THESIS PROJECT PORTFOLIO

Solar Installation on Ivy Landfill

(Technical Report)

From NIMBY to Neighbor:
Social Dynamics and Public Perception in Green Infrastructure Development

(STS Topic)

An Undergraduate Thesis

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Sociotechnical Synthesis

The rapid expansion of green infrastructure, catalyzed by the growing climate crisis, frequently encounters local opposition, resulting in higher project costs and inefficiencies in delivering much needed clean energy. Recognizing the dual necessity of social and technical solutions in solving this problem motivated this exploration into uniting social theory and technological innovation towards more efficient approaches to renewable energy development. The technical component of this thesis explores successful methods for transforming a capped landfill into a productive solar energy facility, is coupled with my STS research which examines strategies to overcome community opposition to such projects. This holistic approach emphasizes the relevance and utility of sociotechnical perspectives in engineering practice, highlighting the need for ethical and culturally informed engineering solutions.

The technical portion of my thesis produced a detailed strategy for transforming a local capped landfill into a 3-megawatt solar facility, accounting for the nuanced design elements required by such a project. Historically, installing solar arrays on capped landfills posed risks as any penetration or buckling of the cap layer could lead to contaminant leaks threatening local ecology. Innovative ballast-based anchoring systems have been leveraged in recent years, eliminating the need for subsurface foundations or posts and preserving cap integrity. Drawing on real-world precedents, my analysis shows that leveraging such non-invasive techniques lets engineers efficiently redevelop contaminated sites, reduce costs and environmental risk, and deliver tangible community benefits.

Technical ingenuity alone, however, cannot guarantee success; projects live or die on

local acceptance. My STS research examines the social dynamics that shape opposition and support, viewing the problem through Actor-Network Theory (ANT) and reinforcing that lens with Social Exchange Theory (SET) and Social Representations Theory (SRT). ANT illuminates how new renewable-energy actors can restructure existing relationships and disrupt residents' sense of place. SET underscores that community support is encouraged when developments are framed as reciprocal exchanges offering direct, tangible benefits. SRT highlights the power of framing projects within familiar narratives and shared meanings, turning unfamiliar technology into an extension of local identity. This research revealed that effective community engagement hinges on transparent communication, equitable distribution of benefits, and active stakeholder participation and collaboration. Case studies reinforce these insights and show that transparent communication, equitable benefit distribution, and active stakeholder participation can transform opposition into resilient support in both construction and long-term operation.

Applying sociotechnical perspectives highlights the essential ethical responsibility of engineers to consider technical, organizational, and cultural elements simultaneously. This approach encourages engineering solutions which are genuinely reflective and respective of community interests, mitigating negative social impacts. By recognizing these processes as occurring within a network of both human and non-human actors—residents, technology, policy, narratives, outside groups, etc.—which deeply interact and effect one another, engineers can anticipate conflicts, reduce resistance, and foster sustainable development. Integrating STS concepts into engineering practices supports projects which go farther than meeting technical specifications, aligning with established cultural and social values to enable holistic and ethical infrastructure solutions.