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AN INVESTIGATION INTO SOLAR ENERGY FOR SUB

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ABSTRACT

"AN INVESTIGATION INTO SOLAR ENERGY FOR SUB"

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This document reports the research that has been done on using the solar panel as a renewable energy source and the feasibility of using it in the new Student Union Building (SUB)**.** One of the biggest issues is that these panels are made in various ways and their productions determine their efficiency and cost. To identify the total cost for installing the solar panel system for the new SUB the main sources of cost is being calculated. However, since we were not informed about the structure of the new SUB and the total energy consumed annually by the existing SUB the details costs were not calculated. Having the system to work at highest efficiency, the panels should be chosen properly based on the amount of energy can be producing considering Vancouver weather condition. Based on our research equipping the new SUB with solar panels will be very expensive. However, the SolarBC assists up to $40,000 per small project. Also, there is some other social end environmental benefits that compensate the cost. In addition, this system may not be financially beneficial initially. However, it will be advantageous in long run. It is also expected that the cost of the solar panels will drop in the near future which will extremely lower the over all cost of the system.

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LIST OF ABBREVIATIONS

SUB	Student Union Building
STH	Solar Thermal Heating
STE	Solar Thermal Electricity
DC	Direct Current electricity
PV	Photo Voltaics
Cd	Cadmium

1.0 INTRODUCTION

This Solar energy has many ways of being harnessed, whether it be through Photo Voltaics (PV), Solar Thermal Heating (STH) and Solar Thermal Electricity (STE). Our group decided to focus on Photo Voltaic harnessing of solar energy since we found it to be the most efficient, practical and viable technology out there. It satisfies our triple bottom assessment the best, as will be discussed below. Our findings have been almost solely based on secondary research, such as papers and studies already conducted on the pros and cons of solar energy harvesting. We will break down our assessment into three sections: Economical, Social and Environmental.

2.0 ECONOMIC ASSESSMENT

When it comes to solar cells, there are advantages and there are disadvantages. First the disadvantages, installing solar panels on the Sub roof will cost more than you saving on electricity bills before the panels have to be replaced. The advantages are that it leads to carbon footprint reduction and save energy. The economic assessment is discussed in the following sections.

2.1 Cost of Manufacture and Installation

The Solar panel system consists of different components. Knowing the components gave us the chance to look for the price of the components separately or considering the companies which include some components for free in their packages. The solar panels comes in different shapes and sizes and they all convert sunlight into DC electricity. An inverter converts DC (Direct Current electricity) electricity from the solar panels into AC electricity. Therefore, once the solar panels have made DC electricity this needs to be turned in AC with an inverter. A Charge controller can be used if the system is utilized with batteries. A charge controller regulates the voltage and current coming from the solar panels going to the battery. They also stop the batteries from getting overcharged. And a net metering is an electric meter that can spin backward this allows selling power back to grid. A circuit breaker is used to disconnect solar panels from the SUB electrical system and the power grid. Approximately a solar panel with size of 1.5 *1 * 0.039 (meters) produce between 180-200 watt-hour (Wh) and costs about $550. It is good to know that one kilowatt-hour (kWh) equals the amount of electricity needed to burn a 100 watt light bulb for 10 hours. The inverter costs between $1000-$2000 , batteries costs between $200-$500, charge controllers costs between $300-$800, net metering cost between $300-$800 and circuit breaker costs between $300-$500.The following table summarize the above

information.

Solar panel system components	**Price**
Inverter	$1000-$2000
Battery	$200-$500
Charge controllers	$300-$800
Circuit breaker	$300-$500

Table 1. The price of solar panel components

The Solar panel installation should be done by a registered electrician who has solar experience. The reasons for this are that most council require the electrics to be certified-this means the work must be done by a certified installer. Also, Solar panel suppliers often require a certified installer as well. Depending on the small print in the guarantee, doing the installation by an uncertified person can sometimes void the guarantee. In addition, in order that solar panels to work at maximum efficiency, there are many factors that need to be taken into account. Having a competent solar installer ensures that solar panels working at optimum efficiency-thus saving more money. Based on our research, the cost of solar panel installation can vary from $3000 to $20000.

