per shower for each minute of shower running time, which could lead to considerable financial savings.

The regulations at SLK require each visitor to shower before entering the pool. Since the pool is chlorinated, almost all visitors take a shower after visiting the swimming pool as well. Every year nearly 470,500 visitors visit the pool (accounting department of Kópavogur, personal communication, March 22, 2013). If we estimate the average shower time per person to be 3 minutes, both prior to pool entry and after swimming, we get approximately 51 million liters of water consumption annually, just from the showers. If showerheads with a flow rate of approximately 10 liters per minute were used at SLK, the annual water usage from the showers would be approximately 28 million litters, demonstrating a reduction of 33 million liters of water per year. The estimate of 33 million liters of water is for cold and hot water combined. The monetary savings from showerheads replacement will be approximately 3.21 million ISK[5].

At SLK, people tend to leave the water running even when they are not using it. In some swimming pools in Reykjavík, push-button showers were installed to solve this problem. The water starts running after the button is pressed and stops after a preset time-period. This prevents people from letting the water run when they are not under the shower, which could lead to further water savings. Using push-button showers also would allow SLK to decide whether to set one water temperature for all showers, or let the customers regulate the water temperature individually. The control of the water temperature could lead to further savings in water and hot water usage.

Adding automatic faucets (also called 'hands-free faucets') is another way of saving water. In order to save water, some swimming pools already use button showers and/or automatic faucets (Sundhöll Reykjavíkur and Laugardalslaug). The managers of SLK could contact such swimming pools and track the water usage data before and after the installation of those products. In this way, SLK decision-makers could make more informed decisions, and gain understanding on the most beneficial practices for water saving.

[5]According to the accounting department of Kópavogur (personal communication January 15, 2014) the ratio for hot and cold shower-water is approximately 75% (hot) - 25% (cold). Therefore, the savings will be approximately 24,750,000 liters of hot and 8,250,000 liters of cold water. Kópavogsbær measures water usage in cubic meters (m^3). SLK pays 118.18 ISK per m^3 of hot water and 34.55 ISK per m^3 of cold water. After the showerhead replacement hot-water savings would be 24,750,000 liters = 24,750 m^3 = 2,924,955 ISK; cold-water savings: 8,250,000 liters = 8,250 m^3 = 285,038 ISK. Total showerhead savings = 3,209,993 ISK.

6.2.2 Evaporation

In swimming pools, evaporation is considered to be the greatest source of energy loss (Figure 9). According to the U.S. department of Energy (2012) evaporating water requires tremendous amounts of energy. It only takes 1 Btu (British thermal unit) to raise 1 pound (0,45kg) of water 1 degree, but each pound of 80ºF (27°C) water that evaporates takes 1,048 Btu of heat out of the pool (Swimming pool covers, 2012).

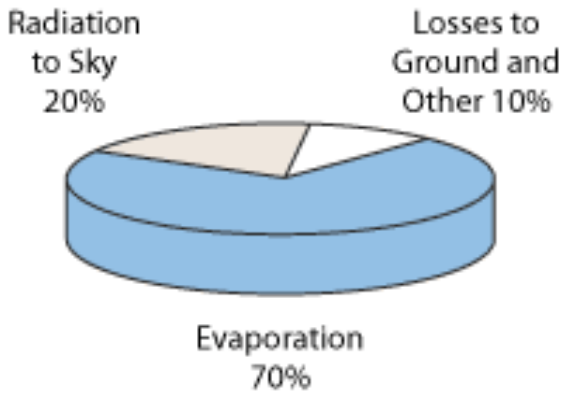


Figure 9: Outdoor pool energy loss characteristics. Retrieved on November 21, 2013 from: http://energy.gov/energysaver/articles/swimming-pool-covers

The evaporation rate of outdoor pools varies largely depending on the pool's temperature, surrounding air temperature and the speed of the wind at the pool surface. The higher the pool´s temperature, wind speed and the lower the humidity, the greater the evaporation rate.

Indoor swimming pools are not affected by the weather conditions as much as the outdoor pools, yet they lose large amount of energy due to evaporation (Figure 10). The level of evaporation in indoor swimming pools is so great that room ventilation is needed to control the indoor humidity. The ventilated air would add to the energy costs (Figure 9).

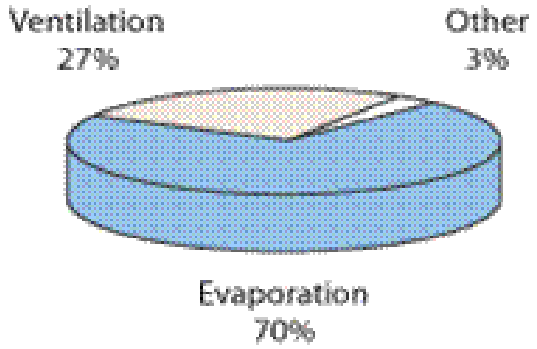


Figure 10: Indoor pool energy loss characteristics. Retrieved on November 21, 2013 from: http://energy.gov/energysaver/articles/swimming-pool-covers

According to the U.S Department of Energy (Swimming pool covers, 2012) evaporation could be decried by using a swimming pool cover. Energy savings of 50%-70% are possible if the water basin is covered when it is not in use.

6.2.3 Swimming pool covers

However, at SLK the water is not heated with electricity, but by thermal hot water (see Case description chapter, p.18). Therefore, the use of pool covers will mostly save makeup water (cold and hot). At SLK, hot water is the most expensive resource. For 2012 alone SLK spent 16.5 million ISK on hot water. According to the U.S Department of Energy, pool covers reduce the water usage by decreasing the amount of make-up water needed by 30%-50% (Swimming pool covers, 2012).

Swimming pool covers are specially designed for swimming pools. They are most commonly made of UV-stabilized polyethylene, polypropylene, or vinyl. These are special materials that make the pool cover flexible, durable and even transparent (if needed).

However, there are different types of pool covers suitable for different conditions. The bubble cover, also called solar cover, is made from material similar to bubble packing material and is one of the cheapest options on the market. It has UV inhibitors and is made from a thicker grade of plastic than typical bubble packing material. This type of cover transmits part of the solar energy that strikes its surface to the pool´s water. It is therefore suitable for covering swimming pools in areas with long sun hours and long lasting daytime (Swimming pool covers, 2012).

