Grey-to-Green Energy Transition in New York City

Urban Planning Studio
Spring 2020
Graduate School of Architecture, Planning and Preservation
Columbia University

Preface

The Grey-to-Green Energy Transition studio is challenged to identify strategies and opportunities related to the eventual closure of peaker power plants in New York City, specifically balancing community priorities with future energy-related demands.

As the COVID-19 pandemic reminds us, there's one thing that remains true. The simple truth that things change, and the equally simple truth that things can be made to change. Today's events reaffirm that we must take actions beforehand in order to prevent the worst case scenario. Thus, our focus has been to identify strategies that can be an active driving force of change, for a more equitable, cleaner, and resilient future.

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Credits

The New York City Grey-to-Green Energy Transition studio would like to thank our client, the New York City Environmental Justice Alliance (NYC-EJA), for their valuable insights and to all the parties that responded to our outreach, especially given this unprecedented situation. Also, we want to thank the critics, who gave encouraging comments throughout the semester. Finally, we want to express our sincere appreciation to our studio instructors, Prof. Anthony Borelli and Prof. Graham Trelstad, our teaching assistant Gayatri Kawlra, and to all the studio members. This work would not be possible without the trust and efforts from all of us.

New York City Grey-to-Green Energy Transition Studio

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Project Background

Political Activism

Paris Agreement

The United Nations Framework Convention on Climate Change adopted the Paris Agreement on December 12, 2015, marking a historic turning point for climate justice (Denchak, 2018). The Paris Agreement's central goal is to "strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below two degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius" (UNFCCC, n.d.). 196 nations have signed the Agreement in 2015 and President Obama called the Paris Agreement, "the single-best chance that we have to deal with a problem that could end up transforming this planet (Somander, 2016)." However, the Trump Administration gave a formal notice of intention to withdraw the United States from the Paris Agreement on November 4, 2019, sparking a widespread international backlash (Friedman, 2019).

Green New Deal (GND)

The GND resolution was introduced to the US Congress by Representative Alexandria Ocasio-Cortez and Senator Edward Markey on February 7, 2019. This nonbinding resolution calls on the federal government to lay out a comprehensive plan for tackling climate change, particularly to achieving "net-zero greenhouse gas (GHG) emissions through a fair and just transition" and to promoting "justice and equity by stopping current, preventing future, and repairing historic oppression of frontline and vulnerable communities" (H.Res.109, 2019). On March 27, 2019, The Senate rejected the bill largely on party-line vote, but the GND brought environmental justice to the center of political debate (Friedman, 2019).

Source: Don Emmert

Climate Mobilization Act (CMA)

On April 18, 2019, the New York City Council passed the CMA, one of the most ambitious climate initiatives for a major global city. This comprehensive legislative package aims to reduce NYC's GHG emissions by establishing emissions caps for large buildings, assessing the feasibility of replacing gas-fired power plants with battery storage from renewable sources, and requiring buildings to equip with solar photovoltaic (solar PV) systems or a green roof (New York City Council, n.d.).

OneNYC 2050 & 80x50

Since2007,thelastyearoftheBloombergAdministration, NYC Mayor's Office has been working on a strategic project to find solutions to the challenges of climate change facing the City. The De Blasio Administration has continued Bloomberg's initiative and have committed to the 80X50 action plan, to decrease 80 percent of GHG emissions by 2050 (based on 2005 levels). Recent studies have shown that the 80x50 commitment is technologically feasible.

In addition, environmental justice is at the center of OneNYC. The most recent report released in April 2019 called for "promoting justice by recognizing, and repairing the damage caused by, historic oppression of communities of color, migrant communities, youth, and other frontline and marginalized communities" (Fuleihan et al., 2019). NYC has been releasing a new report every year, detailing strategies and providing a progress report on the 80x50 commitment and socioeconomic indicators for climate justice.

*"the CLCPA emphasizes helping **disadvantaged communities,** such as those that have been suffering from **poor socioeconomic conditions** and **environmental pollution,** or those with legacies of **racial discrimination."***

Source: Mike Groll


Source: Torsten Kjellerman

Source: Denise Garcia

Climate Leadership and Community Protection Act (CLCPA)

The CLCPA, passed by the New York State (NYS) Legislature and signed by Governor Cuomo on July 18, 2019, is a legally binding commitment to sharply reduce NYS's GHG emissions and transition generation of electricity to renewable energy. In addition to these technical requirements, the CLCPA emphasizes helping disadvantaged communities, such as those that have been suffering from poor socioeconomic conditions and environmental pollution, or those with legacies of racial discrimination. The CLCPA mandates the energy transition as an opportunity to provide energy investments and jobs to vulnerable communities.

The Grey-to-Green studio identified 3 key provisions in the CLCPA (NY State Senate Bill S6599, 2019):

01 /

Reduce GHG emissions.

From the 1990 baseline level, NYS aims to reduce 40% of GHG emissions by 2030 and 85% of emissions by 2050.

02 /

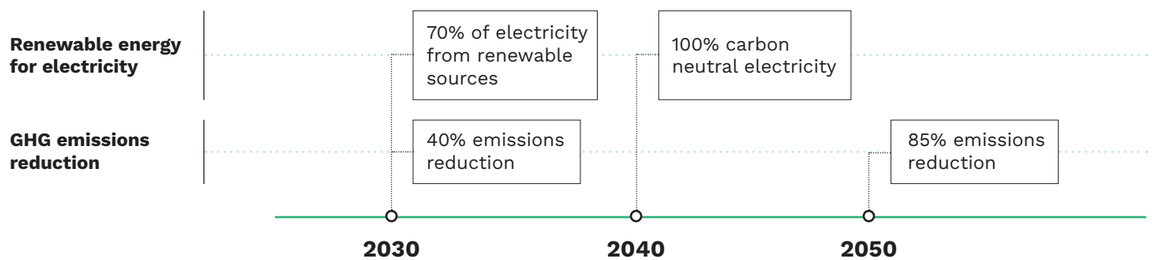
Transition to renewable energy.

NYS aims to generate 70% of electricity from renewable sources by 2030, and 100% carbon-neutral electricity by 2040.

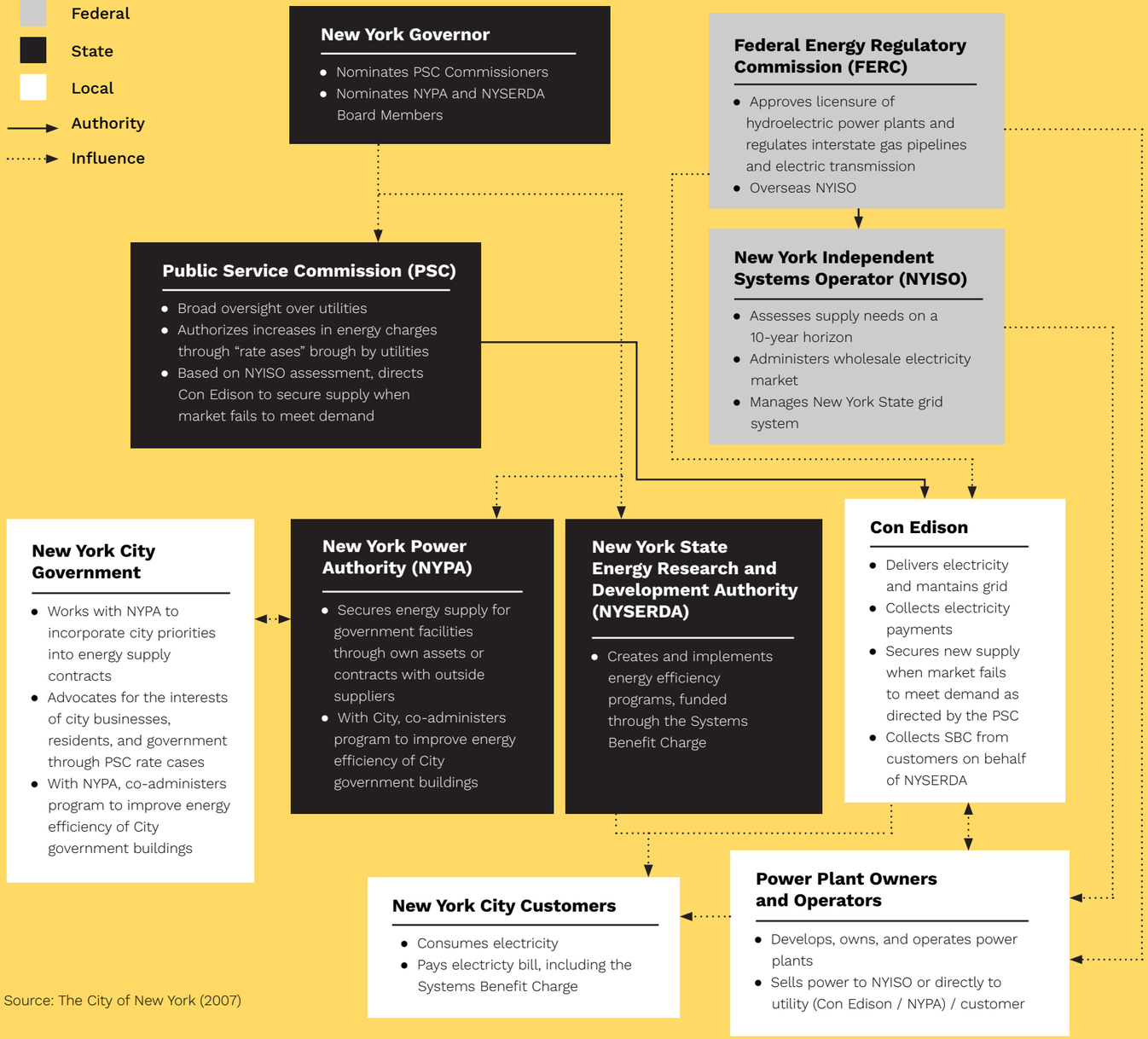
03 /

Ensure that at least 35% of "benefits of spending" be directed to "disadvantaged communities."

The Climate Justice Working Group established by the CLCPA is responsible to identify "disadvantaged communities." Since the bill is under active interpretation, it is yet to be seen how "disadvantaged communities" and "benefits of spending" would be operationalized in practice.



Energy Planning Structure in New York City

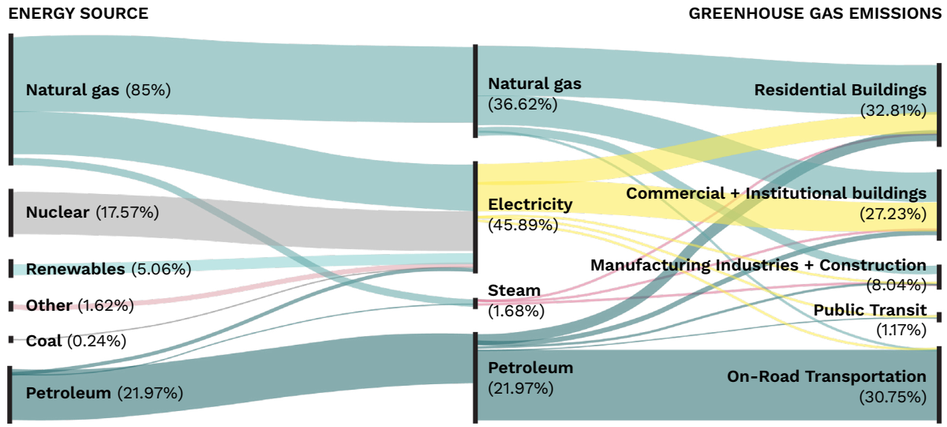


Source: The City of New York (2007)

Electricity Generation in New York City (NYC)

According to the 2019 OneNYC report, 27% of electricity consumed in NYC comes from renewable sources (Fuleihan et al., 2019). Historically, the Robert Moses Niagara Hydroelectric Power Station near Niagara Falls has been a major source of renewable energy for NYS (Rueb, 2017). Since 2014, solar capacity in NYC has increased sevenfold and NYS has committed to a number of renewable energy projects, including Empire Wind, a large offshore wind farm off the coast of the Rockaways (Fuleihan et al., 2019; Equinor, n.d.).