2.2 Cost of Maintenance

Although solar panels are often guaranteed for 10 to 25 years, there are certain items that n eed to be taken care. The solar panels power out put needs to be checked every few mont hs to measure the drops in productivity. This can simply be done by keeping track of powe r bills. Also, the flashing and sealing around the roof penetration need to be checked. In ad

dition, two to three times a year the solar panels should be hosed down to avoid the dust a nd dirt which drop the solar panels performance. The cost can vary from $200-$1000 per year.

2.3 Cost of Reuse and Recycle

In 2007 study, PV CYCLE urges producers to “continue to look for technical solutions which would solve the conflict between manufacturing modules with a very long shelf life and the issue of environmental impact and recycling-compatible construction.”

PV CYCLE's Clyncke remarked at the beginning of 2009: “We will only be able to say that solar energy has become truly sustainable when the life cycle of photovoltaic modules is closed, allowing the industrial use of recycled raw materials necessary to their manufacturing.”

Photovoltaics (PV) technology is undergoing a conversion to a new generation of, l ow-cost products based on thin films of photoactive materials. PV technology has definite environmental advantages over competing electricity generation technologies, andthe PV industry follows a pro-active life-cycle approach to prevent future envir onmental damage and to sustain these advantages. A feasible answer is recycling th em when they are no longer useful. We have researched on this topic and introduc e a feasible study for recycling thin-film solar cells and manufacturing waste, base d on the current collection/recycling infrastructure and on current and emerging rec ycling technologies.

A feasible recycling program for solar panels will require careful attention to the e xperiences of comparable industries and to the economics of collection and material s.

Another challenge for recycling solar panels is that the total amount, concentration, and value of reclaimable material are low. For example, indium, the most costly of the thin-film constituents which is used in CIS solar cells, accounts only for 2.5 -5% of the total projected cost of a CIS module. The lack of significant quantities of any key material makes it unlikely that the recovery of materials from spent modules is economically warranted. Based on M. Fthenakis who has done lots of r esearch on solar panels recyclying methods. Large smelters (e.g., Noranda, ASAR CO), routinely recycle circuit boards, computer monitors, consumer electronics and telecommunication equipment to recover metals. Such facilities might incorporate th e recycling of spent PV modules. Today they recycle the relatively small amounts of scrap generated by PV manufacturers. The low concentration of metals in PV m odules and scrap does not generate any significant recycling value, but their glass content has a certain value to smelter operators who buy silica for their fluxing op eration. Therefore, the glass reduces the costs of treatment, which presently is $175 -200/ton (&$0.02/W), for large deliveries (e.g., 20 ton containers). In all the conver sions from $/ton to $/W, we assumed thin film cells encapsulated within two 2mm glass sheets, 2 kg of Al frame per m2 of module, and a 10% electrical conversio n efficiency. Transportation cost is an additional $220/ton). The process can recover more than 84% of the input module weight with up to 6N purity o f the fractions. The glass (>90%) is for use in new products and 95% of the semiconductor materials for use in new solar modules after remelting. The energy of the polymer inciner ation could be used in other processes or for pre-heating new charges in future productions.

3.0 SOCIAL ASSESSMENT

3.1 Visual Impact

Visuals play a strong role in society's acceptance and criticism of solar panels. Until recently, solar panels were hidden from plan view so as to not attract attention. It was made invisible, and society liked it as such. Often, visible solar panels drew names such as "tree-hugger" to those who utilized them, shunning their use. However, recently this view has changed. Architects are now using solar panels to improve the look of a building aesthetically, as well as provide other uses such as shade. With awareness of sustainability increasing, more and more people are growing warmer to the idea of solar panels, as a means of generating electricity. Another visual problem stemming from solar panels is its obstruction of natural beauty and scenery, which is met with a very negative response. A simple way to work around this problem is to integrate them, or hide them, so as to not ruin beautiful views.

