

Thesis Project Portfolio

**Smithsonian Institution's Korea Gallery: Art and Web Development
(Technical Report)**

**Superconductivity: Its Potential Implications for Society and the Environment
(STS Research Paper)**

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

This paper examines the relationship between technological advancement and environmental sustainability, focusing on the implementation of room-temperature superconductivity. Technology has advanced tremendously over the past few decades; paradoxically, environmental issues have worsened. Humanity relies on IT, and all these technologies depend on electricity. Electricity impacts the environment in several ways; however, its consumption has been increasing year over year. From this consumption, the United States itself experiences 4-5% loss of electricity during transmission. This is significant because higher electrical consumption equates to greater loss.

To address this issue, this paper explores the innovative technology called superconductivity. Superconductivity is a phenomenon that occurs at extremely cold temperatures, where electric resistance is nonexistent. The potential application using superconductivity is enormous because it offers the possibility to reduce energy losses in electrical systems, revolutionize magnetic levitation for transportation, enable powerful and compact magnets for medical imaging technologies, and significantly enhance the performance of electronic devices.

Due to its wide range of applications, superconductivity has been recognized as a key solution to address various challenges that humanity has encountered. However, with current technology, it is an unachievable technology due to the required stringent conditions to operate, such as extremely low temperatures. For the commercialization of superconductors, numerous experiments have been conducted over decades to raise the temperature at which materials exhibit superconductivity to a more practical level. In 2023, Korea University published a study on a hypothetical superconductor, named LK-99, that operates at room temperature.

Although it has not yet been conclusively determined that LK-99 is a superconductor, it emphasizes the potential to be a significant step forward in humanity. This paper explores the concept of the superconductivity phenomenon, examining its fundamental principles, historical development, and the significant challenges that have hindered its application at ambient temperatures. By highlighting the theoretical and practical aspects of superconductors, it will be possible to observe the potential impact of room-temperature superconductors on various technological fields.

After those explorations, this paper will delve into LK-99's technical aspects to understand its operational mechanisms. This includes an examination of its composition, the conditions under which it exhibits superconductivity, and the theoretical foundations that could explain its ability to operate at room temperature. Through this, it will be possible to see the potential applications of room-temperature superconductors and solutions for electricity transmission.

Though innovative technology leads to better human life quality or solving critical challenges, perceptions of such advancements vary significantly among different social groups. SCOT framework, which stands for Social Construction of Technology, is a theoretical framework that helps to understand how social, political, and economic factors shape technological innovation and development. Utilizing the Social Construction of Technology (SCOT) theoretical framework, this paper lastly analyzes the perceptions and interactions of various social groups with the potential implementation of room-temperature superconductors like LK-99. The intricate relationship between technological advancement and environmental sustainability, with potential room-temperature superconductivity's application and perception from various groups, draws a line of innovation and integration (Bijker, Wiebe E., 2015).