Ariyan Azad

ENGL 21007

Written proposal

Engineering Proposal: School-Based Resilient Microgrid Hubs in New York City

Executive Summary

This proposal outlines an idea for ensuring that New York City Public Schools' infrastructures are secured from urban floods. Most of the 1,500 public schools in New York City continue to be very susceptible to rising seas and coastal storm surges. In such instances, once salt water floods these buildings, critical electrical and heating equipment placed in basements gets destroyed. The proposed engineering approach will involve installation of microgrids powered by solar energy and energy storage facilities at strategic locations in order to ensure that crucial facilities are not flooded.

Introduction & Problem Context

The occurrence of flooding as a consequence of natural disasters poses a threat to New York City's infrastructure. There are over 1,500 public school facilities in the city, many of which are built in coastal areas that can be easily inundated by storm surges. Typically, building structures contain critical mechanical equipment, including central switchgear and boilers, in basement spaces.

When such disasters occur, seawater gets into the basement and causes physical destruction. Such physical failure causes an immediate loss of electricity and temperature regulation. The restoration of the energy network in the event of a major coastal disaster can take weeks. To avoid lengthy school shutdowns and protect local communities, there should be another source of energy supply for schools.

Audience & Impact

As such, the main target audience to seek funds from is made up of government organizations like the New York City School Construction Authority and the Federal Emergency Management Agency (FEMA). These organizations mainly work on minimizing the cost incurred in repairing the damages caused by such disasters and any other response measures that come with it.

The humanitarian effect of this proposal on people will include all public school students, teaching staff, and poor residents living in the area’s coastline due to lack of personal means to respond during a time of a disaster. This way, the schools are protected and thus the city is able to protect their academic schedule, which includes shelters for local people.

Proposed Solution

Our engineering solution shifts the school design model from centralized grid dependence to decentralized resilience hubs. The system combines structural civil barriers with independent electrical networks.

- **Modular Flood Barriers:** We will install perimeter shields around all low-level entry points to block water from entering the structure.
- **Decentralized Solar Microgrids:** Each school will feature a dedicated rooftop solar panel array connected to localized lithium-ion battery storage banks.
- **Utility Elevation:** Engineering teams will permanently relocate electrical control panels, inverters, and switchgear from basements to upper floor levels.

- **System Isolation:** The microgrids will include automatic islanding switches to safely disconnect the building from the main utility grid during a failure, ensuring continuous local power generation.

Feasibility & Implementation

Implementing this project across high-risk urban zones requires a phased engineering schedule to manage costs and technical constraints.

Tasks Weeks: 1 2 3 4 5 6 7 8

Task 1: Flood Risk Assessment [===]

Task 2: Utility Elevation Design [===]

Task 3: Barrier & Solar Installation [=======]

Task 4: Microgrid Integration [=======]

Task 5: System Testing & Handover [===]

- **Phase 1: Engineering Assessment:** Teams will analyze historical flood heights and local structural load capacities to determine precise battery placement.
- **Phase 2: Infrastructure Relocation:** Industrial contractors will rerun main electrical conduits from the basement up to designated second-floor utility rooms.
- **Phase 3: Grid Integration:** Technicians will install the solar arrays and integrate the battery storage units with localized distribution panels.
- **Project Constraints:** Older school facilities present structural space limitations on upper floors and require specialized reinforcement to support heavy microgrid components.

Budget Overview

Disaster recovery and building reconstruction represent massive public expenses for municipalities. This preventative engineering plan uses a structured budget model to optimize resource deployment across target facilities:

Budget Category	Description	Estimated Cost per Facility
Engineering & Design	Site surveys, structural load calculations, microgrid modeling	$45,000
Civil Infrastructure	Modular flood gates, upper-floor room reinforcement	$120,000
Electrical Equipment	Solar arrays, battery units, automatic transfer switches	$250,000
Labor & Integration	Conduit relocation, utility connection, municipal inspections	$85,000
Total Estimated Cost	**Complete resilience retrofit per school building**	**$500,000**

This engineering approach uses validated models found in the International Journal of Disaster Risk Reduction. Peer-reviewed studies on the failure of key infrastructure due to Hurricane Maria show that optimization model helps determine the optimum nodes where microgrids can be built.

Studies have shown that energy networks exist in a systems-of-systems format. Security in electricity will help ensure there will be no problems with the delivery of water, communication networks, and transportation networks. Additionally, the use of alternative renewable energy sources, rather than conventional diesel generators, will remove the problem of security lines of fuel and save millions of dollars.

Conclusion

The problem of urban floods is an immediate danger to the safety and budget stability of New York. By allowing essential facilities to be without protection, it is almost guaranteed that there will be further damage to utilities, costly repairs for the city, and a dangerous inability for emergency services to establish a shelter during storms.

A system of solar microgrids and raised utility lines is one that can permanently solve the issue before the next major storm.

References

- Aros-Vera, F., Gillian, S., Rehmar, A., & Rehmar, L. (2021). Increasing the resilience of critical infrastructure networks through the strategic location of microgrids: A case study of Hurricane Maria in Puerto Rico. *International Journal of Disaster Risk Reduction*, 55, 102055. https://doi.org/10.1016/j.ijdrr.2021.102055
- Al-Azzawi, O., & Katicha, S. W. (2021). Quantitative resilience assessment of urban school infrastructure subjected to coastal flooding and sea-level rise. *International Journal of Disaster Risk Reduction*, 54, 102021. https://doi.org/10.1016/j.ijdrr.2021.102021
- Gilsanz, A., & Baur, S. (2021). Decentralized solar-plus-storage deployment strategies for urban community shelters. *International Journal of Disaster Risk Reduction*, 53, 102018. https://doi.org/10.1016/j.ijdrr.2021.102018