Energy Consumption and Greenhouse Gas Emissions in 2017

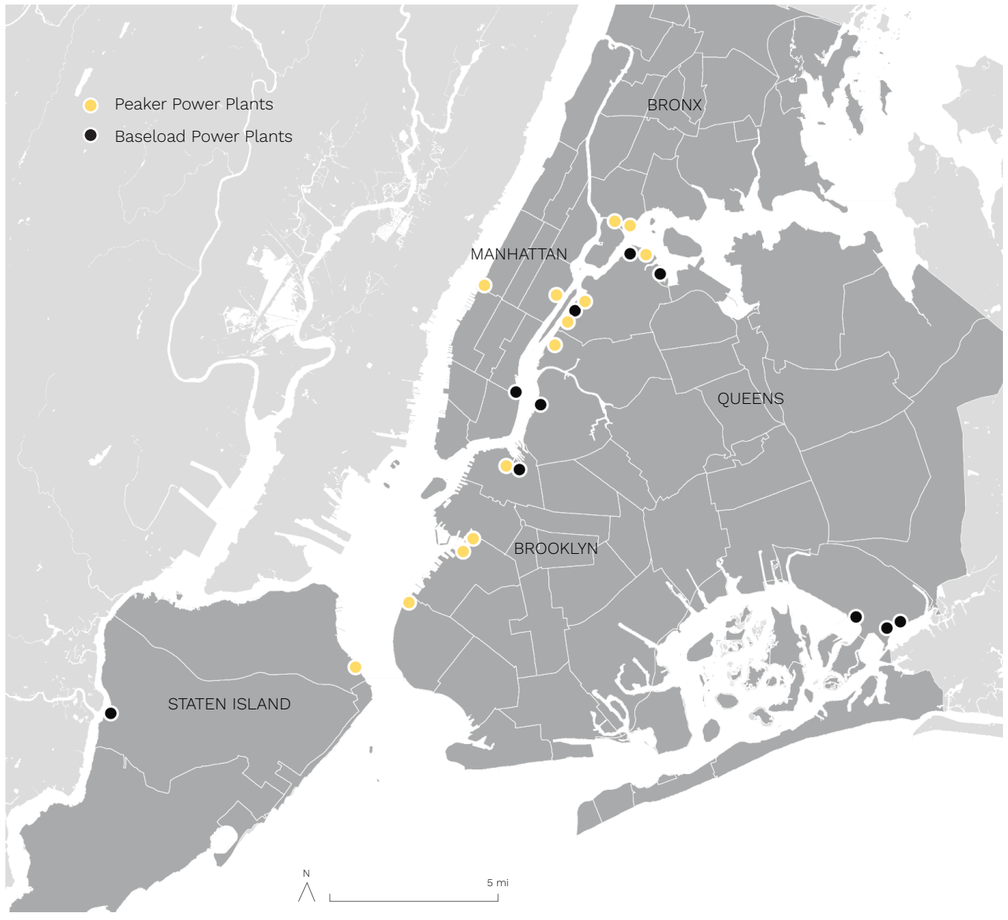


Source: NYC Mayor's Office of Sustainability (2017)

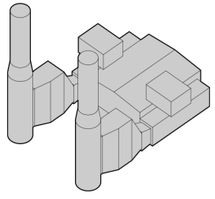
Peaker Power Plants in NYC

Peaker power plants are small electricity generating stations that are capped at 80 MW. These power plants only run when the demand for electricity is at its peak, usually on the hottest days of the summer. In NYC, there are 16 peaker power plants, usually along waterfronts of low-income communities of color.

Peaker power plants are vital to the electricity grid. NYISO requires that each electricity zone (zone J for NYC) needs to be able to generate at least 80% of its electricity within the zone. This 80% capacity requirement is in place to prevent congestion in the state's electricity grid. Though most of the electricity in NYC comes from outside zone J on normal days, peaker power plants provide vital electricity supply when there is peak demand.



Typical Peaker Power Plant



Peaker Power Plant Capacity: < 80 Megawatt

NYISO Zone J (NYC) Energy Summary

	2018	2019	2020 (forecasted)
Annual Energy Consumption (Gigawatt hours)	53,360	52,003	48,946
Summer Peak Demand (Megawatt)	10,890	10,015	11,316
Winter Peak Demand (Megawatt)	7,674	7,398	7,551

Source: New York Independent System Opereator, 2020

PowerNow! Project

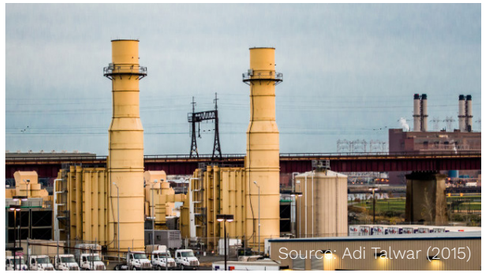
In May 2000, NYISO concluded that NYC's electricity supply in the summer of 2001 would be short by 315 MW. At the same time, California was suffering from one of the worst electricity crises and NYISO argued that New York would experience widespread blackouts like California if it did not act to resolve the forecasted shortage of supply. Only a couple months later in August 2000, NYPA approved the purchase of 11 natural-gas turbines from General Electric for $510 million, with a goal to install these generators as peaker power plants by the summer of 2001. Each turbine has a capacity of 47 MW, which means dual-turbine sites have a capacity of 94 MW. In order to install electricity generators over 80 MW capacity in NYC, the State Environmental Quality Review Act (SEQRA) review is necessary. However, the NYS Department of Public Service granted an exemption to the SEQRA environmental review process for these peaker power plants by approving a legally binding commitment not to generate more than 80 MW using 94 MW capacity electric turbines. Thus, the process of installing peaker power plants shows how energy regulators bypassed legal mechanisms intended to protect community interests (Parker & Malatras, 2002).

'Peaker' vs. Baseload Power Plants

Peaker Power Plant

Site: Harlem River
Capacity: 80 Megawatts

The capacity of peaker power plants is usually under 80 Megawatts to avoid environmental review.



Source: Adi Talwar (2015)

Baseload Power Plant

Site: Ravenswood
Capacity: 2480 Megawatts

Baseload plants run everyday to supply most of the electricity for daily use.

Source: Greentech Media (2019)

Studio Mission

Studio Goal

The Grey-to-Green studio is challenged to identify strategies related to New York City's energy transition. Specifically, the studio aims to develop strategic recommendations and planning tools to facilitate a just energy transition in NYC.

Client

The studio client, Eddie Bautista, executive director of the New York City Environmental Justice Alliance (NYC-EJA), has been coordinating community organizations for decades to achieve environmental justice goals. NYC-EJA lobbied for the passage of the CLCPA and, recently, launched the Peak Energy Alternative Kilowatts (P.E.A.K.) Campaign that aims to replace peaker power plants in the City with renewable energy.

Eddie Bautista
Executive Director, NYC-EJA

Peak Energy Alternative Kilowatt (P.E.A.K) Campaign

As the first comprehensive effort in the US to reduce the negative and racially disproportionate impacts of peaker power plants, the goal of the P.E.A.K. Campaign is stated as replacing peaker power plants with renewable sources of energy and storage in New York City. This campaign brings in all sorts of expertise, including technical, legal, public health and planning fields. Its partnership consists of the New York Lawyers for the Public Interest, studio's client NYC-EJA, THE POINT CDC, UPROSE, Clean Energy Group, Physicians, and Physicians, and Scientists and Engineers for Healthy Energy (NYC-EJA, 2020).

Calros Garcia
Energy Policy Planner, NYC-EJA

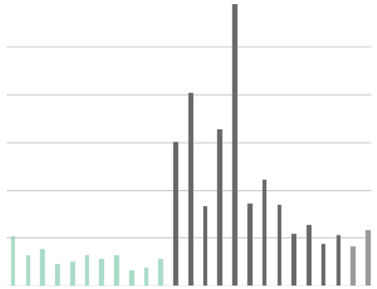
Our Approach

Problem Statement

"As the coming energy transition begins to accelerate, how can we reimagine the energy infrastructure in a way that serves environmental justice communities?"

In order to address the problem, the studio has examined the issue from multiple perspectives.

Community Research



The studio conducted research to understand the surrounding community. A spatial analysis of 311 complaints was conducted to understand community concerns, and other social media and news were reviewed to ensure fresh and close input from community members. In accordance with the studio's goal to develop helpful strategic recommendations and planning tools, this studio developed two proposals from a regulatory perspective and a site planning perspective, respectively.

Regulatory

From the regulatory perspective, the studio has created an index tailored for NYC, the New York City Communities and Environmental Screening (NYC CES) index, to identify 'disadvantaged communities,' and developed strategies for 'benefits of spending' through case studies and test scenarios.

Site Planning

From the site planning perspective, the studio considered repowering and repurposing as major study areas not only to closure of peaker power plants, but also to help NYC's transition to renewable energy in the long run. In studying repowering, the studio conducted feasibility studies on solar and batteries based on Project Sunroof's estimation for evidence-based research and analysis. And finally, the studio reimagined how peaker plant sites can be repurposed to house innovative, clean energy-infrastructure on peaker power plant sites in Port Morris and Sunset Park.

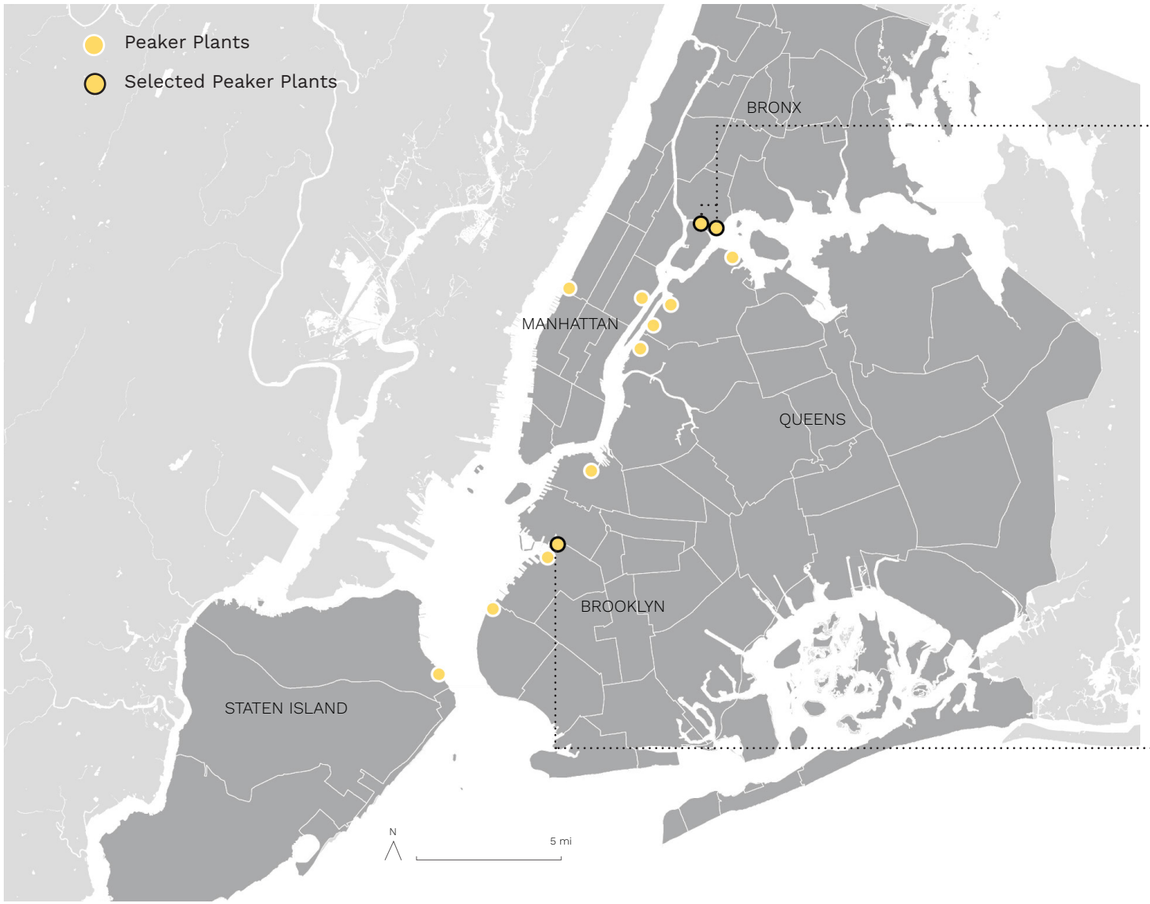
Contextual Research

Site Selection

The Process

At first, this studio evaluated all 23 power plants in NYC, trying to understand the characteristics of the surrounding neighborhood, physical site of the plant, and suitability for the studio project.