Another type of pool cover is the vinyl cover. It consists of a heavier material and has a longer life expectancy than bubble coves. There are also vinyl covers available with a thin layer of flexible insulation compressed between two layers of vinyl.

Nevertheless, using the wrong type of pool covers can have some disadvantages for outdoor swimming pools. Outdoor swimming pools absorb up to 85% of the solar energy that contacts the water surface (Swimming pool covers, 2012), which is an important contribution to the pools' heating. Different pool covers affect the solar gain of the outdoor pool in a different manner. A transparent bubble cover reduces the absorption of solar energy by 5%-15% depending on the weather conditions, while a completely opaque cover can reduce the absorption by 20%-40% (swimming pool covers, 2012).

According to the U.S Energy Department, pool covers offer much more than energy savings. They reduce the chemical consumption of the pool by 35%-60% and decrease the need of water sanitation by keeping dirt and other debris out of the pool (Swimming pool covers, 2012). Furthermore, pool covers in indoor swimming pools can decrease the need for ventilation. The ventilation system can be switched off while the pool is covered, which will bring additional energy savings.

Evaporation rate and makeup water needs could be further decreased by adding some kind of windbreak such as trees, shrubs or a fence. The windbreak should be in a close proximity to the pool and high enough so it does not increase evaporation by creation of turbulence over the pool. The windbreak should not shade the water basin since the sun provides additional heating to the water.

According to 'swimming pool covers' (2012), the use of pool covers could lead to 35%-60% decrease in chemical use and 30%-50% decrease in the need of makeup water. If the annual cost of hot makeup water is 12 million ISK[6], SLK could save between 3,6 - 6 million ISK on makeup water. However, the complete water bill was presented to the researcher, without any separation between the water used for the swimming pool and the water used for the shower areas. Therefore, it is difficult to estimate the exact amount of water-saving potential, or the projected financial savings produced by installation of swimming pool covers and windbreaks, before measuring the evaporation levels at SLK.

The average annual chlorine use for a period of five years (2008-2012) equals 48,683 liters (Graph 4, p.38), a liter of chlorine costs 85 ISK (accounting department of Kópavogur, personal communication, September 21, 2013). Accordingly, SLK pays around 4,138,055 ISK on chorine per year. Therefore, chlorine savings due to installation of pool covers could range between 1,4 - 2,3 million ISK per year (35%-60%).

[6]SLK´s visitors use approximately 51 million liters of shower water (p.62). According to the accounting department of Kópavogur (personal communication January 15, 2014) the ratio for hot and cold shower-water is approximately 75% (hot) - 25% (cold). Therefore, 38,3 million liters (75% of the total) it is hot water and 12,7 million liters(25% of the total) is cold water. SLK pays 118.18 ISK per m^3 of hot water and 34.55 per m^3 of cold water. The bill for the hot water used at the showers would be approximately: 38,300,000 liters = 38,300 m^3 = 4,526,294 ISK; SLK would pay approximately: 12,700,000 = 12,700 m^3 = 438,785 ISK for cold water. The hot water bill for hot makeup water and shower water is 16,5 million ISK. Therefore, the cost of the hot makeup water is approximately 16,5 - 4,5 = 12 million ISK.

If those approximations are correct, the use of swimming pool covers could be among the most potent suggestions for improvement, since the variables 'Hot water' and chemical use ('Water purification') are at the top of SLK´s operational cost list (Figure 8, p.35).

However, swimming pool covers could be quite expensive. The prices vary depending on the size of the basin and the type of the cover. A cover for a hot tub or Jacuzzi range between 100,000 - 200,000 ISK, for a 25 meter indoor swimming pool the range is between 3,5 - 4 million ISK and for 50 meter pool the price range is between 5,5 - 6 million ISK (Ársgeir Friðriksson, representative of Á. Óskarsson ehf, personal communication, January 08, 2014). Most of the companies selling swimming pool covers (Á. Óskarsson, Aquasport, Normx, Altis, etc.) are willing to make discounts and offers for large purchases. The representatives of those companies could not offer any approximate calculations of reimbursement period of their products. However, Reynir G. Karlsson - a former state sport representative (íþróttafulltrúi ríkisins), advocates the use of swimming pool covers (Karalsson, R. n.d.). He provides many practical examples of the benefits of swimming pool covers: 60% hot water savings at Bessastaðahrepps swimming pool and 50% water savings at Hvolsvelli swimming pool. In addition, Reynir claims that swimming pool covers could save so much hot water that their payback period could be approximately one year. SLK´s executives could purchase swimming pool covers for some of the little water basins and decide whether it is a product worth investing in.

6.3 Energy

Electricity is the second most expensive resource for SLK after hot water consumption (Figure 8, p. 35). For 2012, the swimming pool spent nearly 11 million ISK on electricity. The pumps of the water circulation system, the chlorine pumps and the filtering pumps consume the largest amount of energy, followed by the lighting system (Jón Jónsson, personal communication, November 22, 2013). The energy use of the pumps can be slightly reduced by applying pool covers. There are several ways of further lowering the electricity demand through improvements in the lighting system, such as putting lights on timers, installing motion sensors, changing incandescent light bulbs to LED or CFL bulbs, or simply increasing in diligence about turning the light off when they are not needed. At SLK, motion sensors could be installed in storage rooms and in the basement

of the swimming pool. Those areas are visited only several times a day, yet many lights bulbs can result in extra spending if left on when the premises are empty.

Replacing incandescent light bulbs with LED or CFL lights is another way of saving energy. They are both suitable alternatives because they produce high quality light and can use the same infrastructure as the currently-used light bulbs. LED lights are generally more efficient in terms of electricity saving better, but they cost nearly five times as much as a CFL light bulb. However, the life expectancy of the LED bulbs is much longer. The life expectancy of the incandescent light bulb is 1,500 hours, while the CFL has 5,000 and the LED has 25,000 hours of life expectancy (Bluejay, 2013). The managers of the swimming pool should differentiate between short-term versus long-tem cost, in order to make more informed decision when choosing the most-suitable lighting option for SLK.

