Undergraduate Thesis Prospectus

Solar Energy Installations: Combating Misconceptions for Community Benefit

(technical research project in Civil Engineering)

The Promotion of Vaping to American Youth

(sociotechnical research project)

by

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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.

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Technical advisor:	Professor Leo Liu, Department of Civil Engineering
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General Research Problem

How do innovative tech companies promote themselves as beneficial and trustworthy?

As technology plays an increasingly central role in daily life, consumer trust is critical for technological adoption and the success of the manufacturer. Gaining trust can set a foundation for loyalty, as customer retention often hinges on trust in the products and the brand itself. Researchers have investigated promotional methods of successful tech companies. Wang and Lestari (2013) found that marketing directly drives success for tech companies, where promotion and branding effectively communicate the benefits of their products, and transparency positions a company as accessible and responsive to customer expectations. Wei et al. (2022) found that customer participation in market orientation plays a significant role in innovation performance, as engaged customers are more invested in the success of the company's customer base can significantly impact their attitudes towards the company, as consumers are more likely to trust a company when they perceive other product-users as aligned with their own values or needs.

Solar Energy Installations: Combating Misconceptions for Community Benefit

How can misconceptions about solar energy installations be combatted for community benefit?

Within the civil engineering department, my capstone advisor is Prof. Leo Liu and student collaborators are Caroline Maher, Mina Gorani, Demari Jackson, Anusha Jain, and Erik Hammerquist. My capstone group will provide a design and community engagement plan for the installation of a solar power facility on the local Ivy Landfill site, a sanitary landfill used as a storage facility by the University of Virginia, the City of Charlottesville, and Albemarle County from 1966 to 2001; the site was capped in 1998 (RSWA, 2024). The proposed solar energy

design will contribute approximately 3 MW of renewable energy and will be absorbed into Dominion Energy's grid (fig. 1).



Figure 1. Proposed Solar Layout on Ivy Landfill, Charlottesville, VA (author)

Transforming a closed landfill into a productive solar power generation facility will contribute clean energy to the local grid, reduce reliance on fossil fuels, and allow otherwise undevelopable land to have a second use, decreasing wasted space and emissions. Broad Axe Creek, located 0.2 mi north of the site, imposes unique constraints on the design of stormwater management systems. The cap of the landfill constrains the installation of the structural ballasts of the solar panels, as the ground cannot be penetrated further than a few feet.

The Virginia Clean Economy Act, passed in 2020, requires the state's major utility companies to transition to carbon-free electricity. Under this legislation, Dominion Energy, the state's largest utility, must own 16,100 MW of solar electricity by 2035 and maintain renewable portfolio standards (Paullin, 2024b). The Virginia Corporation Commission and Department of Environmental Quality has approved 9,500 MW of solar; Dominion owns ~2,200 MW. Energy demand is projected to more than double by 2048 in Dominion Energy territory, due in part to

data center proliferation. Since 2019, Dominion has connected 75 data centers in Loudoun County alone, home to the largest concentration of data centers in the US (Busse, 2024).

Solar installations have been opposed by local communities across the state seeking to preserve the state's farmland, which has declined by 500,000 acres since 2019 (Paullin, 2024b). Other communities have expressed concerns about radiation hazards, water quality degradation, and property appeal (Glass, 2023). The Virginia Farm Bureau argues that solar developments limit farmers' ability to meet water quality standards contingent on forested buffers (Paullin, 2024b). In the past 18 months, 33 large utility-scale solar projects, poised to provide 3,236 MW of power, have been rejected by local communities across the state. While almost 2,000 MW of solar were incorporated into the state's grid in 2020 and 2021, only 500 megawatts have been incorporated in 2022 and 2023 (Paullin, 2024a). Currently 34 counties have restrictive ordinances and 16 have limitations that restrict the construction of solar facilities.

Previous case studies demonstrate the effectiveness of brownfield locations for solar installations when combatting community opposition (Szabó, 2017). Closed landfills are unable to bear significant loads or be penetrated for structural redevelopment, and pose real estate and land value concerns for surrounding neighborhoods. Transformation of these sites into solar energy installations has been shown to increase land value and attract investors. Communities are more likely to support these projects as their location prevents any encroachment on agricultural lands or forests. Electricity generated on the site can contribute to the clean energy goals of local authorities, and the project may create solar industry jobs. The proposed design will only require 16 acres, and has the potential to power 750 homes in Albemarle County, directly benefiting those in neighborhoods close by. Condensed into a community engagement plan alongside data debunking public health misconceptions, this information will effectively communicate the

benefits our design will provide citizens.

The Promotion of Vaping to American Youth

How has the vape industry promoted vaping among American youth despite the warnings from federal agencies?

