WERC NYC: Neighborhood-Scaled Waste-to-Energy + Recycling + Public Space

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This graduate architecture studio investigates a climate change mitigation strategy that scales down and localizes waste collection, situating it within the urban fabric at the scale of New York City community districts. In these proposals, infrastructural programming is combined with public amenities that take advantage of the byproducts of the waste treatment process . This mixed-use infrastructure proposes a model for urban densification that makes more strategic use of transportation infrastructure and urban land use by interweaving green manufacturing and industry within urban community environments. The project assumes the incorporation of the latest filtration technologies developed in places like Japan, Sweden and Denmark that are able to filter 95-99% of different types of emissions. This makes it possible to situate these facilities in dense urban environments where they can locally capture waste streams where they are generated. It is understood that the long-term solution to waste management is the elimination of the use of fossil fuels and the complete recycling of waste. Localizing the waste to energy facility eliminates the pollution issues associated with transportation. Waste to energy puts garbage to good use by converting it to steam for electricity production and has been proven to be environmentally preferable to landfill, which are known for their greenhouse gas emissions. Combining infrastructure with public programming that can take advantage of the heat and energy byproducts of the WTE process has the added benefit of bringing visibility to the issue of waste. When neighborhoods are constrained to effectively live with their waste they are incentivized to process it as efficiently as they can. The test sites for the project were waterfront locations chosen to align with proposed East River Ferry stops to bring more visibility and efficiency to the proposed system of localized waste processing. Site One is situated on Pier 36 in Manhattan and includes the Lower East Side and Chinatown. Site Two is adjacent to the Brooklyn Nayv Yard, which includes the Hasidic community as well as other Williamsburg residents. This work has been presented at the Center for Architecture in collaboration with the Committee on the Environment (COTE) in a symposium featuring work from Pratt Institute and the New Jersey Institute of Technology. The studio format, combining design and technical faculty, was awarded special commendation by the NAAB in the program's most recent accreditation. Several of these projects have been recognized in national student award competitions.

THE PROBLEM OF WASTE

New York City generates 14 million tons of garbage per year, or 12,000 tons per day.[1] Seventy-five percent of waste is exported out of the city to landfills upstate and to Pennsylvania, Virginia, and South Carolina. Two-thirds of recyclables end up in landfills.[2]A 2009 EPA study shows that waste-to-energy plants produced lower levels of pollutants than the best landfills did, but nine times the energy.[3] Technological developments in facilities located in countries like Denmark, Sweden, and Japan have drastically reduced harmful methane and carbon dioxide emissions to far below governmental regulatory limits.[4] Localizing waste management reduces transportation pollution and expense and combining waste and recycling collection improves proper sorting. In countries like Denmark, citizens are comfortable living adjacent to where their waste is processed, and heat from the burning garbage can be piped directly into their homes. Layering public programs onto infrastructural programs anticipates the increased densification of the city, where the increasing scarcity of ground-level space will prompt public spaces to continue to stratify. Industrial mixed use allows for public programs to take advantage of the byproducts of the waste to energy process like heat and energy.

The project proposes to locate small scale waste-to-energy and recycling facilities that serve community districts within the New York City limits. The studio projects investigated how to address the issue of locating trash collection and incineration processes which are typically segregated from residential districts within the dense urban fabric of the city. Do you celebrate it? Do you conceal it? Do you disguise it? How does the public engage with it?

There is an established history of architects exploring the architectural potential of infrastructural typologies. Frank Lloyd Wright and Hugh Ferriss were focused on the then novel technology of electricity and its potential as a medium for architectural expression. Wright's unbuilt Lenkurt Electric Company design celebrated electric light through a transparent glowing roof. Bjarke Ingels Group's Copenhill in Copenhagen, Denmark,

Figure 1. Elevation Montage, Brooklyn Navy Yard. Max Sopher and Man Hin Ivan Yan.

which combines a waste to energy facility with grass skiing facility, is a well known contemporary precedent. Toshima, a facility in Tokyo, is located in a dense urban context that incorporates a recreational center that uses the heat byproduct from the WTE process to heat the pool.

INDUSTRIAL MIXED USE AND WASTE MANAGEMENT

Mixing industrial programs with commercial and retail programs is an urban densification strategy gaining traction in urban areas.[5] This approach has the potential to have far-reaching effects on the way the city operates and on its environmental footprint. Rather than segregating zones and requiring people, goods, materials, and waste to travel from one part of the city to another, mixing uses within a district and even within a building can reduce pollution and traffic and create jobs. The mixing of public programs with infrastructural ones keeps the streetscape active and engaged with the community. It also heightens awareness of issues of waste.