The swimming pool could gradually change all incandescent light bulbs to LED. When one of the incandescent light bulbs burns out, it could be changed to a LED bulb. This process would be slow, but it allows the use of incandescent light bulbs until they burnout, and thus would prevent unnecessary waste, while spreading out the upfront costs of the LED bulbs.

For lights that are always on, the use of the lowest-wattage bulbs available is recommended. Replacing 75-watt incandescent light bulbs with 15-watt incandescent bulbs will reduce the energy usage by 80% and changing the bulbs to lower wattage LED or CFL will save even more energy (Bluejay, 2013).

The indoor pool's lighting system is composed of fluorescent magnetic ballasts. It could be replaced with electronic fluorescent ballasts. For long-tube fluorescent lighting (as opposed to screw-in compact fluorescents), an old-style magnetic ballast might use 100W to power two 40W tubes, while an electronic ballast might use only 60W (Bluejay, 2013). In addition, the electronic ballast eliminates light flickering and humming. They also generate less heat, which saves additional electricity. Nevertheless, it is difficult to estimate the exact amount of electricity that would be used after the proposed changes, since SLK has one electricity bill for the entire building. Employees of the swimming pool could monitor the electricity use of different systems on a regular bases and accumulate data on electricity use. In this way, the employees could calculate the

exact amount of savings in monetary value and in electricity (kW) for each of the proposed changes before and after the implication of any suggestion for improvement related to energy saving.

Most employees admit that they are not aware of the environmental impact of the swimming pool and are sometimes rather careless when it comes to saving resources. Therefore, increasing environmental awareness among employees is probably one of the most effective ways of saving electricity at SLK. The employees of the swimming pool control the lighting system of the entire building. Employees often forget to turn off the lights in premises that are not being used. Nearly half of the employees at SLK claim that increasing environmental awareness among employees would lead to savings in not only electricity, but also in all resource consumption at SLK.

6.4 Paper plastic and cartons

6.4.1 Admission system

The regular customers of SLK buy a membership card or a membership chip. The membership chips can be put on the customers' wrist (like a watch) and are waterproof. They are used for the membership period (6 months to 1 year) and can be renewed multiple times. Since they are waterproof, they are very durable and can be used for many years. However, membership cards are made of cardboard and are the same as the one-time entering ticket in terms of physical make. They can rarely be used for more than one year, since the barcode at the end of the card becomes unreadable. The swimming pool offers admission cards that have 10, 30 or 60 admission points, with each point accounting for one visit. Around 70% of SLK´s customers use one of the described options for multiple visits. The rest of the customers (30%) use one-time tickets (Jón jónsson, personal communication, November 22, 2013).

When a person pays to go once to the swimming pool, he/she receives a ticket, goes to the entrance, approximately five meters from the reception desk, uses the ticket and then disposes of it. SLK purchases the cardboard tickets at 3.58 ISK per peace, regardless of whether it will be turn into a membership card or into a one-time entering ticket. The customers who use a one-time admission ticket account for 30%, or 144,121 people per year. However, this number does not include all the free admission tickets for people who have forgotten to bring their membership card, and all the people who

can visit the swimming pool free of charge, including firefighters, police officers, public transportation bus drivers, children under the age of 6 disabled people, athletes for swimming competition etc. From the listed people, the underage children alone account for more than 5,000 people per year (accounting department of Kópavogur, personal communication, September 2, 2013). If we assume than 150,000 people on average use a one-time admission ticket each year, we can conclude that SLK spends 537,000 ISK per year for printing tickets that are going to be used only once.

However, there is a simple way to change this system: use the one-time admission tickets multiple times. The tickets could be used only one time since their barcode does not allow SLK's employees to set additional admission points once the ticket is used. The barcode of the tickets can be changed by a simple change in the settings of the ticket printer (Strikamerki hf. printing company, personal communication, January 17, 2013). Once the settings of the printer are changed, the one-time admission tickets could be collected and used multiple times.

Containers for the 'one-time' tickets could be set right next to the entrance of the swimming pool, so that people who use them can dispose of the ticket in the containers and not in the trash bin. A simple carton box with a cut-out at the top could be used as a container. The gap should not be larger than two entering tickets in length, in order to prevent people from throwing objects other than the entering tickets in the containers. In order to be used properly, the containers must be clearly marked. At the end of each nightshift, the employees would collect all the tickets from the containers and set more entering points on them, in order to sell them the following day. As time passes, any torn or defective tickets would be removed from circulation. Each of the tickets could be used numerous times. Even if it is assumed that, each ticket can be used only 10 times, the swimming pool would save 483,300 ISK[7] from this minor change.

6.4.2 Extra receipts

Many employees at SLK commented on the unnecessary use of paper at the reception desk. The employees have to use a receipt printer, in order to print receipts different

[7] Using each ticket ten times instead of once, means printing ten times fewer tickets. Therefore, the swimming pool will print 15,000 tickets instead of 150,000. Each printed ticked costs 3,58 ISK to SLK. After the change, SLK will spend 15,000*3.58=53,700 on 'one-time' tickets. Before the change, SLK spent 537,000 ISK on one-time tickets. Therefore, SLK will save: 537,000-53,700= 483,300 ISK annually.

from the ones that people get (and sign) from a pos credit card terminal after using their credit card. One paper role for a pos credit card terminal costs 67 ISK and a roll for the receipt printer costs 233 ISK.

The receipt printer should be used only when the SLK´s employees are paying back a person or when a double receipt is needed (e.g. for the accounting of a company).

However, at SLK the receipt printer is set to print receipts after each and every purchase at the swimming pool. These receipts are not used for the accounting of the swimming pool and are directly disposed of, right after they are printed. The printer prints receipts even when the employees at the reception desk print free of charge tickets.

The receipt printer could be easily reprogrammed to print receipts only when the employees need to print one, and not for the purchase of every good and service at the swimming pool (Jón Jónsson, personal communication, January 17, 2013). According to the employees at SLK, it takes approximately seven days to use an entire receipt paper roll (personal communication, November 28, 2013). Therefore, SLK uses approximately 52 rolls of double receipt paper per year. In monetary value, that equals 12,116 ISK per year. A double receipt is needed less than three times per week. The reset of the receipt printer will save approximately 80% of the paper used, or 9,693 ISK per year.

