Design and Construction of a Ferrofluid Kinetic Art Clock

Exploration of Micro Nuclear Reactors as a Solution to The California Energy Crisis

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Mechanical Engineering

By
Will Pfister
12/06/2021

Technical Team Members:
Trenton Bilyeu
Julian Dixon

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

ADVISORS

Kathryn A. Neeley, Department of Engineering and Society

Gavin Garner, Department of Mechanical and Aerospace Engineering

Undergraduate Thesis Prospectus

Heating up to Cool Down: How Heat is a Solution to the Climate Crisis

(technical research project in Mechanical Engineering)

Changing Image in a Changing World: How Fuel Companies are Maintaining Their Brand

(sociotechnical research project)

by

Will Pfister

November 1, 2021

technical project collaborators:

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Will Pfister

Technical advisor:	Michael Momot, Department of Mechanical and Aerospace Engineering
STS advisor:	Peter Norton, Department of Engineering and Society

General Research Problem

How can the effects of climate change be mitigated?

Greenhouse gas levels are rising (Boden, Marland, and Andres, 2017). To avert catastrophic climate change, the increase in global average temperatures must be limited to a maximum of 2°C relative to pre-industrial levels. Greenhouse gas emissions must be reduced by about 25 percent by 2035 (Liberman 2021). Success will require technological and social innovation.

Heating up to Cool Down: How Heat is a Solution to the Climate Crisis

How can heat in materials be stored or recycled to reduce the need for air conditioning and heat in buildings?

This independent technical research project is based on Professor Patrick Hopkins' research within the mechanical engineering program. With this being an independent project, access to tools and lab time will be limited. Heat transfer properties of materials will be investigated with the goal of reducing energy consumption in buildings. For example, heat can be stored during the day, then released at night when it is cooler; reducing the need for heating and cooling in buildings. Density, specific heat and thermal conductivity impact how well materials transfer heat to one another, also known as thermal mass (Greenspec). Finding the correct combination of materials can drastically reduce the energy needed to keep buildings at a comfortable temperature. Presently, the temperature of a building is more affected by building design than anything else. For example, two buildings could have the same thermal mass, but have different window layouts and see great temperature differences depending on the time of year (Moffiet et al. 2014). The experiments conducted by Moffiet show the need for better materials that can be effective year round. To achieve this, tests with new building materials can

be conducted, and the efficiency of each can be recorded. If successful, new materials and building methods can be incorporated into buildings to make them more efficient.

Changing Image in a Changing World: How Fuel Companies are Maintaining Their Brand

How have fossil fuel companies sought to protect their brand value and reputations as climate change accelerates?

How have the companies that are most often blamed for the climate emergency sought to protect their reputations? Fossil fuel companies are among the world's biggest polluters (Taylor & Watts 2019). To protect their business models and their reputations, companies have responded through a combination of public relations and sustainability initiatives. Carbon capture projects have so far primarily served reputational needs, but may ultimately reduce net CO2 emissions.

To improve the industry's public image, in 2008, the American Petroleum Institute launched the Energy Tomorrow project.. Through advertisements, Energy Tomorrow stresses the economic benefits of the industry. According to Bell, Fitzgerald, and York (2019), in its publicity, Energy Tomorrow associates "stereotypically feminine women with the *production* of fossil fuels" (Bell et al., 2019). The public relations strategy is similar to that of U.S. tobacco companies from the 1950s to the 1990s. When big tobacco was under fire for causing negative health effects, their advertisements shifted. "A Frank Statement" was the first ad campaign run by major tobacco companies to cast doubt by disputing scientific studies (Cummings, Morley, Hyland, 2002) . They both ran campaigns in an effort to save their businesses, According to Kaupa (2021), "Like the tobacco industry, the fossil fuel industry will not cede easily."