Based on the studio mission, this studio focuses on three peaker power plants located in two neighborhoods. The Hell Gate and Harlem River power plants are in Port Morris in the Bronx; and the Gowanus plant is in Sunset Park in Brooklyn.



Selected Peaker Power Plants

Hell Gate Power Plant
Port Morris

Owner	NYPA
Capacity (Megawatt)	80
Fuel	Natural Gas
In Service Date	August 1st, 2001

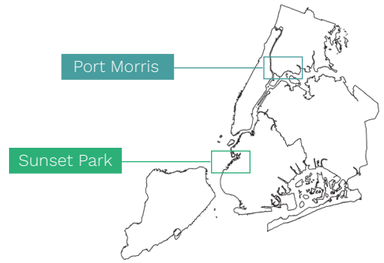
Harlem River Power Plant
Port Morris

Owner	NYPA
Capacity (Megawatt)	80
Fuel	Natural Gas
In Service Date	August 1st, 2001

Gowanus Power Plant
Sunset Park

Owner	NYPA
Capacity (Megawatt)	80
Fuel	Natural Gas
In Service Date	August 1st, 2001

Site History



Both Port Morris and Sunset Park have a legacy of being an industrial waterfront, as hubs of manufacturing, transportation and storage.

Port Morris

Since the 1800s, industrial and commercial uses dominated Port Morris. Many of the structures still standing are remnants of rail yards and factories built during the initial phases of development. During the 1970s, the area saw a great deal of tension that led to the destruction of many properties. Currently, a lot of these damaged areas are being converted into luxury housing, dining, and office spaces. Such revitalization efforts have been met with support as well as skepticism among community advocates and residents (Historic Districts Council, n.d.).

1924

1996

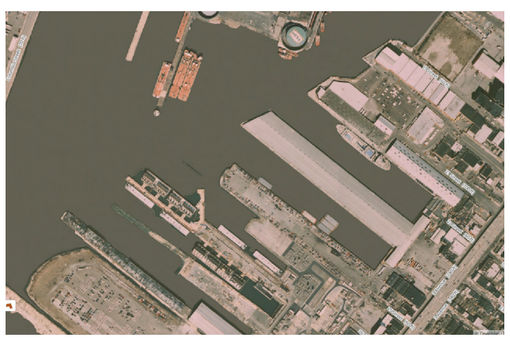
2016

Sunset Park

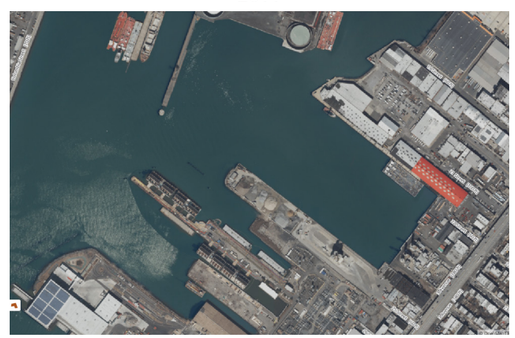
In the early 1900s, Sunset Park saw a boom in residential and business development coinciding with the extension of subway lines and the construction of major transportation corridors like Gowanus Expressway. However, the expressway ended up compromising the area's ability to develop as a commercial and residential area. This ultimately led to a geographical disconnect that manifested in the neighborhood's decline (Ment & Donovan, 1980).

1924

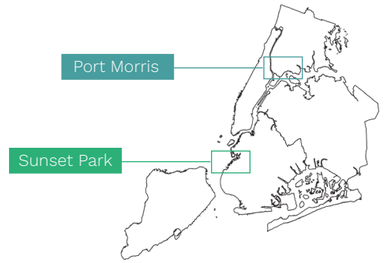
1996



2014



Site Characteristics



Port Morris

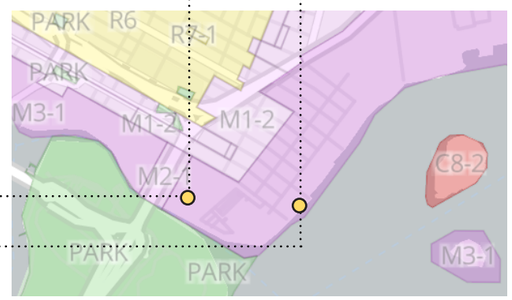
Port Morris has two closely-located peaker power plants. The sites are located on the waterfront in proximity to NYCHA developments, waste management facilities, printing plants and film studios. However, the Randall's Island Connector and the Bruckner Expressway intersect the area, making the site less integrated into the rest of the neighborhood.

Flood Zone

Land Use

- 35% Residential
- 27% Industrial and Transportation
- 14% Commercial
- 11% Public & Institutional
- 6% Open Space
- 8% Others

Zoning



- 39.16% Manufacturing
- 3.41% Park
- 49.36% Residence
- 8.06% Commercial

Harlem River

Hell Gate

Sunset Park

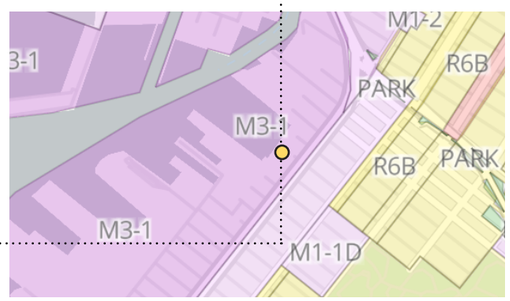
Sunset Park has one peaker power plant. It is located on the waterfront, between Gowanus Bay and the Gowanus Expressway. The plant is surrounded by industrial sites and a ConEdison substation, which delivers power to customers. This site sits adjacent to residential land uses, which implies there could be heightened negative public health effects caused by pollution to residents.

Flood Zone

Land Use

- 32% Residential
- 32% Industrial and Transportation
- 7% Commercial
- 3% Public & Institutional
- 27% Open Space
- 3% Others

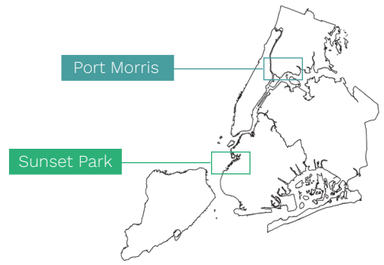
Zoning



- 34.79% Manufacturing
- 1.68% Park
- 62.15% Residence
- 1.38% Commercial

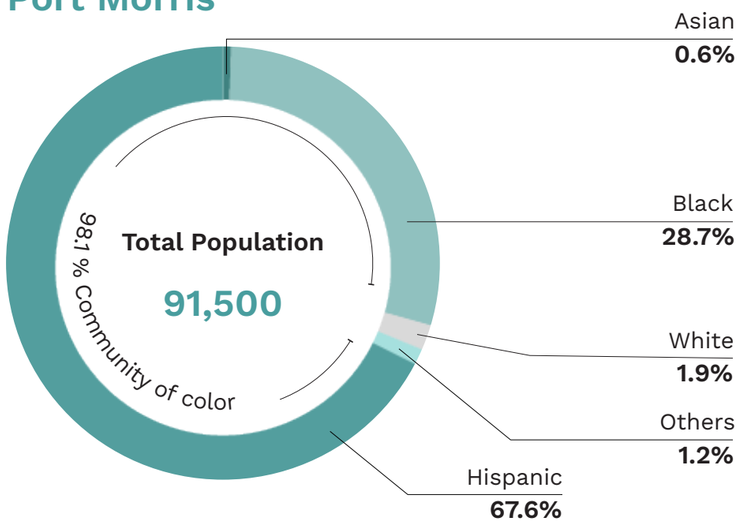
Gowanus

Demographics



Both communities are representative of the disadvantaged communities criteria provided by the CLCPA. Their characteristics, such as low house-hold income and high percentage of people of color are aligned with the client's campaign.