6.4.3 Recycling

Sundlaug Kópavogs recycles only cans and plastic bottles. In order to save resources, the swimming pool should start recycling paper and cartons. For 2012, the trash service company, Íslenska Gámafélagið (hereafter IGF), transported 14,950kg of trash, which costs SLK around 206,000 ISK (Íslenska Gámafélagið representative, personal communication, September 4, 2013). According to representatives from IGF, the swimming pool could use the green trash bin. The green trash bin is a special bin for paper and cartons. Currently the trash of SLK is not separated and no estimates have been made on the amount of paper and cartons that goes to the common waste bin. Nevertheless, according to Jón Jónsson (personal communication, November 22, 2013), there is a large quantity of carton and papers that enters the common waste bin, and each kilogram of trash costs the swimming pool 14 ISK.

6.4.4 Plastic bags

Currently there are 31 trash bins that use a plastic bag. They are all changed twice a day, every working day. Each of those plastic bags costs 12 ISK. Therefore, SLK pays 744 ISK per day for trash plastic bags, which is 22,320 ISK for every 30 days. Every shift has to throw the trash. Consequently, the plastic bags are replaced twice a day, regardless of the amount of trash in them. The trash bags should be replaced only if there is a need for it.

In total, there are 10 trash bins for all 3 male locker rooms. The researcher conducted a small experiment and changed only trash bags that needed changing for period of one year. The researcher ended up using no more than 6 trash bags per day instead of 20. The same practices are applicable for all areas of the swimming pool. In addition, two of the trash bins at the reception desk could be transferred to specialized paper only trash bins. In this case, they will not need plastic bag at all. If these practices were applied at SLK, the swimming pool would use 20 plastic trash bags per day instead of 62, which will lead to daily savings of 504 ISK. Therefore for a period of 30 days, SLK would save 15,120 ISK. In one year (SLK is open 359 days per year), SLK would use 14,360 fewer plastic trash bags and would save 180,936 ISK.

6.5 Soap and cleaning materials

In all shower areas, SLK provides skin and head soap for visitor's disposal. The company Mjöll Frikk supplies the soap. The soap and most of the other Mjöll Frikk products are not eco-certified.

The soap is pumped from the basement of the swimming pools to hand-pumps near the showers in all changing rooms. The hand pumps are not very effective at saving resources. When fully pressed they provide more than a handful of soap, in addition they often leak and leave large amounts of soap on the floor. The same soap pumps were once used at a swimming pool in Reykjavik - Laugardalslaug. However, the managers of the pool realized how inefficient the system was, and changed it to soap dosing system. Each pump has a motion detector; if one puts a hand in front of the pump, the pump will release a preset amount of soap. The dose of soap can be regulated according to the thickness of the soap. According to a representative of Laugardalslaug "the dosing system proved to be very efficient - it saves us large amount of resources and that is benefiting both the environment and the swimming pool" (Þór Níelsen, personal communication, March 14, 2013). The

representative was not willing to share the exact amount of the savings, unless he is contacted by another swimming pool executive, yet admitted that the monthly savings of soap due to the new system greatly exceeded 20%. For the year, 2013 SLK used 61 barrels of soap (Magnús Kristinsson - mjöll frigg, baðsápa representative, personal communication, January 8, 2014). Each barrel contains 200 liters of liquid soap and costs 23,000 ISK. Therefore, for 2013 SLK spent over 1,4 million ISK for 12,200 liters of liquid soap.

A dosing system could be applied at SLK as well. The dose of soap could easily be regulated by changing the time interval at the nozzle of the pump. The longer the nozzle is open, the more soap will be dosed. In order to prevent dosing more soap than needed, the time intervals of the nozzle should be regulated after each soap supply. When the soap is less dense, the time interval should be shortened and when the soap is denser, the time interval of the nozzle should be increased. SLK´s expenses for soap for 2013 are 1,4 million ISK. Therefore, a 20% decrease in the use of soap due to the dosing system could bring annual savings of 280,000ISK and 2,440 liters of liquid soap. According to Þór Níelsen (personal communication, March 14, 2013) SLK is a large swimming pool with many locker rooms and soap savings due to dosing system could exceed the soap savings in Laugardalslaug. The executives of Sundlaug Kópavogs can contact swimming pools that already use this system, such as Laugardalslaug, in order to get precise estimates on soap savings.

6.5.1 Cleaning materials

SLK buys all cleaning materials used at the swimming pool, including the products used by the cleaning company, Þrifaspör. None of the cleaning materials were eco-certified or environmentally friendly until the end of 2012. A few months after the researcher started inquiring information about the cleaning materials and asking whether eco-certified cleaning materials were considered, some of the cleaning materials at SLK were changed. The new cleaning materials are eco-certified, cost less, and are just as effective (Jón Jónsson, personal communication, February 7, 2013). However, the cleaning materials used by Þrivaspör remain unchanged. According to representatives from both the swimming pool and Þrivaspör, most of the eco-certified products are not as effective (Heiðar Leyfsson, personal communication, February 10, 2013). Nevertheless, only one substitute was tested in order to confirm this statement. The

researcher composed a list of cleaning materials (Appendix III), which, according to representatives from Reykjavik Campsite and Reykjavik Hostel, are "both effective and affordable" (Margrét Anna and Þórdís Pála, personal communication, May 5, 2013).

Nevertheless, employees of the swimming pool and the cleaning company directly control the amount of cleaning materials used. Therefore, increasing the environmental awareness of employees of both SLK and Þrivaspör is one of the best ways for limiting unnecessary use of cleaning materials and increasing the economic and environmental efficiency of SLK.

6.6 Networking

Swimming pools in Iceland use different cleaning materials, admission systems, and water purification practices. They try to increase the quality of their services and compete to attract more customers. Competition is very important, since it drives the companies to improve in order to have more visitors. However, the word ‘compete’ is often misunderstood. It originates from the Latin *competere* meaning 'strive or contend for (something)', from *com* - 'together' and *petere* 'aim at, seek'. Therefore, the meaning of the word is to strive to achieve something together. In order to improve their economic and environmental efficiency companies should share their ideas and experience.

Currently at SLK, there is very little communication between executives and employees. Furthermore, communication between different swimming pools is almost non-existent. Discussion of ideas and sharing experience can bring many solutions to existing problems. Nevertheless, establishing communication between different parties is often difficult.