The waste to energy process is linear, though there is some flexibility in the positioning of the various elements of the system. The process starts with the arrival of municipal solid waste, which is dumped from trucks into a tipping hall. It is picked up by a crane and sent down through a series of conveyor belts into the incinerator. The conveyor belts filter out some recyclable materials like metals. The incinerator converts the waste into gas which boils water to convert to steam, which powers a generator that generates electric energy. Other byproducts include fly ash, heat, and other gaseous emissions, which pass through a series of filters and scrubbers before exiting through the chimney.[6]

We coupled the waste to energy plant with a recycling center in order to more directly divert recyclables into the proper waste stream. The process starts with recycling materials being dumped into a tipping hall, and the complex optical sorting machine which separates out different types of materials and ends with bailing for transport onto barges or rail lines. In our research on New York City waste management, we learned that of the 14 million tons generated per year/12,000 tons generated per day, most is sent to landfills. The SANKEY waste stream diagram shows the alarming fact that half of the recyclable paper, plastic, metal and glass ends up in landfills. This waste stream ultimately finds its way through global waste trade networks into the Global South, where it then becomes their responsibility. In addition to waste to energy and recycling programs, students were asked to add public programs that would take advantage of the byproducts of the waste to energy process.

The facility was sized to serve New York City community districts, which range in population between 130-155,000 residents. We would expect 130,000 people, each generating 2.2 pounds of garbage/day, to be generating 143 tons/day. A local Covanta waste to energy facility in Huntington, New York, which is scaled to serve the local Long Island municipality with a population of 200,000 residents was a reference for the sizing of the project as well as a case study for the studio. The sites were located on the water to capitalize on the need for water in the waste management process. They were also chosen to align with potential East River Ferry stops in four boroughs to combine an infrastructural program with a public one. Water-based transportation is planned to continue to expand as a way of offering another way of addressing growing density and navigating the city.

The local populations are a mix of different income levels where there is already a lot of development investment. The Manhattan site is intended to serve Community District 3, which includes the Lower East Side and Chinatown. The Manhattan site is located on Pier 36 at the west end of the East River Park, which is slated to get rebuilt at a higher elevation in response to rising water elevations. The park and adjacent pier were built on landfill that was incrementally added beginning at the 20th century to replace the working waterfront of the Lower East Side. The local communities include Manhattan's Chinatown and Vladeck Housing and other NYCHA housing projects as well as young professionals living in the Lower East Side.

The Brooklyn site is located adjacent to the Brooklyn Navy Yard within Community District 2 along the eastern edge of Wallabout

Figure 2. Section, Brooklyn site. Ayesha Agha and Sara Brandt.

Channel, formerly Wallabout Creek that was shaped beginning in the 19th century to create the shoreline that is there today. Today, the Brooklyn Navy Yard is a center for urban manufacturing, attracting a wide range of businesses in the furniture, fashion, and food industries. The community of South Williamsburg, meanwhile, is a mix of Hasidic Jews, a Puerto Rican and Dominicans populations, as well as young professionals.

COURSE STRUCTURE

This studio is the fourth of six studios in the MARCH sequence and is formally known as the integrative studio. The studio and final technical seminar, called Integrative Building Systems, have overlapping course times and deliverables, and the technical faculty and design faculty co-advise the student groups on their projects. The courses aim to achieve a high degree of technical detail and resolution. The students work in teams of two, and their work is advised by a team of instructors comprised of the studio instructor and structural, mechanical and façade consultants. The students were prompted to reconsider the balance between human and machine-centered spaces in their approach to the project. Rather than walling off or sequestering industrial spaces, projects sought to find ways to weave them through public spaces and selectively expose industrial processes. Students were introduced to the concept of subnatures as discussed by architectural historian David Gissen. They were encouraged to rethink how a building might manage environmental conditions such as dust, mud, gas, smoke, and debris. Rather than representing materials and surfaces as pristine and clean, projects sought to express the reality of materials exposed to the environment over time. They were also encouraged to think of the project in the context of the Anthropocene, where the distinction between nature and man made is blurred.

STUDENT PROJECTS

The Manhattan site projects treated the landfill terrain as material that could be freely removed or manipulated according to the demands of the project. In one project, the ground was entirely removed, and the building was designed to be constructed on piles and accessed via docks. Tunnels for barges and ferries were carved into the mass at the water level. The equipment was organized into a nine circle grid which transformed into orthogonal shapes as it met the surface of the river. The students chose to add a water park with slides and a pool to the program. Heat from the waste to energy process was used to heat the water. Rather than locating the public space in the primary volumes in the building, the students chose to locate the water park elements in the interstitial space between the cylindrical forms, inverting the typical relationship between human-centered space and infrastructure. Slides slip in and out of the cylindrical volumes containing the waste to energy and recycling machinery, affording intermittent glimpses of the sorting and burning processes. The façade is conceived as precast recycled content that is textured to attract plant growth and animal inhabitation. The exterior is mute, concealing the nature of what takes place inside. In contrast, another project created a billboard out of the waste to energy process visible from the elevated highway (the FDR) that runs parallel to the building. The machinery shines behind a glass façade that acts like a vitrine, putting the equipment on display. The building mass steps down to the waterfront, interrupted by a series of semi enclosed cementitious volumes of spa environments heated at different temperatures.