3.2 Effect on Safety

Over their lifetime, solar panels are very safe to operate, and pose no more risk than any other electrical device currently in use. They require very little human interaction to perform. Most pollution, and thus risk to the health and safety of the public, occurs during the manufacturing process of the solar panels. There are toxic chemicals used in the manufacture of these panels, such as Cadmium (Cd), although in very, very small quantities. They would only pose a small risk in case of fire, in which case the cadmium would be released as toxic fumes. Since solar panels do not have many moving mechanical parts, they are in much less danger of failure, catastrophic or otherwise, and thus a much lesser risk to human life.

3.3 Effect on Sustainability

Installing solar panels at home or on office building makes a strong statement towards sustainability. It pushes the conventional norm of dependence on fossil fuels. It portrays a better image, because caring for the environment is generally seen as the right thing to do. It in itself is being sustainable, and cheaper in the long run, which makes for an easier sales pitch. In addition to being sustainable, it causes curiosity and eventually encourages sustainable growth in others, by being examples and pioneers in the development and use of solar panels in the community. It offers opportunities to be recognized by others and adapted, increasing sustainability and its awareness.

3.4 Effect on Jobs

Manufacturing of solar panels and solar energy capturing devices is very under-developed in North America, and almost non-existent in Canada. This can be a great entrepreneurship opportunity. With relatively low competition, and incentives as those provided by the government, jobs can be created and sustained as increasing demand for sustainable energy sources increases. Europe is the leader in manufacturing of parts. This dependence on foreign products can be reduced, thus creating jobs locally. Construction and installation of such panels is another industry waiting to boom hand in hand with the aforementioned manufacturing industry. A new sector of skills will be required and people will need to be trained, requiring teachers and schools.

4.0 ENVIRONMENTAL ASSESSMENT

In consideration of rising energy prices and global warming phenomenon, the solar energy has become an important energy alternative in both industry and daily life. This environmental friendly alternative has excellent demonstration in the following three environment assessment areas: pollution, renewable energy and efficiency.

4.1 Pollution

The most persuading advantage of solar energy is non-polluting when compared with the fossil fuels, one of traditional forms of electricity gener ation. Electricity is generated through the burning of the fossil fuels. One of the concerns i n using the fossil fuels is that the burning of fuels would release carbon dioxide and other greenhouse gases such as methane or other emissions that warm the atmosphere. Anther co ncern is the loud noise produced when heating appliances using the fossil fuels. In addition al to those two concerns, the process of obtaining those fuels could result in “damaging the ecosystems through dredging or spills” (Andrews, 138).In contrast, solar energy does not raise concerns in producing pollutions when generating electricity. Instead of releasing pol lutants and greenhouse gases like many traditional forms of electrical generation do, the so lar energy system could potentially eliminate “18 tons of greenhouse gas emissions from t he environment every year” (Andrews, 206). The solar energy is natural and the way to ob tain it does not involve pollutions. It is also silent and does not make any noise that might otherwise negative impact human and animals.

Although some toxic materials such as Cd would be adopted in producing the solar panel, the quantities are not big enough to raise concerns because the insignificant risks can be ke pt at a minimum level with effective safeguards and strict regulations. Moreover, the lifeti

me of the solar panel is approximately 30 years. When considering the pollution saved by t he solar panel in 30 years, the pollution produced in the recycle process of the panel can b e ignored. Solar energy is an excellent alternative energy resource because it actively contr ibutes to reduce the harmful greenhouse emissions. As a successful representative of clean energies, solar energy is protecting the environment by reducing pollution with each watt of power it generates. The adoption of solar energy might not be able to lower the total e nergy consumption all over the world, but it guarantees fewer phenomenon for air pollutio n such as “climate change, acid rain and smog” (Franchi,24) .

