RECOVERY OF COPPER & GOLD FROM WASTE ELECTRICAL & ELECTRONIC EQUIPMENT

THE BALANCE OF POLICY, PRESTIGE, AND POWER: A COMPARISON OF NANOTECHNOLOGY RESEARCH FRAMEWORKS IN THE U.S. AND CHINA

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SOCIOTECHNICAL SYNTHESIS

In an increasingly globalized time, nations are more than ever butting heads in an era of multinational collaboration and competition. China and the United States (U.S.), age-old rivals on the international scale, have already demonstrated interesting dynamics in how they interact and differ across multiple areas of socio-politics and modern technologies. One major example is the rise of waste electrical and electronic equipment, which pervades countries such as China, and is exacerbated by unethical handling from mega-electronic waste producers such as the U.S. The technical project seeks to address this issue by designing an economically sound and ethical plant with downstream metallurgical processing, which can produce raw energy and extract precious metals from discarded electronic waste. The motivation for this work stems from the growing tensions between the U.S. and China over the rise of electronic waste streams, as well as the dangerous nature of electronic waste as an inherent environmental and health hazard which threatens the lives of millions. The Science, Technology, and Society (STS) portion of the project deals with analyzing the differences and similarities between the U.S. and China in the area of novel research, specifically dealing with nanotechnology. The importance of this work lies in drawing a spotlight to scrutinizing ethical and efficient research methods, and does so through a case study of the U.S. and China. While nanotechnology and electronic waste can be considered as two strikingly different topics, the combination of analyses of both these loosely coupled topics points out ways in which nations can better interact, learn, and collaborate with one another in the technology space.

The technical project focuses on the design and economic analysis of a large metallurgical plant which can process up to 181.5 tons/ year of waste electrical and electronic equipment. Calculations were primarily carried out through a combination of advanced

Microsoft Excel sheets and macros, as well as Aspen Plus simulations. Research papers, metallurgical handbooks, and prior capstones were all used as the design basis to properly scale and design the process flow of the plant. Overall, we have determined that the plant can generate up to 31.9 tons/year of copper, 0.15 tons/year of gold, and could require as little as 1,160 kW of energy to run per year. An economic analysis reveals that the internal rate of return on the plant is impossibly high, nearly 9,500%, due to the huge market value of the gold that is recovered. Considering all of these factors, we can report this project as a worthwhile investment based upon its economic profitability and potential social/environmental impact to mitigate a huge waste source which pervades multiple countries around the world.

The STS paper addresses current trends in research, specifically concerning nanotechnology, in the U.S. and China. Current information provided via research articles, editorials, and a publication database points to China potentially being more *quantitatively* driven in its research rather than *qualitatively* like the U.S. The research question is thus focused on addressing why this may be the case, taking a deeper look into the research structures present in each country, their resource allocation, public sentiment, and the overall interaction of relevant stakeholders in the nanotechnology sphere. Han and Appelbaum assert that academia in China is driven by a system which uses quantity as its main metric of success. Based on current laws and policies put into place, China may also be devoid of proper ethical considerations that U.S. policies have, and may also be setting up an academic structure that is overwhelmingly commercially driven. Forum speakers from the 2016 Sixth International Conference on Nanoscience and Technology echo this thought in their discussion of how nanotechnology research is often economically driven in China compared to the U.S. Taking all this into account,

this research points out that China may improve from drawing several inspirations from the U.S. in terms of its research structure and priorities put into place by the government.

The U.S. and China rivalry provides an interesting case study to evaluate important topics of today. The technical topic proposes a solution which has the potential to drastically improve an issue that affects millions of people worldwide and strains ties between the U.S. and China, while the STS portion investigates their unique relationship of competition and collaboration in the case of novel research. Overall, the combination of both topics will help strengthen the way we understand how different countries in the international arena approach technological development.

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