# MEMO

To: Miriam Novick

From: Student Writer

Date: March 18th 2019

Re: “Smart Windows” Research Proposal

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**“Smart Windows” to Decrease a Building’s Energy Consumption**

A major source of a building's energy consumption comes from heating and cooling a building to maintain a desired and consistent temperature. Windows are the primary place where heat transfers between the interior and exterior of a structure and thus different types of “smart windows” have been developed. My report will focus on electrochromic windows which use an electric current change the amount of light and heat transferred through windows.

**Heat Loss is Directly Related to Energy Consumption**

Unwanted heat constantly flows between the interior and exterior of a building, specifically through windows and rough openings. This increases the amount of energy needed for heat and air conditioning. Even with sustainability becoming more prevalent, the majority of energy still comes from non-renewable resources. Grynning et al. (2013), authors at the Norwegian University of Science and Technology, restate that “previous studies show that a large part of the heat loss in buildings occurs through the glazed parts of the envelope.” (para 7). They have also discovered that “heat loss related to windows contributes over 40% of the total heat loss through the building envelope for a typical Norwegian office building” (para 7). Regardless of being a statistic for Norwegian office buildings, 40% of heat loss through windows illustrates why heating and cooling a building consumes a significant amount of energy and non-renewable

resources. Therefore, minimizing the heat transfers through windows will have many environmental benefits in addition to reducing one's electricity bill.

**Emerging Electrochromic Windows to Save Energy**

A solution to the proposed problem is a technology referred to as “smart windows”. Cannistraro et al. (2018) explains that the purpose of these windows is the change the colour and opacity of glass to determine the amount of light and heat transmitted through. This then reduces the amount of energy heating and air conditioning consume. The three types of “smart windows” currently being researched are electrochromic, thermochromic and photochromic windows. I will be specifically researching electrochromic windows which use ions and electrons to create an electric current that powers the transition in the glass (para 13-17). First, I will need to further research the parts that make up the window, and the process they take to transition the glass. Then, since this technology is constantly being redeveloped, I will need to research the most effective, efficient and current discoveries. Finally I would like to research how photovoltaic cells (solar cells) are being incorporated into electrochromic windows to produce the energy needed to power the transition process.

**Annotated Bibiliography**

Grynning, S., Gustavsen, A., Time, B., & Jelle, B. P. (2013). Windows in the buildings of tomorrow: Energy losers or energy gainers? *Energy and Buildings, 61,* 185-192. https://doi.org/10.1016/j.enbuild.2013.02.029

All of the authors work in the Department of Architectural Design, History and Technology and/or the Department of Materials and Structures at the Norwegian University of Science and Technology. The journal was published in 2013 and is thus relatively recent. The intended

audience for this article is for people who have background knowledge of and are researching the energy performance of windows. Therefore, the purpose of the article is to inform the audience of heat gain/loss through windows and 3 different rating methods to access the energy performance of windows (Grynning et al., 2013, para 4). Although the statics in this article are for Norwegian office buildings, since information that is needed for my research is the general understanding of the heat performance of windows, this journal article can be useful in the "problem" section of the report.

Cannistraro, M., Castelluccio, M. E., & Germano, D. (2018). New sol-gel deposition technique in the Smart-Windows – Computation of possible applications of Smart-Windows in buildings. *Journal of Building Engineering, 19,* 295-301. https://doi.org/10.1016/J.jobe.2018.05.018

Mauro Cannistraro works in the Department of Architecture at the University of Ferrara in Italy and the other two authors are Italian freelance Engineers. This journal was very recently published in 2018, which is important when researching new emerging technologies. In addition, the tone of the writing is factual and unbiased because the authors list both the benefits and the challenges. Also, there are 22 citations to other journal articles to verify reliability. The purpose of this article is to inform its readers about a 2 new methods to manufacturing electrochromic windows. This article explained the process and outcomes of electrochromic windows and will be useful in the "solution" section of the report to give a general definition and description.

Syrrakou, E., Papaefthimiou, S., Skarpentzos, N., & Yianoulis, P. (2005). Electrochromic windows: Physical characteristics and environmental profile. *Ionics, 11(3-4),* 281-288. https://doi.org/10.1007/BF02430390

All four authors work in the Department of Physics at the University of Patras in Greece, illustrating their high level of education and work. This journal article was published in 2005, which is over 10 years ago, and it explains the process and design of how electrochromic windows work.. The development in electrochromic windows has evolved since then, however, the article will be relevant in the "solution" section as a general background explanation. I will also be able to see how electrochromic windows have evolved over the past 15 years and what technological discoveries have occurred since then.

**Everyone Will Benefit**

Electrochromic windows will significantly reduce the amount of heat that is lost or gained, especially within large buildings and buildings designed with a lot of glass. As well, electrochromic windows are powered by a switch and eliminate the need for curtains or blinds while maintaining the same level of privacy. There are no risks to not solving this problem, however, everyone will benefit from them. For example, research and manufactures will profit, less renewable energy will be consumed and consumers will have lower electricity bills.

**Authorization Request**

Overall, my report will explain why heating and cooling a building consumes the most energy and how electrochromic windows will significantly decrease this amount. This proposal is to request authorization to continue researching the benefits of electrochromic windows as well as future challenges to overcome.