4.2 Renewable Energy

Renewable energy is energy obtained from sources at a rate that is less than or equal to the rate at which the source is replenished. Solar energy is considered as renewable when compared with other traditional energy resources.

The two widely used traditional energy resources are “fossil fuels such as petroleum, natural gas and coals and nuclear fuels such as uranium” (Franchi, 120). Since their supplies are very limited and difficult to discover, quite a huge amount of funds and resources have been spent to find and extract them before they can be used directly and benefit the human being. Compared to the efforts made to use those traditional energy resources and consequences of environmental pollution brought by them, it is difficult to define whether they are renewable energy or not.

Unlike those traditional energy resources, solar energy is an inexhaustible because the remaining life of its provider, the sun, is measured to be at least million years. This kind of energy is available to human being for many generations. It is not necessary to set aside big funds to look for solar energy because it is in every corner of the world and ready for use every day at sunrise. The sun will provide us with moderate natural lighting even in

mid winter because PV systems do not require bright sunlight to operate since their energy production simply varies with sunlight intensity. This energy supply is easy to adopt and never runs out. Although it is not sunny everyday, it is still very reliable as the radiation from the sunlight can be collected for the renewable energy purposes. The solar energy is widely recognized as renewable since it is long-lasting, ready to use, reliable and also cost-effective when compared with other traditional energy generation forms.

4.3 Efficiency

Efficiency is the last but not the least important factor considered in the environment assessment. Efficiency refers to the proportion of the energy being converted to energy. Solar radiation is converted to electricity by PV in current. The lab data shows that the efficiency of PV cells can be achieved to up to 50%, but only around 25% is achieved in industry. The factors that might negatively impact the performance of PV panels include: “imperfect alignment, dust and water vapor in the atmosphere, dust on panels, aging of the cells, losses in wiring and inverters, losses due to protective covering glass and the heating effect of sunlight on the cells” (Franchi, 165). The statistics show that PV collection efficiency ranges from 40% to 50%, electrical conversion efficiency is 80%, and the overall efficiency for solar to electrical conversion is approximately 30%.

In recently years, many measures have been taken to increase the conversion efficiency of the solar energy. New multi-layer cells are used to offer higher efficiencies and integration into architectural glass. Arrays of tiny silicon solar cells have been proved in the research to have higher efficiencies when incorporated into window tinting. More and more technical efforts have been made to improve the efficiency by looking for new materials, developing new concepts of cell production, manufacturing better multi-layer cells and conducting relevant researches.

The environmental problem is one of hot topics for global issues such as global warming and sustainable development. The environment assessment of the solar energy is definitely an important part of it. As a good substitute for other traditional energy generation sources, solar energy has significant competitive advantage in terms of environmental concerns with merits in its non-pollution, renewable sources and efficiency.

5.0 CONCLUSION

Our group tasked ourselves on determining the feasibility of using solar panels in the new SUB, using the triple-bottom-line assessment. This type of assessment takes into account the social and environmental factors in addition to the economic factors to determine a product's feasibility. Socially, solar panels have a few cons in social stigma, and visibility, but many more pros such as safety and increasing social awareness to sustainability. Environmentally, solar panels provide clean energy. They use solar energy that would otherwise be going to waste. They do not harm the environment during the usage stage of their life, and their sole source of pollution comes during the manufacturing stage. Overall, environmentally, solar panels are a very feasible option to provide energy and caring for the environment indirectly by reducing dependence on fossil fuels. Economically, their main stumbling block is their high initial cost, which increases as efficiency demands increase. These are offset by their low maintenance costs, and savings. Comparing lifecycle and overall costs of solar panels, they are as feasible to use as alternatives such as obtaining power from the grid. We recommend the use of solar panels.

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APPENDIX