While the Manhattan projects focused on water-based programs, the Brooklyn ones looked at air and atmosphere. One project proposed a night club with spaces of different temperature, light, and humidity conditions in a series of distributed volumes, intermixed with the waste and recycling spaces. The trash and recycling winds through conveyor belts through the club spaces while people circulate through the waste processing spaces. A series of stepping volumes created a navigable terrain on both ground and roof levels. Some spaces are planned as blue roofs and others as bioswale rainwater catchments. Channel glass wraps the facades and offers a diffused view of activities inside. In another project, a large greenhouse clad in ETFE is proposed to wrap over and weave through the waste and recycling spaces, which are encased in glass at the ground level. They are pulled apart to create an exterior public space consisting of floating docks interspersed with water gardens that leads to the waterfront. This space is crisscrossed by tubes carrying the recycling and trash as it travels from one part of the process to the next. The greenhouse is organized into different zones according to the level of natural light and humidity required. Changing temperature and humidity is intended to increase or decrease visibility of the interior accordingly. A public amphitheater with

Figure 3. Aerial montage, Brooklyn Navy Yard. Katie Gaines and Ekta Patel.

a view of the Manhattan skyline is located at the roof level. A third project configured the program as a composition of vessels containing a mix of waste to energy and recycling equipment and thermal baths. The vessels pivot in different directions to provide views or emit steam. The vessel massing and materiality effectively obscured the differentiation between programs within the building. Striated porcelain cladding splits to provide glimpses of the interior as one approaches the building.

CONCLUSION

It is a given that zero waste is the ultimate goal. However, in the short term, waste to energy using the latest filtration technology has proven to be an effective waste management solution. Localizing waste management, where it is visible within a community and where it integrates with other public programming, means that citizens must live with their waste. This strategy will push the conversation forward toward that ultimate goal. This approach is also a densification strategy. The climate battle for the planet will be won or lost in cities. Cities are searching for sustainable ways to densify cities that improves efficienciies, protects the complex ecosystem of the urban fabric Densification strategies that layer infrastructural and public programs together improves efficiencies and reduces pollution in the urban collection and distribution systems of waste and energy. Creating a neighborhood-scaled waste to energy closed loop could serve as a model for other urban areas and have far-reaching benefits to infrastructural and supply chain issues inherent in the need to transport waste and distribute energy. Mixing public and infrastructural uses is a challenge with a number of clear benefits, especially in high value areas like waterfront property. The greening of waterfront areas for the benefit of public use should be designed to accommodate manufacturing that can safely operate in dense urban contexts. Mixing industrial and public programming and maintaining manufactuing within the urban context is the sustainable and economic way to build density. Industrial mixed use may be a new typology that addresses the need to preserve manufacturing within the city while maximizing the utility of valuable urban land.

The team-taught seminar and studio structure is an ideal testing ground for exploring the boundaries between infrastructure and architecture and the areas of overlap between technology and design. The test case offers students an opportunity to play a key role in the discussion on the future of urban waste management and densification in the context of climate change mitigation.