Pressure on fuel companies rises when things go wrong. BP's public relations response to the 2010 Deepwater Horizon disaster was a failure. An expensive advertising campaign was

assailed for diverting resources from the cleanup. BP blamed contractors, evading responsibility for the spill. Widespread disapproval of the company ensued (Kanso et al., 2018)

ExxonMobil claims that carbon capture projects can make net zero emissions targets reachable (ExxonMobil, 2021). API members participate in its “Energy Excellence” program (API, n.d.), an effort to improve existing processes and develop new ones.Gazprom, a major natural gas company, claims it seeks to reduce waste and its carbon footprint, for example by reclaiming disturbed land and building waste water treatment plants (Gazprom, n.d.).

World growth in greenhouse gas emissions began to flatten in 2010 (Boden, Marland, and Andres, 2017). While fossil fuel companies contend that CCS can make net-zero targets achievable, the technique so far captures only 30 million tons of CO2 annually (Craddock, 2018) at an extraordinarily high cost.

References

API (n.d.). American Petroleum Institute. API energy excellence. Energy API. https://www.api.org/oil-and-natural-gas/api-energy-excellence.

Bell, S. E., Fitzgerald, J., & York, R. (2019). Protecting the power to pollute: Identity Co-optation, gender, and the public relations strategies of fossil fuel industries in the United States. *Environmental Sociology*, *5*(3), 323–338. https://doi.org/10.1080/23251042.2019.1624001

Boden, T.A., G. Marland, and R.J. Andres. (2017). Global, Regional, and National Fossil-Fuel CO2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy

Craddock, H. A. (2018). 10.2.2.5 Carbon Capture. In *Oilfield chemistry and its environmental impact*. essay, John Wiley & Sons, Inc.

Cummings, K. M., Morley, C. P., & Hyland, A. (2002, March 1). *Failed promises of the cigarette industry and its effect on consumer misperceptions about the health risks of smoking*. Tobacco Control. https://tobaccocontrol.bmj.com/content/11/suppl_1/i110.

ExxonMobil (2021, Sep. 16). Carbon capture and storage gains wide industry support in Houston. https://corporate.exxonmobil.com/News/Newsroom/News-releases/2021/0916_Carbon-capture-and-storage-gains-wide-industry-support-in-Houston.

Gazprom (n.d.). Environmental impacts https://www.gazprom.com/nature/environmental-impact/.

Greenspec. (n.d.). *Thermal mass*. Greenspec. https://www.greenspec.co.uk/building-design/thermal-mass/.

Kanso, A., Nelson, R., & Kitchen, P. (2018, December). *BP and the Deepwater Horizon Oil Spill: A case study of how company management employed public relations to restore a damaged brand*. Taylor & Francis. https://www.tandfonline.com/doi/full/10.1080/13527266.2018.1559218?casa_token=9KvidFPJb98AAAAA%3AF8-JLwWDwH-oCGRdEypHui3kCkvtsAN7WngTYwkMIE8Ql5FbBcedC2XlD2LkSWv2V1TZkI4hD8NDKw.

Kaupa, C. (2021, Feb. 16). Smoke Gets in Your Eyes: Misleading Fossil Fuel Advertisement in the Climate Crisis. *Journal of European Consumer and Market Law*.

Lieberman, B. (2021, August 25). 1.5 or 2 degrees Celsius of additional global warming: Does it make a difference? " *Yale climate connections*. https://yaleclimateconnections.org/2021/08/1-5-or-2-degrees-celsius-of-additional-global-warming-does-it-make-a-difference/.

Moffiet, T., Alterman, D., Hands, S., Colyvas, K., Page, A., & Moghtaderi, B. (2014, Jan. 8). A statistical study on the combined effects of wall thermal mass and thermal resistance on internal air temperatures. *Journal of Building Physics 38*(5): 419-43. SAGE Journals.

Taylor, M., & Watts, J. (2019, October 9). Revealed: The 20 firms behind a third of all carbon emissions. The Guardian. https://www.theguardian.com/environment/2019/oct/09/revealed-20-firms-third-carbon-emissions.

U.S Department of Energy. *Carbon capture R&D*. Energy.gov. (n.d.). https://www.energy.gov/fecm/science-innovation/carbon-capture-and-storage-research/carbon-capture-rd.