Arranging world café sessions for swimming pools is a good way to increase the exchange of experience and ideas among people. A world café is a simple, effective, and flexible format for hosting large group dialogue (see: http://www.theworldcafe.com/method.html).

The sessions should be attended by executives and employees, but would be open to customers as well. Each swimming pool willing to participate in a combined world café session should first organize its own world café. The idea is to introduce the method to executives and employees, and to produce a creative environment where ideas and suggestions for improvement are shared and discussed. This is a good way to introduce

the viewpoint of the employees to the executives and vice-versa. Each session should be followed by fun activities for the participants. It will make the employees more cohesive and create a feeling of unity, which is beneficial for any work environment. When executives and employees are comfortable with the method, a few swimming pools could organize a combined word café session. This will increase the spread of innovative ideas and establish connections between the executives of different swimming pools. In addition, the sessions could be used to increase the environmental awareness of the participants and introduce ways of saving resources, which in turn will increase the economic efficiency of the companies.

If the sessions are beneficial, the executives of swimming pools could organize a world café session for entire regions; invite swimming pool representatives from other parts of the country or even from other countries through video calls. The sessions could be organized for executives only, executives and employees, or open to the public. Regardless of the executives' choice, the sessions will increase the communication and the flow of ideas.

6.7 Summary

There are many practices that could improve SLK´s operations and infrastructure (Figure 11, p. 72)[8]. Applying all suggestions for improvement could decrease the need for ventilation and water sanitation; decrease the use of chemicals and lead to savings of: water, electricity, plastic, paper, and soap. In addition, decreasing energy consumption (up to 80% at given areas) and installation of push-button showers and motion detector faucets could further decrease SLK´s expenses.

Nevertheless, SLK´s employees should measure evaporation levels at indoor and outdoor water basins; and energy demand of lights that could be changed to LED or CFL lighting in order to get more precise estimations of savings due to appliance of pool covers, LED and CFL lighting.

[8] Figure 11, (p.75) displays only benefits of applaying suggestions for improvement, and not their costs. E.g. the cost of pool covers is not subtracted from the benefits. Thus, these are not net savings.

suggestions for improvement	annual savings	additional benefits
membrane cell electrolysis system	3,75 - 5 million ISK	decrease in the amount of cl used
economy shower heads	3,21 million ISK	saving 33 million liters of water
soap dosing sustem	280,000 ISK	2,440 liters of soap
re-use admission tickets	483,300 ISK	saving paper
dectrease extra receipts	9,693 ISK	saving 80% of receipt paper
decrease plastic trash bag use	180,936 ISK	saving plastic
pool covers	5 - 8,5 million ISK	35%-60% less chemicals; 30%-50% less makeup water; decrease the need for ventilation & water sanitation
LED&CFL lighting	up to 80% *(at given areas)	longer life expectancy
total annual savings	13 - 18 million ISK	decreasing the use of costly resources and minimizing SLK´s negative environmental impact

Figure 11: Suggestions for improvement - annual savings and additional benefits.

However, SLK´s executive could use the improvement suggestions (Figure 11) to create different improvement strategies for the swimming pool. They could develop strategy for long-term improvement, where suggestions for improvement are applied only when needed e.g. lights and showerheads are changed only in a case of burnouts or malfunctioning and invest the accumulated savings in applying more financially demanding suggestions for improvement. This approach demands little financial investments, yet environmental and economical benefits are likely to occur at slow rates.

SLK´s executives could also choose a radical approach with high initial investments, ensuring more noticeable environmental and economic benefits, or a strategy that combines some of the costliest suggestions for improvement with suggestions that require little financial investment. However, regardless of the path they choose SLK´s executives should most certainly take in consideration ways of increasing environmental

awareness among employees and visitors. Personal observations show that a possible increase in environmental awareness could bring great benefits for both the environment and the economics of the swimming pool.

7 Discussion

The main business drivers altering decision-making processes at SLK are the resource and the regulatory driver. The regulatory driver affects SLK´s operations through municipal regulations concerning hygiene and safety, where as the resource driver alters decision-making processes regarding purchase and use of resources.

SLK´s executives try to use less and fewer resources in accordance with the leading role of the resource driver. Nevertheless, in order to comply with safety and hygiene regulations SLK´s executives are obligated to use a certain amount of resources and invest in additional infrastructure. Therefore, tradeoffs can occur between the two leading business drivers. In order to create balance between the resource and the regulatory drivers SLK´s managers try to use less and fewer resources and low amounts of purification chemicals and at the same time comply with hygiene and safety regulations.

The use of great quantity and variety of resources is often costly and can increase the negative environmental impact of companies. However, using less and fewer resources could benefit both the environment and the economic wellbeing of the company. In this context, as long as safety and health regulations are fulfilled, tradeoffs should not occur between environmental and economic efficiency at SLK. Therefore, increasing SLK´s economic efficiency could also increase its environmental efficiency.

7.1 Areas of improvement

SLK´s executives can view the environment either as a foe or as an ally. They could choose the cheapest operational options and low-quality resources in order to decrease the operational cost of the swimming pool. Nevertheless, such scenario would probably bring only short-term benefits for the financial state of the swimming pool while increasing SLK´s negative environmental impact. SLK´s decision makers could rather try to increase both environmental and economic efficiency, by undertaking actions, which benefit both parties. Saving resources could be accomplished in a way that increases both economic and environmental efficiency.

7.1.1 Increase environmental awareness

Upon observation of the visitors' behavior, it becomes evident that SLK´s visitors are not aware (or not concerned) of the need of saving resources and most notably water. Water at showers and sinks is often left running for long periods, while it is not needed. Some visitors do not consider it necessary to turn off the water after they take a shower. The swimming pool could prevent this by either increasing visitors' environmental awareness or investing in installation of push-button showers and motion detector faucets.

Increase in environmental awareness is likewise needed among SLK´s employees. According to the survey for employees, most of SLK´s employees are concerned with environmental issues and more than half of the personnel are willing to participate in additional activities in order to decrease the negative environmental impact of the swimming pool. However, upon observation of the employee behavior the employees' actions do not reflect the conclusions derived from the survey. Many employees prefer throwing their trash in the nearest dustbin instead of making a few more steps and throw it for recycling; the light system is often left on when there is no need to; and water from faucets and showers is frequently left running, although not in use.