Port Morris

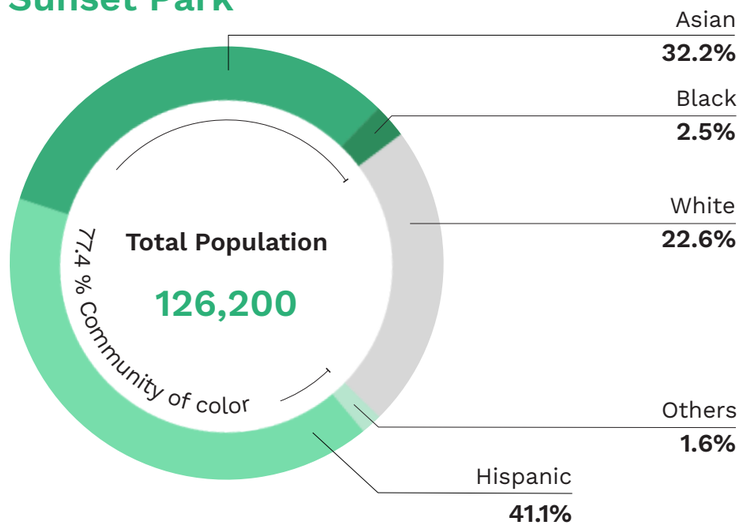


Area (sq miles)
2.2

Density (persons per sq mi)
41,590

Median Household Income
$21,370

Sunset Park

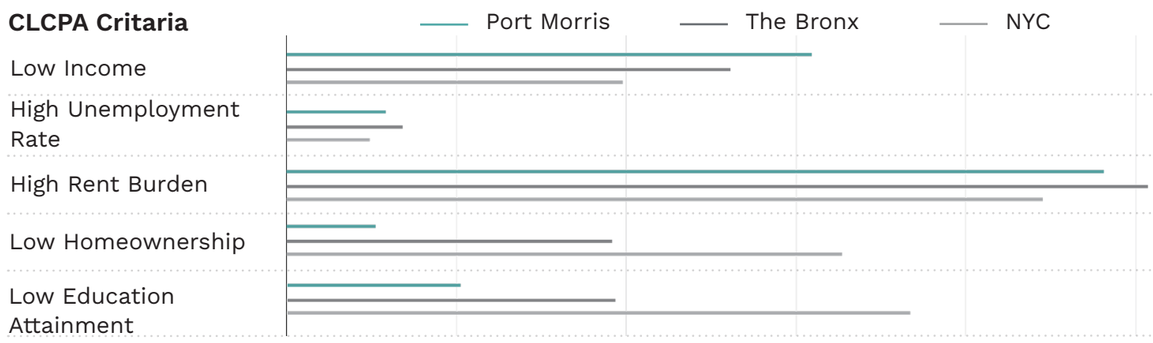


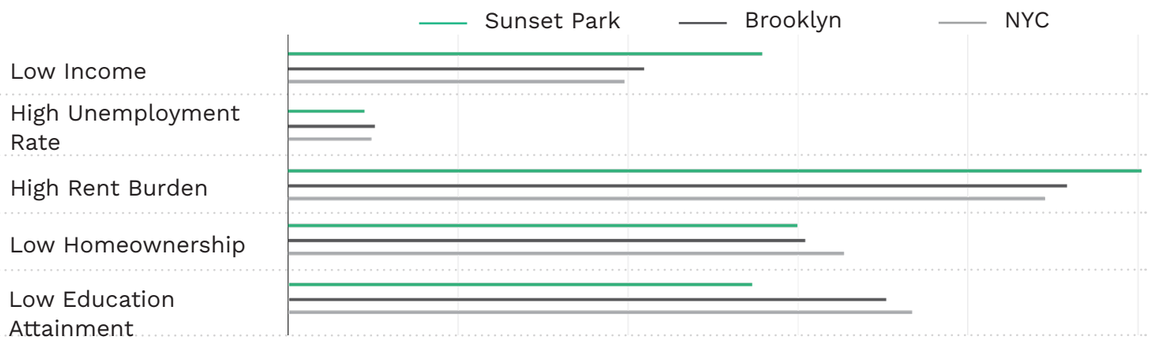
Area (sq miles)
3.7

Density (persons per sq mi)
34,116

Median Household Income
$57,870

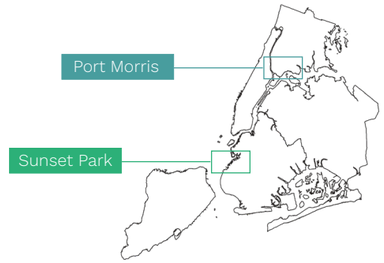
CLCPA Critaria





Data Source: NYC Commuinity District Profiles (2019); NYU Ferman Center (2018).

District Needs Statement



To understand the needs of the community, we based our assessment on district statements of needs in 2021:

Port Morris

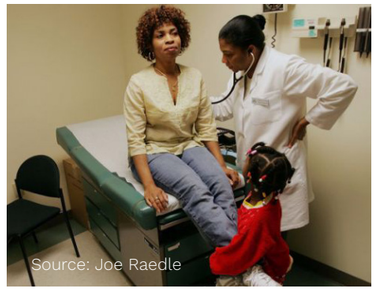
In Port Morris, the top pressing issues are (Bronx Community Board 1's Statement of Community District Needs (FY 2021), 2020):

Affordable Housing


Source: Kevin Chum

Port Morris is the fourth least affordable neighborhood in the city and has the highest rent-to-income ratio in the Bronx.

Health Care Service


Source: Joe Raedle

Port Morris has been designated as part of the Asthma Corridor. The asthma rates are eight times higher than the national average. There is a need to create a healthy environment for the communities especially seniors and children, including expanding health screening services.

Unemployment


Source: Jennifer Brown

In Port Morris, high poverty rate and language barriers contribute to the high rate of youth being disconnected to jobs and education.

Sunset Park

In Sunset Park, the top pressing issues are (Brooklyn Community Board 7's Statement of Community District Needs (FY 2021), 2020):

Affordable Housing


Source: Adi Talwar

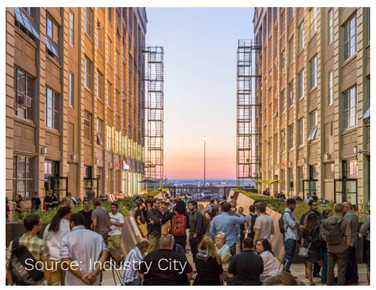
In Sunset Park, over 35 percent of residents live in doubled up apartments and the average household size is higher than New York City average. It's one of the most overcrowded neighborhoods.

Education


Source: Cheryl Senter

Overcrowding is not only an issue of housing, it has also been a persistent issue in education in Sunset Park. The neighborhood lacks school space for the appropriate number of students; particularly pre-K students, students with disabilities, and students whose native language is not English.

Economy and Jobs


Source: Industry City

Recent development and proposed plans along the Sunset Park waterfront pose opportunities and challenges. While they may create new jobs with good wages, low-skilled manufacturing workers will be impacted by these changes.

311 Data Analysis

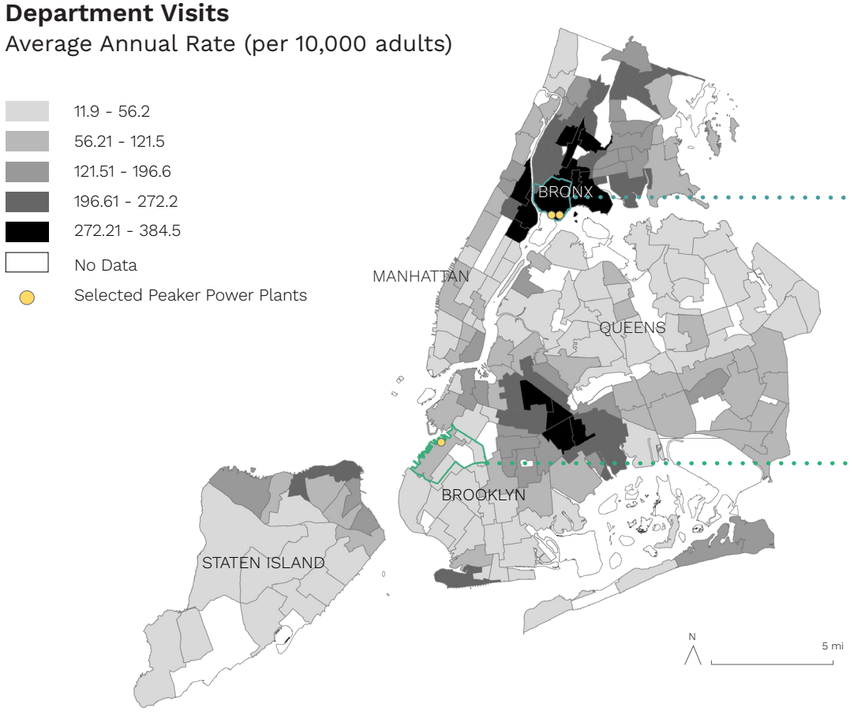
The Grey-to-Green Energy Transition studio looked for ways to connect with local residents and community based organizations once we have established a basic understanding of the community. The two stakeholders anticipated to be our primary points of contact were UPROSE and The POINT. Both have working relationships with our client, NYC-EJA, and are already involved in organizing efforts around components of NYC-EJA's PEAK Campaign. We also reached out to contacts in various city agencies and community boards.

Unfortunately, as circumstances in the city began to develop pertaining to the COVID-19 response, it became clear that collaboration with these organizations would be extremely difficult. In light of this development, the studio began to look for other ways to capture community needs in the context of the studio outcomes.

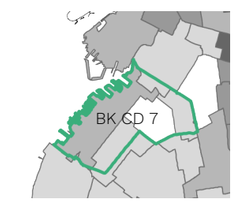
Based on the conversations with our client and our initial research, it was clear that asthma and air pollution are major health concerns in both communities. Thus, we conducted an analysis of 311 complaints data.

Asthma Related Emergency Department Visits

Average Annual Rate (per 10,000 adults)



330
Asthma Emergency Department Visits per 10,000 adults



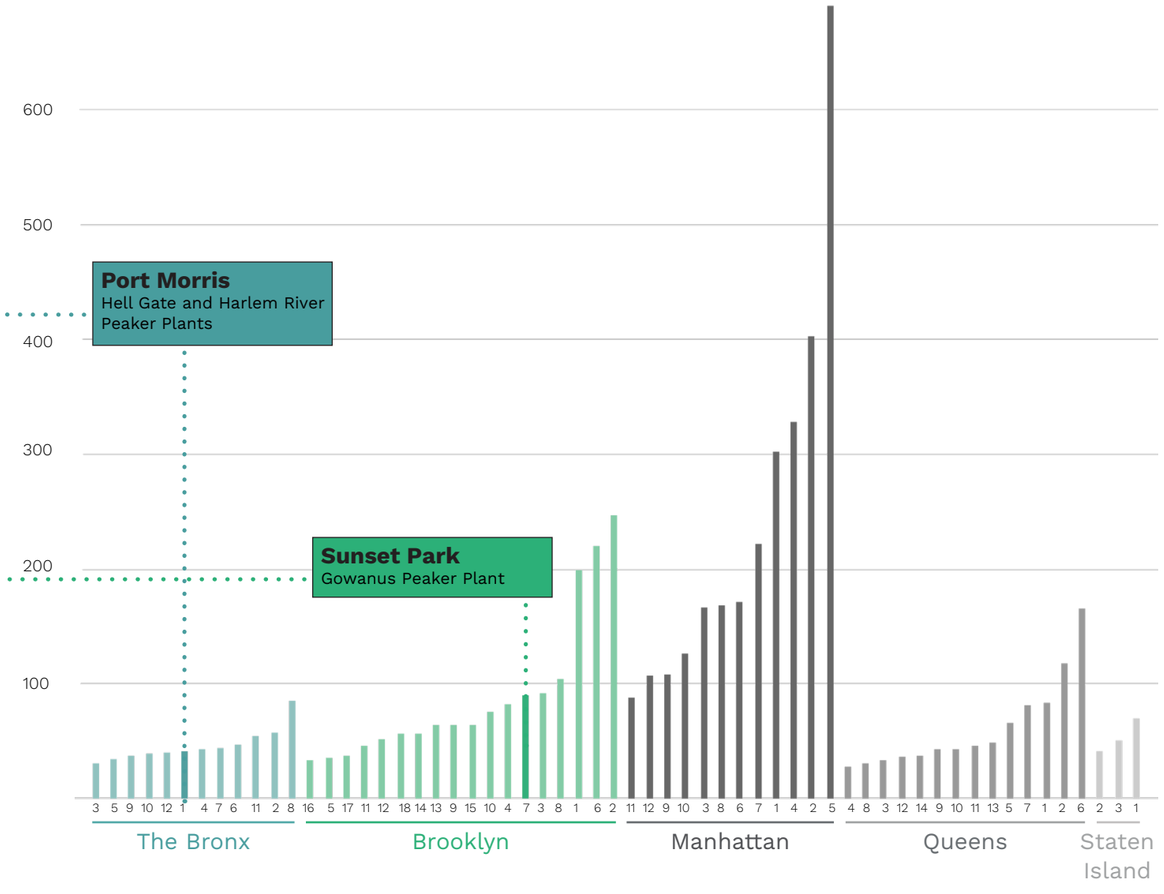
89
Asthma Emergency Department Visits per 10,000 adults

Data Source: Department of Information Technology & Telecommunications (2010-2020, updated daily); NYC Department of Health and Mental Hygiene (2016)

Air Quality Complaints & Asthma Emergency Department Visits

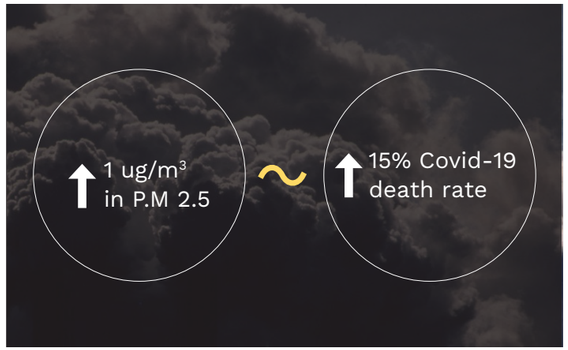
In mapping the count of 311 air quality complaints per community district against asthma hospitalization and emergency department data, we saw that the areas with the highest numbers of hospitalizations and emergency department visits due to asthma had some of the fewest air quality complaints, while areas with relatively low hospitalization and emergency department visit rates had the largest number of air quality complaints.

