Thesis Portfolio

Recovery of Copper & Gold from Waste Electrical & Electronic Equipment

(Technical Report)

Network Challenges in Advancing Energy Technology in the U.S.

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Introduction

This portfolio addresses issues in energy generation in the 21st century. The technical work focuses on a method of recovering precious metals from electronic waste, a process that also generates a mixture of gases called *syngas* which is frequently burned to generate energy. This work therefore finds a way to generate a usable fuel from landfill pollutants. The STS research paper more directly investigates the systemic and sociological factors that influence energy policy from an actor-network theory (ANT) perspective. Combined, these two works address governmental and technological changes that can be made to uphold sensible development of sustainable & renewable energies.

Summary of Recovery of Copper & Gold from Waste Electrical & Electronic Equipment

The Capstone Project details the design and economics of a plant designed to recover precious metal from 181 kilotons of waste electronic & electrical equipment (WEEE). In this design, 181.5 kilotons of WEEE per year is combusted & gasified in a large molten salt reactor, evolving syngas – a gaseous fuel used in this process to supply heat to the reactor. The rest of the WEEE that is not burned is recovered, washed, and cooled down before undergoing a series of extracting steps to recover copper and gold. Using this design, a non-discounted cash flow of around $3.4 billion per year is achieved from utilizing this growing global waste stream.

Summary of STS Research Paper

As one of the world's leading energy producers and consumers, the U.S. is responsible for maintaining high energy throughput while sensibly developing sustainable & environmentally benign energy. In developing energy policy, myriad societal, political, and cultural forces compete in the U.S. for influence, often with opposing goals.

To examine the challenges faced in crafting sensible American energy policy, this work utilizes actor-network theory (ANT). The main actors of the network under study include those directly involved with energy policy: lobbyists, energy companies, researchers, energy technology, energy consumers, and U.S. policymakers. This network is threatened by opposing views in addressing the United States' massive energy needs while developing renewable and low carbon-emission energy technologies. In studying this network using ANT principles, this work seeks to investigate how a compromise can be reached to enact sensible energy policy.

This work mainly utilizes policy, network, and literature analysis. Work reviewed includes energy statistics published by the DOE, renewable energy regulations featured in bills, and international agreements on addressing climate change.

In this paper, ANT as a conceptual, theoretical framework lends itself to pragmatic use. If successful, this work will illuminate core problems faced in enacting energy policy and will generate potential solutions to current and future challenges. More broadly, this work seeks to illustrate how STS analysis can simultaneously deepen insight into a policymaking process while impartially attempting to mediate challenges revolving around technology.

Concluding Reflection

STS research provides keen insight into the social forces affecting energy development, but does not provide a complete image of how those forces are further constrained by technological limits. Similarly, studying novel technologies related to sustainability and energy development may illuminate the technical limits of modern science and engineering, but fall short in investigating the impact of such work on broader society. For instance, though the capstone project is optimized to maximize gold and copper recovered, it is designed also so that the syngas fuel will not be feasibly usable outside of the plant; hence, this project alone does not provide any new insight into the needs of society apart from economics, nor how new science can address them.

Combining the technical and STS works allows for a broader view of what needs to be changed in society *and* in technology to meet the nation's growing energy needs. Moreover, studying both allows for the qualitative and categorical STS conceptualization of what values are important to the energy industry, and the quantitative and comparative technical ideas in what challenges are faced in actualizing factories and new energy developments.