Recent CDC data reports that 10.0% of middle and high school students in the US reported regular use of nicotine e-cigarettes, as well as 11.0% of adults aged 18–24 (Birdsey et. al., 2023; Kramarow & Elgaddal, 2023). E-cigarettes, or vapes, contain nicotine, shown to be highly addictive and harmful to parts of the adolescent brain that control attention, learning, mood, and impulse control. In 2020, the FDA banned the sale of flavored e-cigarette cartridges and pods in the United States, due to the widely-accepted belief that fruit, mint, and dessert flavored products have a strong appeal to minors; only products with tobacco or menthol flavors are authorized for distribution and sale (FDA, 2020). Only four companies have received authorization to market their products with the US, all of which are rechargeable, refillable devices that pose minor environmental concern (FDA, 2024).

Conversely, disposable vape devices, cheaper products designed for short-term use, produce plastic waste that is nearly impossible to recycle, and contain lithium batteries, preventing them from being discarded into household trash; the EPA labels such products as hazardous waste, preventing them from meeting current authorization requirements for product approval (EPA, 2024). However, disposable products by the brands *Elf Bar*, *Breeze*, and *Mr*. *Fog* are the most popular choices amongst vapers in the US, especially young users, though the FDA has not authorized the sale of any single-use vape brands (CDC, 2024; FDA, 2024). Approximately 90% of disposable vape products sold in the US are imported from China, where

manufacturers ignore US market regulations on products and capitalize on poor regulatory enforcement (Kirkham & Kirton, 2023). The FDA cannot levy penalties or file lawsuits against foreign companies and lacks enforcement resources to control the millions of illegal devices distributed each year.

Participants include the FDA's Center for Tobacco Products, who implement the Family Smoking Prevention and Tobacco Control Act through policy, regulation, and enforcement (FDA, 2023). The head of the center stated that they are "seeking the authority from Congress to collect fees on the industry" in order to expand "funding to [legally] pursue [foreign] e-cigarette companies" (Kirkham & Kirton, 2023). Additionally, the Centers for Disease Control and Prevention condemn the use of e-cigarette products by adolescents, young adults, and any potential new users, and find significant concern that "current e-cigarette use was highest among adults aged 18-24...and use decreased with increasing age." (CDC, 2020; Kramarow & Elgaddal, 2023). Participants also include the leading disposable vape distributor IMiracle Technology Co. who seek "consistent and coherent regulatory clarity" from the US and to be removed from its import red-list, which allows customs officials to seize shipments; this "prevents [them] from protecting their customer base from counterfeit products" (IMiracle, 2023). A spokesperson of the distributor, manufacturer of popular brands such as *Elf Bar, Lost* Mary, and Geek Bar, insisted that "the company does not market to children and takes youth-vaping concerns seriously," and argued "flavored vapes are more effective in helping [adult] smokers quit than those that mimic cigarettes and...shouldn't be demonized" (Kirkham & Kirton, 2023). Participants also include tobacco control nonprofits, such as the Truth Initiative, who seek to prevent youth and young adult nicotine addiction through online education campaigns and "urge retailers to stop selling illegal, youth-appealing flavored nicotine products."

(Crosby, 2024). The Campaign for Tobacco-Free Kids, lobbies the government at the national, state and local levels to reduce nicotine use and prohibit the sale of flavored tobacco products (CTFK, 2024). Recent president of the group stated that "government failure to enforce the law allows companies like IMiracle to make massive profits...and disadvantages anybody who tries to do the right thing" (Kirkham & Kirton, 2023). Another leading vape manufacturer, Breeze Smoke LLC, filed a petition for a review of the FDA's denial of its premarket applications that reached the U.S. Court of Appeals; eight parties, including the American Academy of Pediatrics, Campaign for Tobacco-Free Kids, and Truth Initiative, filed in support of the FDA's position (US Court of Appeals, 2021). Denying their products disproportionately appeal to children, Breeze Smoke presented studies of its adult users that demonstrated a preference for flavored products, but their request for review was denied. The company's website states that "Breeze Smoke is committed to fighting underage vaping...and [aims] to raise awareness and fight the underage sale and distribution of e-cigarette products" (Breeze Smoke, 2023).

Researchers have investigated the marketing practices of the e-cigarette industry. For example, Lyons (2024) found that over half of respondents to an online study, aged 14-20 years, reported seeing vape marketing on social media platforms. Shroff and Sreeramareddy (2024) found that 57% of analyzed e-cigarette retailer websites had age verification pop-ups, and only 3% required identification proof. Chen-Sankey (2019) found that vape marketing exposure predicted subsequent vape experimentation among national samples of youth and young adults who had never used tobacco. Galstyan (2022) found that the availability of disposable devices advertised in vape shops in Southern California increased from 18% to 98% between 2014-2022, though the FDA did not authorize the marketing of any disposable devices that year. Berg et al. (2021) found that 59% of mystery shoppers in US vape shops were asked for age verification.

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