Air Quality Complaints in Community Districts (2010-2020)



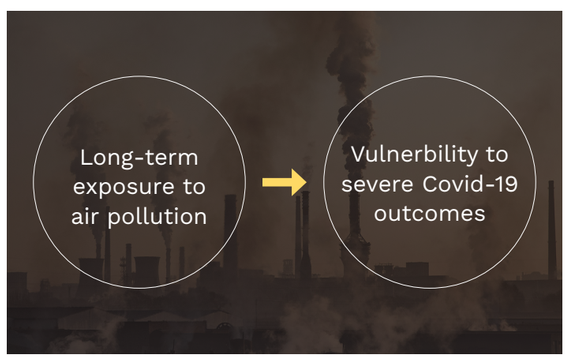
Harvard COVID-19 Air Quality Survey

Air quality is a timely issue today. A Harvard study found that an increase of PM 2.5 level by one microgram per cubic meter is correlated to an increase of 15 percent in the COVID-19 fatality rate (Wu & Nethery, 2020).



"We found that an increase of only 1 µg/m3 in PM2.5 is associated with a 15% increase in the COVID-19 death rate."

Covid-19 National Study
Harvard T. Chan School of Public Health



"The results of this paper suggest that long-term exposure to air pollution increases vulnerability to experiencing the most severe Covid-19 outcomes."

Lisa Friedman
The New York Times

311 Data Limitation

Without being able to conduct interviews with residents and local organizations, it is difficult to infer meaning from these data. However, in looking at available information about how people file complaints (online, by phone, using the 311 app) and length of complaint ticket life (average amount of time it takes each city agency to register and resolve a 311 complaint), we speculate that these trends could be indicative of (1) mistrust of or reticence to engage with systems, (2) not viewing 311 as a pathway to change in local conditions, (3) inaccessibility of the 311 platform in terms of access and ease of use.

Ultimately, while 311 data may not be able to capture the entire story of air quality in the five boroughs, it does serve to corroborate resident and stakeholder accounts of some human impacts of on the ground conditions

Source: Mark Lennihan


Source: Victor J. Blue

" Going forward, we want to make sure that we're thinking about how equitable 311 data is. Bias has always been a concern, but it's not always obvious how of handle it."

James Perazzo
Director of Mayer's Office of Data Analysis


Source: Bebeto Matthews

Community Voice

Community-based organizations and P.E.A.K. campaign partners advocating for environmental justice in Port Morris and Sunset Park.

In an effort to maintain a strong community voice throughout our research process, we also reviewed and compiled news articles and published interviews with community stakeholders. As seen from these quotes, longtime community challenges have been exacerbated by the current pandemic, and urgent actions need to be taken to help.

In addition to other issues encompassed in district needs statements. We hope that the findings produced by this studio can serve to assist our client in achieving the goals set forth in the PEAK campaign and empowering frontline communities given the opportunities provided by CLCPA.

"Environmental and public health injustices from dirty fossil fuel industries continue to overburden our most vulnerable communities, low-income communities of color. The three peaker plants in Sunset Park are natural gas power plants and expose nearby residents to [pollutants] which can cause or worsen respiratory diseases and increase asthma related hospital visits"

Ana Orozco
Program Coordinator
UPROSE

"We're seeing, you know, some of our neighbors, people that have lived here for a long time not only to be able to afford to live here anymore"

Danny Peralta
Executive Managing Director
The Point CDC

"The goal [for Green Resilient Industrial District in sunset park] is to create a local economic engine that addresses both climate change and local economic needs. You can sell avocado toast and lattes somewhere else..."

Elizabeth Yeampierre
Executive Director
UPROSE

"Climate change is a human rights issue. It is an economic, racial, and immigrants' rights issue. And with these bills, New York City is sending a message to the world: we are ready to protect our planet and our children's' futures...I proudly stand [to support] the boldest climate legislation of any city in the country"

Carlos Menchaca
Council Member
New York City Council District 38

Regulatory Proposal

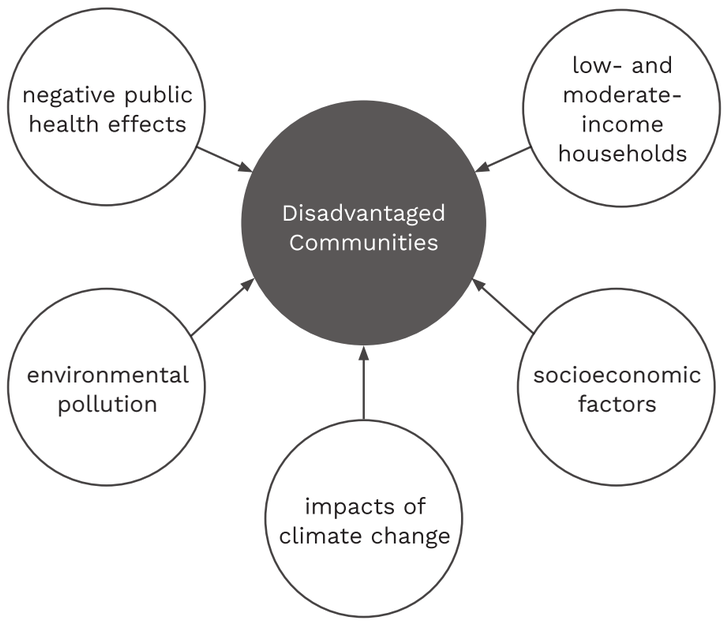
A Just Energy Transition

Benefitting Disadvantaged Communities

Disproportionate share of environmental burden combined with socioeconomic challenges make some communities more vulnerable than others in NYC. Also, there is a growing recognition that community perspective should be integrated into the city's decision making and planning (Chu et al., 2016). Starting in 2017, numerous environmental justice bills have been passed in NYC, aiming to bring New Yorkers' justice in all its forms when leading the city into a green economy. However, although environmental justice is a key sustainable development goal and a prime concern for advocates, providing a just energy transition in disadvantaged communities has been rarely discussed.

Luckily, in 2019, New York State governor Andrew Cuomo signed the Climate Leadership and Community Protection Act (CLCPA), a statewide legally binding commitment to reduce GHG emissions while transitioning to renewable energy. Among the many provisions, the CLCPA establishes the Climate Action Council, which is responsible for identifying "disadvantaged communities" and ensuring these communities receive 35% of "benefits of spending."

CLCPA's Defintion of Disadvantaged Communities



The Challenges

While it is important to determine how energy facilities are sited, it is essential to know how "disadvantaged community" and "benefits of spending" are defined in law. More broadly, they are relevant to exclusion and benefits to accessing renewable energy. For communities in NYC, the biggest challenge is that CLCPA is still under active interpretation; it is uncertain how these definitions are operationalized in practice by the Climate Justice Working Group. Until these uncertainties are clarified by the Climate Justice Working Group, it is difficult for communities in NYC to accelerate the green energy transition.

This section of the report is divided into two parts according to the two undefined terminologies in CLCPA, "disadvantaged community" and "benefits of spending". Part I of this section introduces (i) the New York City Communities and Environmental Screening Index (NYC CES), an index the studio created to assess vulnerable communities in the context of energy transition in NYC. Part II of this section examines (ii) scenarios in which "benefits of spending" could possibly be interpreted.

What indicators will be used for defining "disadvantaged community" in NYC?

What changes will happen to the community after designation of "disadvantaged community"?

What kind of "benefits of spending" will "disadvantaged communities" get?

How to quantify "benefits of spending"?

How will the "benefits of spending" be allocated (equally or with threshold)?

Will there be any legal enforcement for nonattainment?

NYC Communities and Environmental Screening Index (NYC CES)

The studio client, the New York City Environmental Justice Alliance (NYC-EJA) is an active participant in the CLCPA's Climate Action Council working group. NYC-EJA is committed to search for a better definition for these two terms in the context of energy transition in NYC. Our initial meeting with NYC-EJA in January 2020 highlighted the uncertainty of defining "disadvantaged community," the complexity of developing indicators in the context of climate change, and how the CLCPA's criteria would serve as a baseline.

This studio aims to add value to the current CLCPA's suggested criteria of "disadvantaged community." We expected to evaluate multiple climate change stressors that are currently unevenly distributed or possess a severe environmental impact to communities in NYC. In the end, we expected to produce a relative measure of socioeconomic and environmental impacts in NYC communities, identify potential disadvantaged communities in NYC, and propose policy suggestions regarding energy transition and climate change. In light of these goals, this studio has developed the NYC Communities and Environmental Screening (NYC CES) Index, which is a model adapted to assess vulnerable communities in the context of energy transitions in NYC.

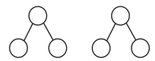
Source: Demetrius Freeman

Source: El Museo del Barrio

Model and Rationale

The NYC CES Model is based on the working definition of CLCPA's suggested criteria for "disadvantaged community" in that:

The model provides information on each census tract for the entire city of New York using spatial analysis in geographic information system. The data are obtained from New York City Planning. These were updated in 2010. There are 2,168 census tracts in NYC, representing a relatively fine scale of analysis. The geographic scale selected should be useful for further analysis and decision making.



The model is made up of multiple components cited in the CLCPA as contributors to cumulative impacts. It includes four main components. Two components, (i) Sensitive population and (ii) Socioeconomic Factors representing PopulationCharacteristics;Twocomponents, (iii) Exposure and (iv) Environmental Effect representing Pollution Burden.

The model uses a suit of city wide indicators to characterize the two components. To preserve simplicity, the model only uses a limited set of indicators. Sensitive population comprises 5 indicators that represent a population's sensitivity to the environment. Socioeconomic Factors comprises 9 NYC specific social indicators. Exposures include 7 indicators representing major pollutants in the city. Environmental effects contain 4 indicators representing environmental impact of hazardous treatment facilities. These indicators are important for measuring climate change, and reflect the uniqueness of NYC.

The model uses a scoring system in which a score (1-10) is assigned to each indicator under the four components (Sensitive Population, Socioeconomic Factors, Exposures, and Environmental Effect). The sum of scores for each set of indicators of the four components is combined and given different weights to produce a NYC CES Index score for a given census tract relative to other census tract in the city, using the formula/weight shown below. The higher the score, the more disadvantaged the community is.

Indicators

Process

Literature reviews

around various criteria that define and identify 'vulnerable communities' in the context of planning, climate change, and environmental justice: The Community Development Block Grant (CDBG), CDC's Social Vulnerability Index (CDC SVI), and EPA's Environmental Justice Screening and Mapping Tool (EPA EJScreen).

Case study

on CalEnviroScreen, a California-based disadvantaged community mapping tool, and referenced its structure for our NYC CES Index.

Common indicators

used in CDBG, CDC SVI, EPA EJScreen and CalEnviroScreen were identified.