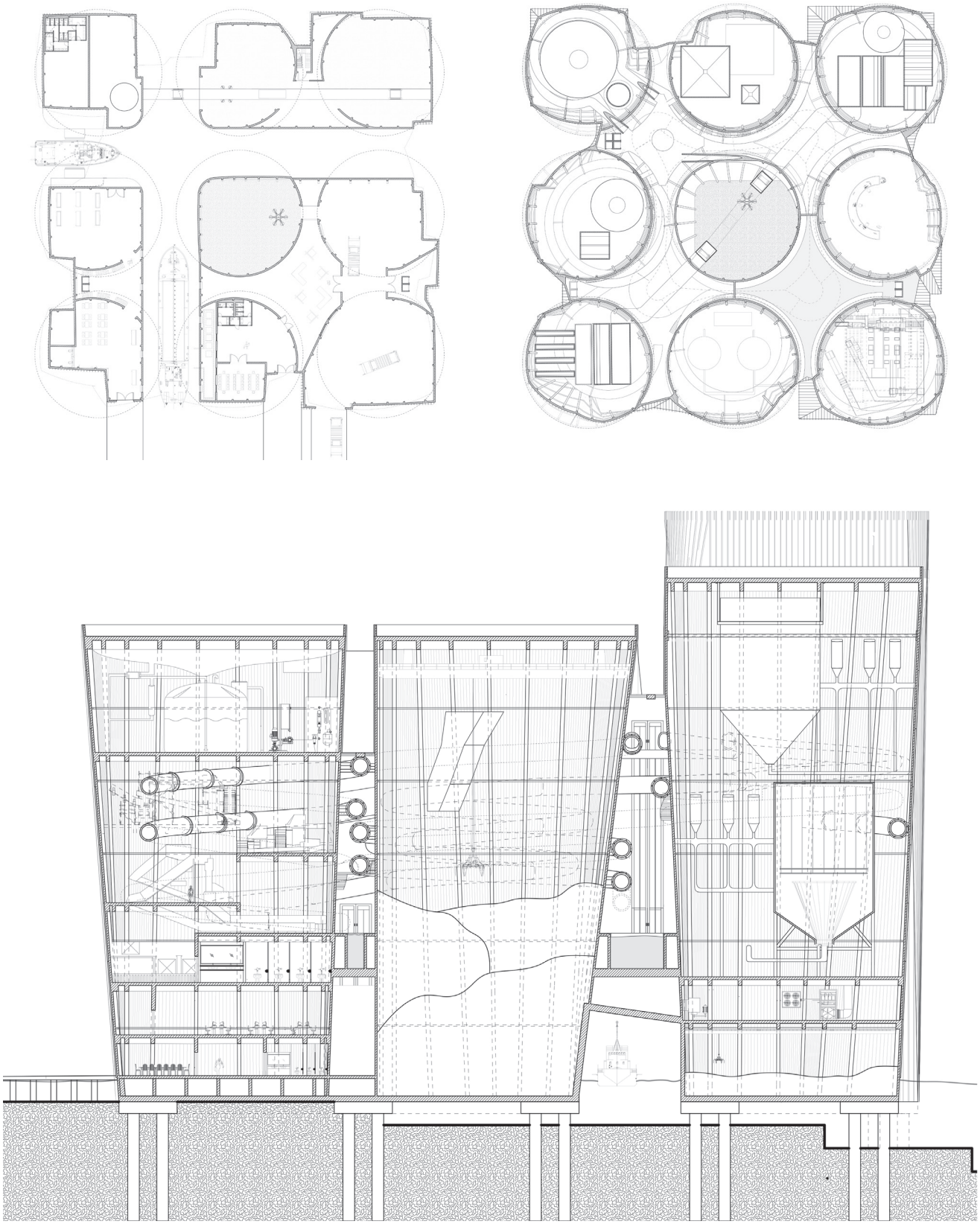

Figure 4.Plans and Section, Manhattan Pier 36. Maria Ugarte and Sirinya Wutthilaohaphan.

ENDNOTES

1. https://www.baruch.cuny.edu/nycdata/environmental/recycling-waste.htm (Accessed 9/25/2021)
2. https://ibo.nyc.ny.us/cgi-park2/2016/07/how-much-of-the-citys-curbside-recyclables-get-properly-recycled/ Accessed 9/25/2021
3. https://www.nytimes.com/2010/04/13/science/earth/13trash.html (Accessed 9/25/2021)
4. https://www.jlgc.org.uk/en/pdfs/casestudies/Toshima.pdf (Accessed 9/25/2021)
5. https://www1.nyc.gov/assets/planning/download/pdf/planning-level/housing-economy/can-industrial-mixed-use-buildings-work-in-nyc.pdf (Accessed October 3, 2021)
6. Hanif Kara, Leire Asmesop-Villora, Andreas Geogoulias, Architecture and Waste – _A (Re) Planned Obselesence. Cambridge: Actar, 2017, 119-126.
7. https://www.sankey-diagrams.com/new-york-zero-waste-scenario-2030/ (Accessed October 14, 2021)
8. Benedetta Cotta, "What goes around, comes around? Access and allocation problems in Global North–South waste trade." *Int Environ Agreements* 20, 256.
9. https://waterfrontalliance.org/2021/07/29/ferry-expansions-will-support-steady-demand-for-post-pandemic-ferry-transit/ (Accessed October 17, 2021)
10. https://www.curbed.com/2021/05/east-river-park-nyc.html Accessed October 10, 2021
11. David Gissen, *Subnature: Architecture's Other Environments,* Princeton: Princeton Architectural Press, 2009, p. 022.
12. https://www.unep.org/news-and-stories/story/cities-where-fight-green-recovery-will-be-won-or-lost (Accessed October 13, 2021)
13. https://www.benoy.com/design-insights/industrial-mixed-use-a-new-urban-typology/ (Accessed October 17, 2021)