The comparison of actual employee performance with potential employee performance could provide SLK´s executive with incentive to increase the environmental awareness of the employees, since their actions could greatly decrease the use of some resources. SLK´s employees control and manage the lighting system at the facility. They could decrease the electricity bill of the swimming pool, by simply switching lights off when they are not needed. Lights in storage rooms and the basement of the premises are sometimes left on during the night, when there is no need to. In addition, SLK´s employees control the amount of cleaning materials used at the premises. Increase in environmental awareness could prevent excess use of cleaning products; prevent unnecessary spending on cleaning material and decrease SLK´s negative environmental impact.

Changing peoples' behavior is a slow and time-consuming process. The actual transition would not be completed until any given change becomes 'the way things are done around here'. SLK´s executives often have only brief staff meetings, where many different topics are addressed in a lecturing manner. Such meetings are not likely to be

effective especially when the aim is change in behavior or operations at the work place. Organizing staff meeting as a world café sessions is a good idea for changing the image and the effectiveness of staff meetings. Employees are less likely to reject an idea if they participate in the discussion and share their own ideas and opinions. Environmental awareness could be increased in such discussions instead of being 'force-fed' during staff meetings. Employees and executives could work as a team fighting for the same goals instead of opposing each other.

7.1.2 Networking

Executives of some swimming pools at the capital region (e.g. Sundhöll Reykjavíkur, Sundlaug Kópavogs and Laugardalslaug) describe their networking to other swimming pools as good because they have a "few phone conversations monthly" (Hördur Már, personal communication, November 15, 2013.). Swimming pools could have great benefits by increasing communication between their executives. Different swimming pools use different operational methods and resources. Better networking could prevent the need of trial and error, since some swimming pool executives consider trying methods already applied at other swimming pools. Different swimming pools have experience in varying fields and every swimming pool needs improvements in a given area. Therefore, exchanging experience can benefit all sides

7.1.3 Resources

Many probable financial savings are not included in the figure that presents approximate annual savings from different suggestions for improvement (**Error! Reference source not found.**, p. 72). For instance, the category 'economy shower heads' includes only savings from replacing showerheads and not probable savings from installing other suggestions for improvement such as push-button showers and motion detector faucets.

In addition, savings from the possible increase in environmental awareness of visitors and employees are not included in the figure displaying annual savings and benefits (**Error! Reference source not found.**, p. 72) as well as possible savings due to increase in recycling practices.

It must be noted, that most of the savings displayed in **Error! Reference source not found.**, (p. 72) represent the lowest monetary saving value. For instance, one time entering

tickets are rather durable and could be used more than the proposed ten times. However, monetary savings due to re-use of 'one time' entering tickets is set to ten in order to limit any unexpected loss of tickets due to mishandling or barcode defects.

However, all areas of improvement except the electrolyses system could be improved either gradually with low initial investments and slow payback period, or in a more abrupt manner with high initial investments and faster payback period.

7.2 Available literature and business drivers

The amount of literature dealing with the topic of this thesis is very limited. The thesis is among the first studies linking environmental and economic efficiency to swimming pools in the context of competitive environmental strategy. The interest in Hoffman´s (2000) framework for business driver analyses is gradually increasing among researchers. In a PhD research, Jóhannsdóttir (2012) confirms that Hoffman's (2000) business drivers are very much relevant today. In recent years, the number of Icelandic companies that acknowledge the existence of win-win scenarios and try to find economic opportunities has also increased (Jónhannsdóttir, 2012). However, in the case of SLK, the level of environmental awareness needs to rise. Only then can the social and the community drivers be activated and have some positive influence on the decision-making processes at SLK.

The executives of the swimming pool need to get familiar with the win-win perspective and examples of companies that have successfully adopted the concept. World café sessions are great tool to increase environmental awareness and introduce new concepts and ideas among employees, executives and visitors.

The swimming pool should use the environmental strategies of Kópavogur as a pillar in its future development, and perhaps even create its own environmental policy. This may add ethical motivation to many actors of the social drivers at SLK. The ethical motivation along with the increase of environmental awareness among executives, employees and visitors could save large amount of resources at the swimming pool, which will benefit both the natural environment and the economy at SLK. Those savings are not possible in the current operational state of SLK, since most of the visitors and the employees are not truly concerned with resource saving and environmental impact of the swimming pool.

7.3 Possible bias and constraints

The researcher is currently employed at SLK. It might be argued that the researcher's work position could lead to bias in the research. However, the researcher has no prejudice in favor of, or against a particular thing, a person or group compared to another and no unfair attitude towards discussed topics and parties. The employment of the researcher provides personal knowledge and insights of the workings of the swimming pool, which benefit the research and would be difficult to attain if the researcher was not an SLK employee. In addition, the researcher was trusted with data (e.g. access to the accounting of Kóopavogur) and information regarding SLK's operations, which is not publicly available and would be extremely hard to attain if the researcher was not at his current work position.

It must be noted, that the conclusions of the consultant at Water Solution might be biased due to his work position. Therefore, the managers of SLK should calculate whether the system is worth purchasing, and include all the pros and cons of the membrane cell electrolysis system.

The researcher encountered unexpected constrains such as lack of monitoring and/or data on the use of some resources (paper, plastic, electricity). The executives of the swimming pool know that the pump system is by far the greatest consumer of electricity, but it was not clear how much electricity it consumed. In addition, there are no calculations or rough estimations of the evaporation levels of the swimming pool, which makes it difficult to estimate saving potential of swimming pool covers.

The lack of LCA analysis for swimming pools in Iceland was a great surprise. If this thesis were written again, the researcher would first participate in an LCA research. The findings of the LCA study in combination with analysis of the business drivers could give a much more complete picture of the operations of the swimming pool. However, in order to perform an LCA study, one must have a great amount of data, which in the case of SLK, is not available.

A possible development of this research would be the accumulation of data and the conducting of LCA analysis of SLK.

8 Conclusion

Hoffman's (2000) framework is a potent tool for business driver analysis and competitive environmental strategy development.