Four components

of sensitive population, socioeconomic factors, exposures, and environmental effects were modulated.

Data

were collected for identifed indicators within each of the four components; indicators were selected and further developed for the model.

Spatial Analysis

was conducted to derive scores for 'Population Characteristics' (sensitive population + socioeconomic factors) and 'Pollution Burden' (exposure + environmental effects)

Decision Analysis

was conducted to attain the overall NYC CES Index score, taking into account all components and applying different weights to evaluate the model.

Data visualization

of layers of indicators with assigned scores of 1-10 for each geographic unit (census tract).

Selection Criteria

The indicators are selected based on several criteria:

Relevance to components and NYC

Indicators should provide a measure that is relevant to the component it represents as well as to the unique context of NYC.

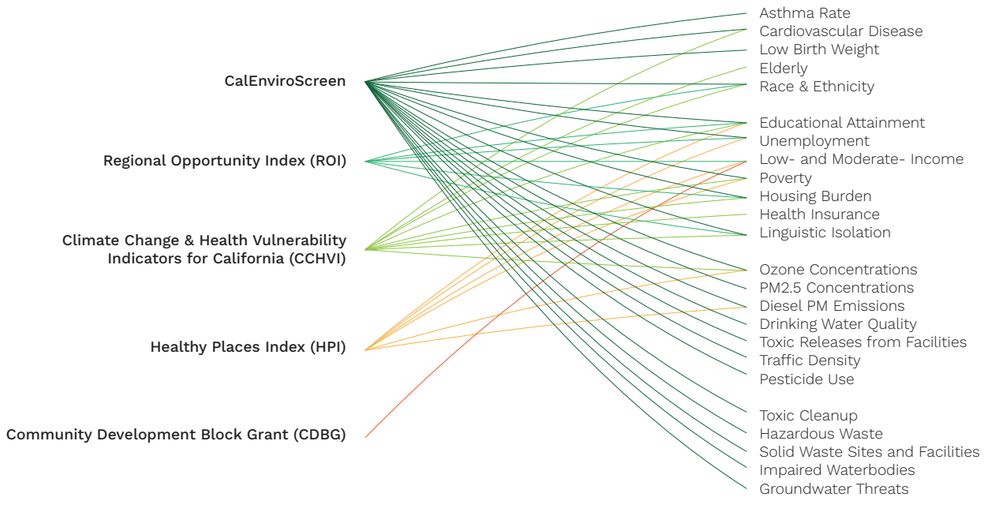
Data representation

Indicators should represent demographic factors and pollution concerns, especially those that are proxies of vulnerability to health risks and hazards caused by pollutants emitted by peaker power plants in addition to climate change.

Data source credibility and availability

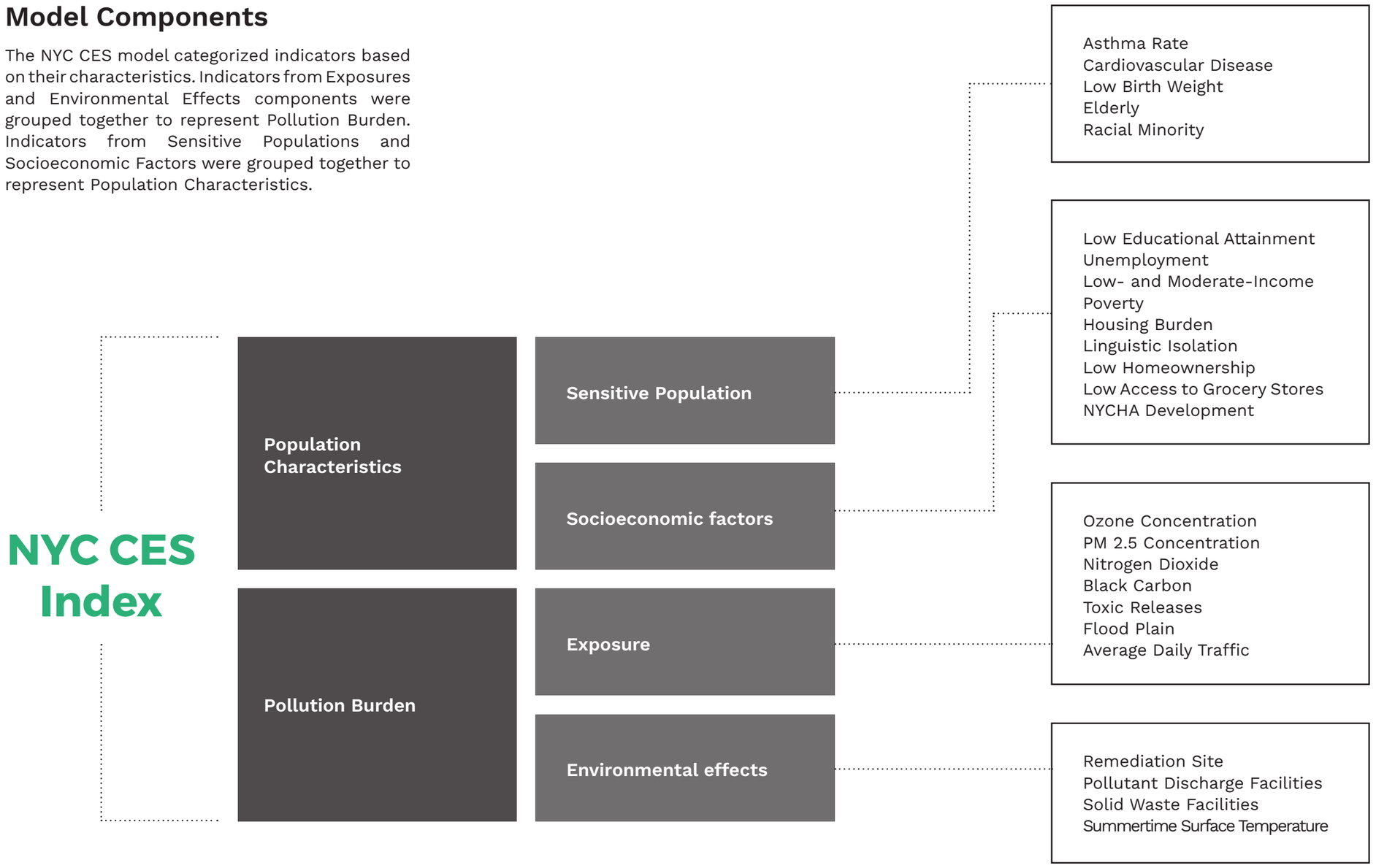
From official sources, data selected for each indicator should be ones that are widely available for the entire city of New York to be analyzed at the census tract level and.

Comparative Case Study Analysis



Model Components

The NYC CES model categorized indicators based on their characteristics. Indicators from Exposures and Environmental Effects components were grouped together to represent Pollution Burden. Indicators from Sensitive Populations and Socioeconomic Factors were grouped together to represent Population Characteristics.



'Sensitive Populations' are people with certain traits that contributed to an increased vulnerability to pollutants. These populations may include people with health problems such as asthma or belong to a sensitive age group. Usually, these people are more susceptible than others to be impacted by pollution.

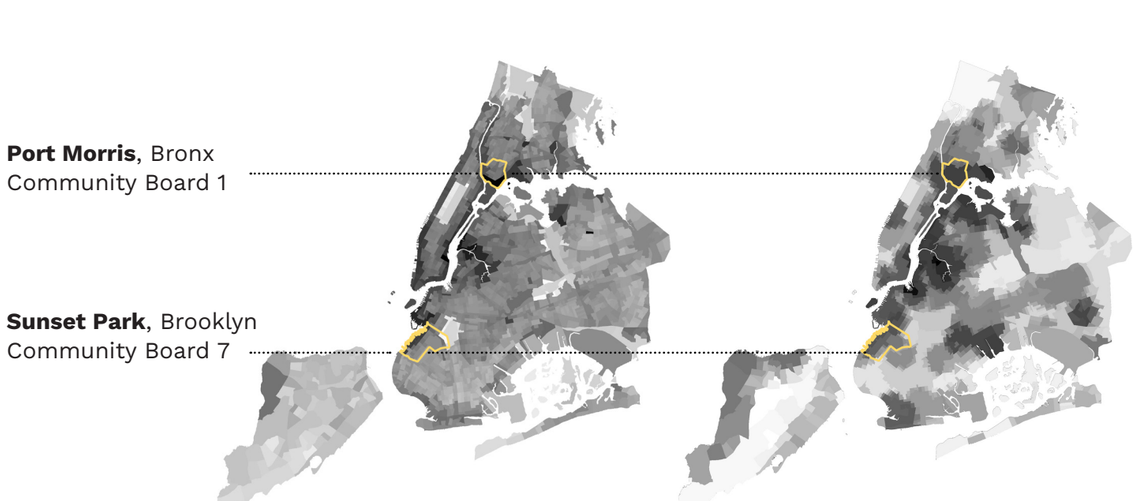
'Socioeconomic Factors' are suggested community characteristics in CLCPA or characteristics that could lead to an increased vulnerability to pollutants. CLCPA's suggested indicators are low income, unemployment, rent burden, levels of home ownership, and levels of educational attainment. Using the suggested criteria as a baseline, NYC CES Index identified nine indicators with two of them being particular to New York City.

'Exposure' indicators include pollutants that could cause adverse health effects if people have long term exposure or direct contact with it. For example, exposure to ground level ozone would cause respiratory diseases and asthma. NYC CES Index uses data relating to environmental concentration, pollution sources and flood as indicators for exposure to pollutants.

'Environmental Effects' include indicators representing adverse environmental conditions and environmental threats to the communities caused by runoff of biological and chemical pollutants from waste or discharge facilities into the environment. Living within a one mile radius of these pollution sources lead to harmful health effects, environmental degradation, and affect people's ability to make use of the ecosystem resources. Such sites or facilities may further cause the community to be unsafe or undesirable.

Results: Multi-Criteria Decision Analysis

Neighborhoods with sensitive populations are those with high asthma rates, cardiovascular disease, proportions of elderly, minorities, and low birth weight. Port Morris has a high sensitive population while Sunset Park has extremely low sensitive populations. In terms of Socioeconomic factors, both neighborhoods have variations of scores per census tract. In Port Morris, a large proportion of the neighborhood scores high which means more vulnerable and the range of scores are wider which indicates higher inequality gap. Meanwhile in Sunset Park, a smaller proportion of the neighborhood scores high and the range of scores is narrower compared to Port Morris. In both neighborhoods, there are variations of vulnerability based on ‘sensitive population’ and ‘socioeconomic factors’ criteria but we observed more vulnerability in Port Morris.



Port Morris has a high risk of exposure to pollution. This is a cumulative result of high risk of exposure to the peaker power plant, traffic, and black carbon, which is consistent with the 311 data. In terms of environmental effect, two communities have similar scores. Both of them are located within 1 mile distance to solid waste and pollution discharge facilities; However, Port Morris has a higher heat island effect than Sunset Park.

Data sources: Department of Transportation (2012, updated 2016); Mayor’s Office of Sustainability (2013, updated 2018; New York City Bureau of Vital Statistics (2013); New York City Community Air Survey (2018); New York City Housing Authority (2013, updated 2019); New York Department of Environmental Conservation (2010, updated 2020; 2014, updated 2019; 2018, udapted 2019); New York State Statewide Planning and Research Cooperative Systems (2016); Reference USA (2016); U.S. Census Bureau (2018); U.S. Geological Survey (2018).

Overall Analysis

The indicator values for the census tracts for the entire city are ordered from highest to lowest. All scores are scaled so that they have a range of 1 to 10. A value of one, typically implies that minimal or no impacts were present. The Population Characteristics score is the sum of the Sensitive Population score and Socioeconomic Factors score. Pollution Burden score is the sum of the exposure score and the environmental effects score. Then, the Pollution Burden and Population Characteristics scores are combined and weighted.

The model adopts an equal weight, meaning each component is assigned a weight of 1. This was done because our studio considered that all the components are equally important in determining disadvantaged communities in NYC.

Component and Combined Scores

Component Group	Max. Score*	Min. Score
Population Charateristics	**140**	**14**
Sensitive Population	50	5
Socioeconomic Factors	90	9
Pollution Burden	**110**	**11**
Exposure	70	7
Environmental Effects	40	4
NYC CES Index Score	**250**	**25**

*Note: A scale up to 10 was chosen for convenience. Enough decimal places were retained in the calculation to eliminate ties.

Port Morris and Sunset Park

The range of NYC CES scores for all census tracts in NYC is 50 to 185, compared to the theoretical score range from 25 to 250. Brooklyn Community District 1 receives the highest score and Staten Island Community District 3 receives the lowest score. The average NYC CES score for all census tracts in the city is 112.

The overall results for the two communities we selected, Port Morris in the Bronx and Sunset Park in Brooklyn, are shown here. Port Morris has a total score of 177 , slightly higher than Sunset Park which has a final score of 132. Port Morris is definitely more disadvantaged than Sunset Park and compared to the average NYC CES score of the whole city, Port Morris could be categorized as one of the most disadvantaged communities in the city.

Areas with Highest and Lowest Scores

There are also some interesting trends. First, there are several clusters of higher scored communities in the city. Areas surrounding the Newtown Creek, especially East Williamsburg and Bushwick, Brooklyn received the highest score (185). The other one is centered around Jamaica, Queens. East Harlem is another one that has a relatively high score in the Index. Second, there is a medium tendency that coastal communities have higher scores than inland communities. This is largely caused by a high risk of flood. Third, communities on Staten Island tend to have the least scores than communities in other boroughs.

Takeaways

Measuring vulnerability is a complex task and one that is more nuanced than quantitative methods. There are a number of ways to define the meaning of disadvantaged communities. We acknowledge that developing an index like NYC CES would be an ongoing process. Applying a vulnerability index in general requires a uniform guideline on how to read and interpret. This index requires further refinement if it is determined to be used in the State's decision-making process. In this regard, proxy variables and indicators can provide a better understanding of patterns and areas that have been bearing a disproportionate impact of climate change and energy use, that accelerates a just transition.

Beyond this context, a vulnerability index like the NYC CES would provide valuable insights in different subject matters. For example, this set of indicators can also provide insights into trends towards disadvantaged communities in various events such as the current COVID-19 pandemic. It could also be used as a tool to evaluate community needs and help community boards or community based organizations prioritize problems. In conclusion, we anticipate that this set of indicators may be utilized as an initial diagnostic tool for further research, policy recommendation, and prioritization.

Limitations

There are various types of uncertainties and limitations that could exist in the development of methods for evaluating each indicator. Three major limitations are:

01 /

Challenge of justification of selected indicators

NYC CES Index is developed based on literature reviews of existing indicators and a case study of CalEnviroScreen. Further assessment and update would be required to test the fitness and appropriateness of our model as well as in justifying the requirements for 'benefit of spending' eligibility within identified disadvantaged communities.

02 /

Challenge of scale of data

Different datasets are available at different scales. There could be loss of information due to aggregation, which can lead to ecological fallacy, in which the outcome and the variables have no correlations. Data may also provide better interpretation in a scale of higher resolution, for example, census block level.

03 /

Challenge of data representation

The model is committed to select datasets that are as current and complete as possible. Yet, environmental conditions and population characteristics change over time. It is noted that the year of the available data could be different or that the database contains a big margin of error itself.

Benefits of Spending

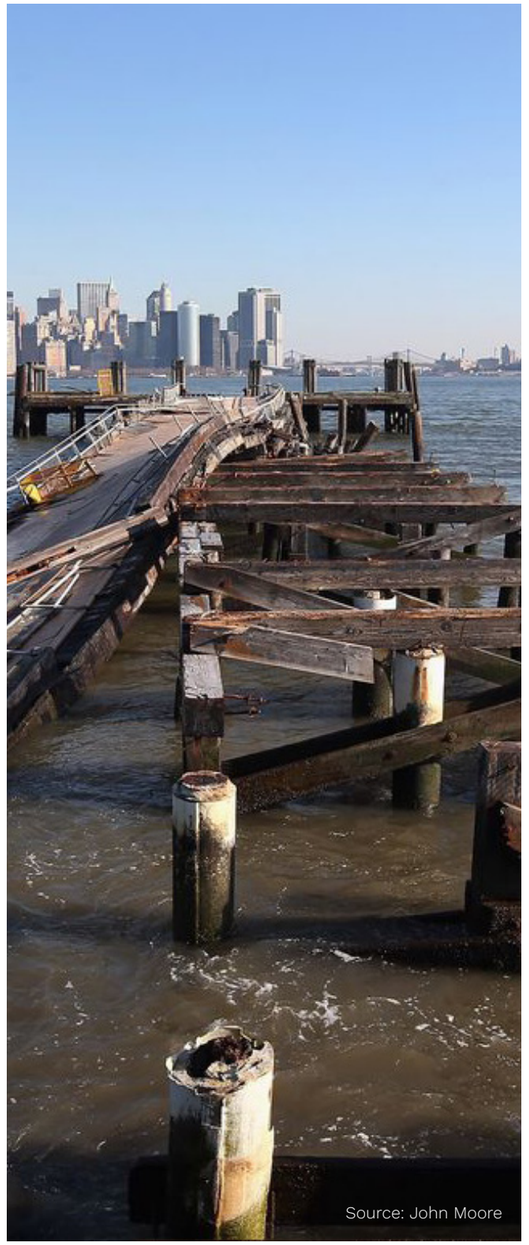
Definition in CLCPA

Even though the CLCPA sets a percentage requirement of “benefits of spending” on “disadvantaged community”, it is still unsure how the state will interpret and execute the forms of funds, method of allocation as well as enforcement measures. Without further explanation in the provisions, it presents difficulties for disadvantaged communities throughout the City to quantify “benefits of spending” and make decisions accordingly.

35%
Benefits of Spending to Disadvantaged Communities

State agencies, authorities and entities, in consultation with the environmental justice working group and the climate action council shall, to the extent practicable, invest or direct available and relevant programmatic resources in a manner designed to achieve a goal for **disadvantaged communities** to receive forty percent of overall benefits of spending on clean energy and energy efficiency programs, projects or investments in the areas of housing, workforce development, pollution reduction, low income energy assistance, energy, transportation and economic development, provided however, that disadvantaged communities shall receive no less than **thirty-five percent of overall benefits of spending** on clean energy and energy efficiency programs, projects or investments and provided further that this section shall not alter funds already contracted or committed as of the effective date of

New York State Climate Leadership and Community Protection Act



Source: John Moore

Case Study: California Climate Investments

Studying how California implemented funding programs and enforcement mechanisms to benefit vulnerable communities from the energy transition is helpful.

State Bill 535 (SB 535) and Assembly Bill 1550 (AB 1550)

Passed in 2012, SB 535 set minimum investments for projects that benefit and are located within disadvantaged communities (Callahan, 2014). In 2016, AB 1550 increased this investment minimums introduced by SB 535 and established new investment minimums for low-income communities and low-income households (Callahan, 2014). Under AB 1550 investments are made according to the following criteria:

≤ 25% projects located within the boundaries of, and benefiting individuals living in, disadvantaged communities

5% projects that benefit low-income households or to projects located within the boundaries of, and benefiting individuals living in, low-income communities located anywhere in the State.

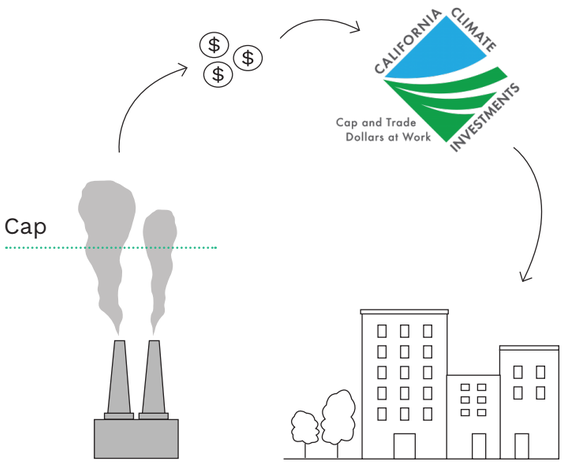
5% to projects located within the boundaries of, and benefiting individuals living in, disadvantaged communities

California Climate Investment (CCI) And Greenhouse Gas Reduction Fund (GGRF)

California Climate Investment (CCI) is a statewide initiative that uses money gathered from the California Cap-and-Trade program and deposits in the Greenhouse Gas Reduction Funds (GGRF) waiting to be appropriated to greenhouse gas reduction programs, particularly in disadvantaged communities, low-income communities and low-income households as required by SB 535 and AB 1550 (California Climate Investment, 2020). These programs focus on reducing pollution burdens, improving public health and increasing the overall quality of life while promoting economic opportunities in these communities (California Climate Investment, 2020). Each project can only be counted toward benefiting a single priority population category; however, these projects may actually provide benefits to more than one priority population category (e.g., to both residents of disadvantaged communities and low-income households) (California Climate Investment, 2020).

Funds in the Greenhouse Gas Reduction Fund (GGRF) are appropriated by the legislatures and the Governor to State agencies through the state budget process (California Air Resource Board, 2020). The California Air Resources Board (CARB), in consultation with other administering agencies, develops individual program targets for each fiscal year of funding (California Air Resource Board, 2020). These targets help drive investments that achieve meaningful and direct benefits to priority populations, as well as help California Climate Investments satisfy the investment levels prescribed in AB 1550. Administering agencies are also responsible for reporting and tracking information on each funded project. A detailed funding process is illustrated below.

Communities where funds and programs are being implemented could gain a variety of benefits including increased affordable housing opportunities, improved mobility through transit, walking, and biking, cleaner air, job creation, energy and water savings, and greener, more sustainable environment (California Climate Investment, 2020).



Source: California Climate Investment (2018)

Funding Guidelines

To guide the investment, the Department of Finance, with CARB, is required to submit an Investment Plan to the Legislature every three years (California Climate Investment, 2018). The Investment Plan identifies priority investments that are in need. CARB has worked with administering agencies to come up with a guideline for programs funded by the GGRF, making sure projects provide benefits to disadvantaged communities through a public process (California Climate Investment, 2018). Importantly, administering agencies must demonstrate that a project provides direct, meaningful, and assured benefits, and meets an important community need (California Climate Investment, 2018). The guiding principles are made based on the State's climate change policies. There are several principles that are critical; However, not all principles are mandatory requirements (California Climate Investment, 2018). It leaves rooms for administering agencies to use strategies they deemed to be appropriate and incorporate into funding programs. A summary of guiding principles for California Climate Investments programs is shown below, with information on whether required or recommended (California Climate Investment, 2018):

Guiding Principle	Required	Recommended
Facilitate GHG emission reductions and further the purposes of California Global Warming Solution Act and related statues	●	
Target investments in and benefiting priority populations, with a focus on maximizing disadvantaged community benefits	●	
Maximize economic, environmental, and public health co-benefits to the State	●	
Foster job creation and job training, wherever possible	●	
Encourage projects that contribute to other State climate goals		●
Coordinate investments and leverage funds where possible to provide multiple benefits and to maximize benefits		●
Avoid potential substantial burdens to disadvantaged communities and low-income communities	●	
Ensure transparency and accountability and provide public access to program information	●	
Conduct outreach to help potential applicants access funding, particularly for priority populations		●

Source: California Climate Investment (2018)

Policy Suggestions

Although the content of the laws underlying the benefits of spending in California and NYC are different, the structure of the law is very similar, so it seems to be possible to make policy proposals applicable to NYC through analysis of the cases in California already in place. Thus, to ensure the "benefit of spending" mandated in the CLCPA would be carried out in an effective manner, our studio provides two check and balance policy suggestions, short term and long term, that will add accountability and transparencies to the entire process.