The analysis of the business drivers displayed the interconnection of environmental and economic efficiency where the resource driver was shown to be the most important driver at SLK. Consequently, this thesis illustrates that limiting or changing the use of resources would benefit both the environment and the economics of the company. Regulatory drivers were also important, as they address issues of hygiene and thus affect resource use. Market and social drivers seemed weak.

SLK's employees consider themselves concerned with environmental issues, yet very few employees could name any environmental impact of the swimming pool. According to the employees of the swimming pool, SLK´s customers show little environmental concern with environmental issues at SLK, and even less concern for environmental issues in Iceland. The head executives of the swimming pool do not demonstrate interest in increasing the environmental and economic efficiency of the swimming pool in the long-term. However, employees are willing to engage in activities that reduce the environmental impact of the pool, and thus could become important actors in improving the environmental conditions at the pool.

Derived from the improvement analysis, this thesis illustrates that many small solutions could be applied at SLK to reduce its environmental impact and simultaneously increase its economic efficiency. Most of the suggestions offered for improvement will increase the economic and environmental efficiency of the swimming pool moderately. However, the accumulation of improvements may lead to noticeable increase of the overall efficiency of the swimming pool with minimal creation of tradeoffs between the environment and the economics of the pool. Once the executives realize that many changes could be done with little or no investment, and lead to considerable benefits, they may consider even more options for increasing the efficiency of the swimming pool. Introducing the win-win perspective and the interconnection of SLK´s economy with the natural

environment could change the current ways of thinking and operating at SLK, while directing the swimming pool towards the path of sustainability.

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Appendix I - Survey for the employees of Sundlaug Kópavogs
Umhverfismál í Sundlaug Kópavogs

/Könnun fyrir Starfsfólk/

*Þátttakandi má sleppa spurningum sem hann telur óviðeigandi eða “leiðandi”. Ef spurning er óskýr eða torskiljanleg mun rannsakandi fúslega útskýra spurninguna betur.

1. Hvað þýðir að vera umhverfisvænt fyrirtæki í þínum huga?

   .....
   .....
   .....
   .....

2. Hver er að þínu mati staða umhverfismála í SLK ?
   [5] Mjög góð [4] Góð [3] Í meðallagi [2] Slök [1] Ábótavant

3. Er Sundlaug Kópavogs umhverfisvænt fyrirtæki?

   [ ] Nei, SLK er ekki umhverfisvænt fyrirtæki af því að:

   .....
   .....
   .....
   .....

   [ ] Já, SlK er umhverfisvænt fyrirtæki af því að:

   .....
   .....
   .....
   .....

4. Þurfa stjórnendur hjá SLK að breyta einhverju til að gera SLK að umhverfisvænu fyrirtæki?

   [ ] Nei, það er fínt eins og þar er, af því að:

   .....
   .....
   .....
   .....

   [ ] Já, við þurfum breytingarnar á:

.....
.....
.....
.....

5. Hver er að þínu mati staða umhverfismála á Íslandi?

   [ ] Mjög góð [ ] Slök

   [ ] Góð [ ] Ábótavant

   [ ] Í meðallagi

6. Spurja viðskiptavinir ykkar út í umhverfismál?

   [ ] Oft [ ] Sjaldan

   [ ] Aldrei

7. Hver telur þú vera helstu umhverfisáhrif í tengslum við starfsemi SLK?

.....
.....
.....
.....
.....

8. Eru viðskiptavinir ykkar fyrirtækisins áhugasamir um stöðu umhverfismála á Íslandi?

   [ ] Mjög áhugasamir [ ] Áhugasamir

   [ ] Í meðallagi áhugasamir [ ] Litill áhugi

   [ ] Ekki áhugasamir

9. Eru viðskiptavinir ykkar fyrirtækisins áhugasamir um stöðu umhverfismála á SLK?

   [ ] Mjög áhugasamir [ ] Áhugasamir

   [ ] Í meðallagi áhugasamir [ ] Litill áhugi

   [ ] Ekki áhugasamir

10. Flokkar fyrirtækið rusl? Vinsamlega merktu við það sem við á:

[ ] Við flokkum ekki rusl	[ ] Gler og flöskur
[ ] Lífrænt	[ ] Hættulegur úrgangur (spiliefni)
[ ] Pappír og pappi	[ ] Plast

[ ]Annað,hvað?……

11. Flokkar þú rusl heima hjá þér?

[ ] Nei [ ] Já

12. Myndir þú vera til í að flokka rusl í SLK?

[ ] Nei [ ] Já

[ ] opið svar (útskýra fyrir neðan)

……
……

13. Er þú til í að leggja á þig auka vinnu til að spara rafmagn, vatn og efni?

[ ] Já [ ] Nei

[ ] get ekki svarað

[ ] opið svar

……
……
……

14. Hefur þú áhyggjur af umhverfinu? Af hverju/hvernig áhyggjur?

[ ] Nei, ég hef ekki áhyggjur af umhverfinu

……
……
……
……

[ ] Já, ég hef áhyggjur af umhverfinu

.....
.....
.....
.....

15. Finnst þér þú bera ábyrgð á umhverfinu?

[ ] já

[ ] nei

Ef svo er, hver er þá ábyrgð þín?

.....
.....
.....
.....

Upplýsingar um þátttakanda:

1. Aldur

[ ] Milli 20 og 35 [ ] Milli 36 og 50

[ ] Milli 51 og 65 [ ] 70 eða eldri

2. Kyn

[ ] Karl [ ] Kona

3. Menntun

[ ] Grunnskóli [ ] Menntaskóli

[ ] Háskóli [ ] Framhaldsnám

[ ] Önnur menntun (vinsamlegast útskýrið)

.....

Appendix II - Umhverfisstefna Kópavogsbæjar

VIRÐING-VITUND-VELFERÐ

Kópavogur er bær, þar sem virðing er borin fyrir náttúruverðmætum og menningarminjum og hlúð er að fólki og umhverfi. Stefna Kópavogsbæjar er að vera til fyrirmyndar í umhverfismálum. Í Kópavogi skal sjálfbær þróun höfð að leiðarljósi við allar ákvarðanatökur, framkvæmdir, rekstur, innkaup og aðra starfsemi á vegum bæjarins. Sjálfbær þróun gerir okkur kleift að uppfylla þarfir okkar án þess að draga úr möguleikum komandi kynslóðar til að mæta sínum þörfum. Í hverju verkefni sem unnið er í anda sjálfbærrar þróunar skal huga jafnt að umhverfisþáttum, félagslegri velferð og hagrænum þáttum.

Markmið umhverfisstefnunnar:

- Kópavogur standi vörð um þær náttúru- og menningaminjar sem í bænum eru, opin svæði, líffræðilegan fjölbreytileika og sérkenni eldri hverfa.
- Íbúum sé tryggður aðgangur að hreinu vatni, hreinu lofti, náttúru og útivistarsvæðum.
- Við allar ákvarðanatökur, framkvæmdir, rekstur, innkaup og aðra starfsemi á vegum bæjarins skal leitast við að neikvæð áhrif á umhverfi, náttúru og íbúa séu í lágmarki. Leggja skal áherslu á vistvæn innkaup á vörum, þjónustu, framkvæmdum og ráðgjöf.
- Dregið verði úr hvers kyns sóun verðmæta, myndun úrgangs og stuðlað að endurnýtingu og endurvinnslu.
- Starfsmönnum bæjarins skal tryggð heilsusamleg og örugg starfsskilyrði.
- Stuðlað verði að vistvænum samgöngum, almenningssamgöngur efldar, svo og göngu- og hjólreiðarstígar í bænum.
- Þekking og vitund um umhverfismál og umhverfisvæna lífshætti verði aukin með fræðslu til starfsmanna bæjarins, íbúa, og starfsmanna fyrirtækja í Kópavogi.

Umhverfisstefnan og framkvæmd hennar skal vera liður í daglegu starfi Kópavogsbæjar

og stofnana bæjarins. Umhverfisstefnuna á að kynna fyrir starfsfólki, íbúum og starfsmönnum fyrirtækja í Kópavogi og birta opinberlega á vef Kópavogsbæjar.

Við framkvæmd stefnunnar skal leitast við að hafa jafnræði allra íbúa og jafnrétti að leiðarljósi og tryggja aðgengi fatlaðra sem ófatlaðra. Umhverfis- og samgöngunefnd Kópavogs ber ábyrgð á umhverfisstefnunni og vinnur hana í samvinnu við allar deildir og

stofnanir bæjarins hvað varðar framkvæmd og eftirlit og í samráði við íbúa. Stefnan verði endurskoðuð á þriggja ára fresti.

Umhverfisstefna Kópavogsbæjar byggir á alþjóðlegum samþykktum, íslenskum lögum, reglugerðum, áætlunum um umhverfismál og stefnu bæjarstjórnar Kópavogs í umhverfismálum. Umhverfisstefnan nær yfir öll svið samfélagsins í Kópavogi og gildir fyrir Kópavogsbæ og stofnanir bæjarins. Íbúar, fyrirtæki og samtök í bænum eru hvött til að vinna að umhverfismálum og til umhverfisvænna lífshátta. Kópavogsbær vill stuðla að því að svo geti orðið m.a. með upplýsingagjöf og fræðslu.

Umhverfisstefnan er í samræmi við Aðalskipulag Kópavogs og er nánar útfærð í Staðardagskrá 21, sem er framkvæmdaráætlun um sjálfbæra þróun í Kópavogi. Haldið er grænt bókhald fyrir Kópavog og gefin út skýrsla árlega um stöðu umhverfismála í bænum. Við gerð áætlana um umhverfismál skal haft samráð við íbúa og hagsmunaaðila í bæjarfélaginu.

Umhverfisstefna Kópavogsbæjar samþykkt í bæjarstjórn Kópavogs 28. júní 2011

Appendix III - List of cleaning materials

Title	View	Dosage	View	Usage	Eco certification
P313 **Planta Soft**		**20-40ml/10l water or 5-10ml/5l water**		**Daily use** ***For all kind of surfaces*** (tables, mirrors, windows etc.)	
P315 **Planta Cleen**		**50ml/10l water or 5ml/5l water**		**Daily use** ***Floor*** (natural stone, clinker, terracotta, linoleum, rubber and PVC).	
UNDRI industrial cleaner		**Engine parts and tools: 1:3 - 1:10; Food industrials: 1:20-1:5; Floor and wall wash: 1:5-1:50**		**Used when needed** ***Cleaning liquid for disinfection and very dirty surfaces.***	Swan Ecolabel
G 452 **Keim - Ex**		**100 - 200 ml/10 l water**		**Showers - Maintenance** Daily hygiene in all wet areas such as sanitary areas, showers and changing rooms. Suitable for use on enamel and aluminum surfaces.	***Environmentally friendly*** *Certificate of ecology G452*
G 577 **Buz Flow**		**Light clogging:** Pour 50 ml into the drain. Contact time: 15 min. **Heavy clogging:** Pour 100 - 200 ml into the drain. Contact time: from 30 min. to 4 hours. Rinse thoroughly with hot water.		**Pipe Cleaner - Maintenance** Opens up clogged drains, pipes, siphons, etc.	***Environmentally friendly*** *Certificate of ecology G577*
P 314 **Planta Aloe**		**Undiluted.**		**Dishwasher – Staff Kitchen** For glasses and cutlery.	
Pro Ren Hand Soap		**Undiluted.**		**Hand soap – Bathrooms** Fill in all containers from bathrooms and area outside bathrooms.	Swan Ecolabel
Novaren Extra		**Use 1 film box per washing.**		**Washing powder** Wash mops, cleaning clothes and sheets from the cabins.	Swan Ecolabel
Fix Universal		**Wipe a few times over the poles of the mass, moisten with water and squeeze the sponge till foam arises. Polish**		**Used when needed** ***Universal cleaning pasta for all kind of surfaces in kitchens*** (sink, oven and etc.), ***bathrooms*** (baths, sinks, shower walls and etc.), ***toilets*** (tanks and surfaces)	***No***
Sanira System		**3-4mls cut the top of the refill and place the brush on top of the refill. One press and you have the dose for cleaning**		**Cleaning liquid *for toilet brushes. Replace in the staff brushes, use daily when cleaning.***	***No***

***Please use gloves when needed.**
***Follow the dosing marked.**
***Don´t mix or use other cleaning liquids.**