Designate A Fund Allocation Governmental Body

To ensure disadvantaged communities successfully receive the funds, it is important to define the roles and responsibilities of each agency. This is especially crucial for the funding process. CLCPA does not specify any governmental bodies will be in charge of deposit and allocate funding money. However, a centralized body will minimize unnecessary funding application and allocation procedures, and will be easier for keeping track of funds.

We evaluate the designation of this sole governmental body could and should be achieved in a short term. The sooner the designation, the more efficient the funding process will be implemented. This government body could be a separate agency established under the framework of CLCPA or designating the roles to an existing agency. This governmental body is likely to exert a variety of roles and responsibilities include but not limited to:

- Identifying possible funding sources.
- Collecting and depositing funds that will be spent on projects benefiting or within disadvantaged communities from various sources.
- Creating funding guidelines for projects eligibility.
- Collecting applications for funding from agencies or communities directly.
- Reviewing project proposals and make funding decisions.
- Releasing funds to eligible projects.

Considering the importance of prioritizing community needs expressed by the CLCPA, we would also anticipate this governmental body to lead on incentivizing and awarding community-led transforming programs. If so, part of the roles and responsibilities of this governmental body would also include reviewing, evaluating and releasing funds to the winning community-led programs.

Source: El Museo del Barrio

Establish Enforcement Measures

To make sure the "benefit of spending" is spent on projects that benefit disadvantaged communities, an enforcement mechanism is required to safeguard this process in the long term. Thus, we suggest implementing a series of reporting and enforcement measures so that the funding process is likely to be trackable and reversible. In addition, the enforcement should be monitored by the above governmental body so that there is continuous consistency in the funding process.

Source: El Museo del Barrio

To increase accountability, policies and procedures need to be established for monitoring funding projects as well as for audit in the future. Each administering agency should have clear policies that allow for audits conducted by the oversight agency. Each administering agency should also have internal policies to monitor their own programs and operational process. Everything should be included in the agency's annual report.

To protect transparency, agencies should be required to provide public access on information regarding:

1. Funding opportunities and sources
2. Public outreach and other community engaging programs
3. Funding applications and detailed proposal on each programs
4. Project status in terms of applying for fund and implementation
5. Project results and evaluation including pollution reduction and co-benefits on disadvantaged communities
6. Project next phase if applicable

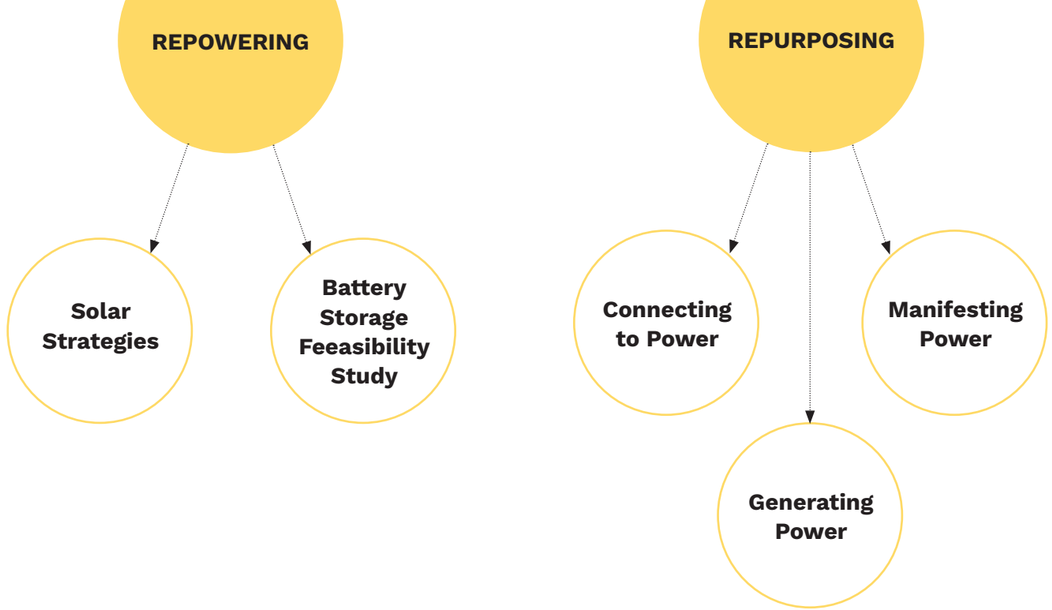
An effective way to publicize the funding process is to create a map visualizing all the funded programs. The map should include the basic information of the program, affiliated agencies, program website link, and its status, and should be distinguished by color with the affected area highlighted. This map would enable the public in the enforcement process and could be combined with the disadvantaged community index to ensure funds are maximuming effect within disadvantaged communities.

Site Planning Proposal

Repowering and Repurposing

The eventual closure of peaker power plants in NYC presents an opportunity to transform current power plant sites to be more approachable and beneficial to surrounding communities. However, it is not possible to cease operations of peaker power plants without replacing its current electricity generation. In other words, electricity generated by peaker plants today must come from alternative sources in the future.

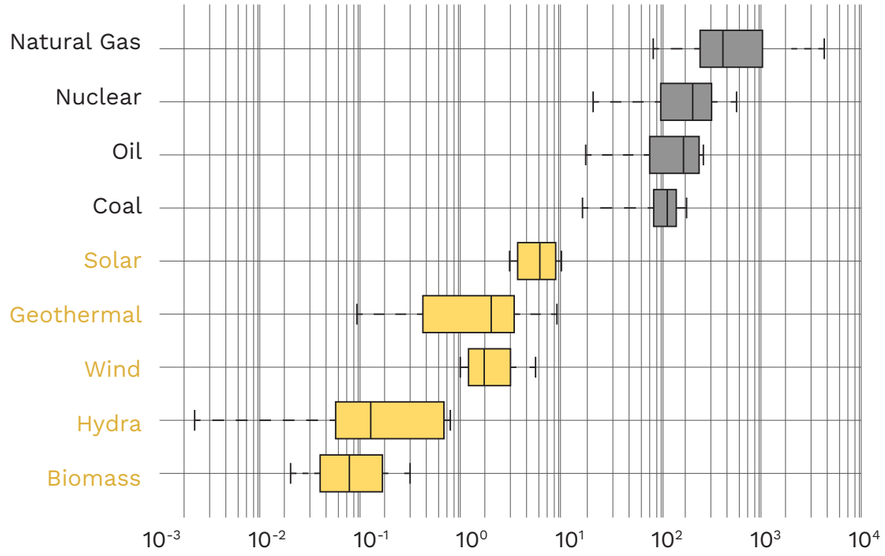
Thus, for the site planning proposal, this studio has examined two approaches. First, the repowering approach evaluates the feasibility of renewable energy in replacing peaker power plants. Second, the repurposing approach reimagines current peaker power plants to house innovative, clean energy-infrastructure that can be representative of a just transition.



Repowering: Solar

Among the many renewable energy options for replacing peaker plants, solar panels and battery storage are the most feasible in terms of cost, flexibility, and energy density. Other renewable energy options are impractical for various reasons, such as unsuitability in a city context or high costs.

Power Density



Data Source: Zalk and Behrens (2018)

The concept of power density is important in evaluating the feasibility of replacing peaker plants. Power density is measured as output capacity per unit area and, generally, solar panels have a substantially lower power density than that of natural gas turbines, like those located at the peaker plant sites.

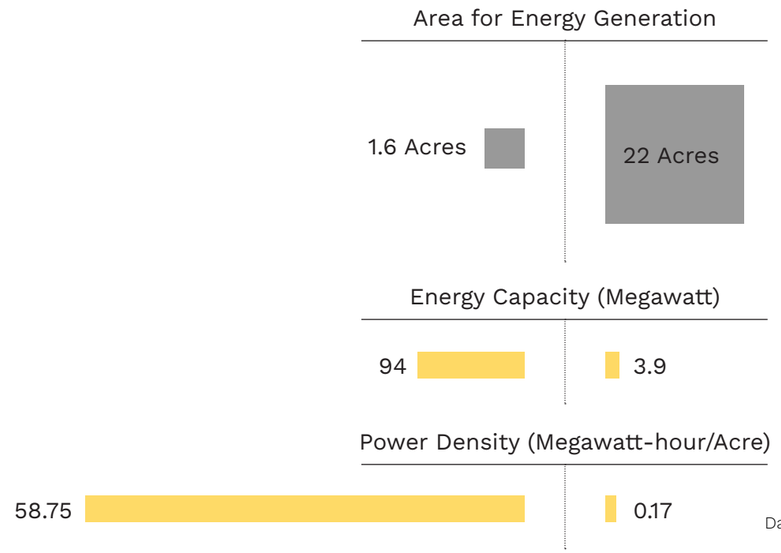
Power Density Example

For example, Stuyvesant Town, a housing project in Manhattan, installed solar panels on 22 acres of rooftops, but the total solar installation generates, on average, 3.9 MW of energy hourly (Cohen, 2017). That is roughly 4% of the 1.6 acre Sunset Park peaker power plant's generating capacity, which is 47 MW (NYISO, 2019).

Thus, solar panels would not generate enough electricity if placed just at the selected sites. Placing solar panels on rooftops in the areas surrounding the peaker power plants (defined here as the zip code in which the peaker power plants are located) would also not replace the generating capacity of the peaker power plants.

Peaker Power Plant
Sunset Park

Rooftop Solar Panels
Stuyvesant Town



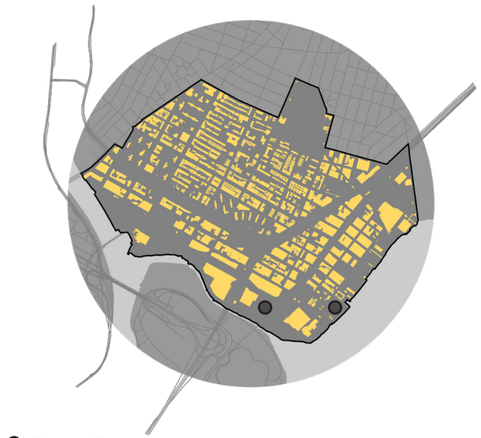
Data Source: Gold Book (2019), stuytown (2018)

Capacity and Annual Generation

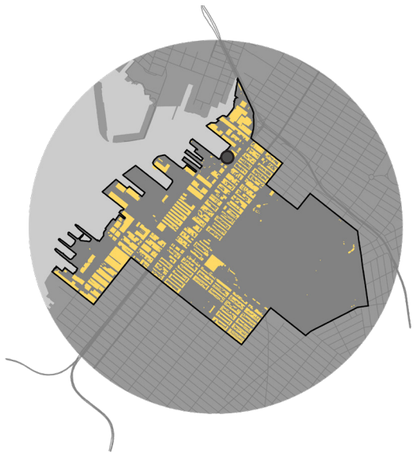
The generating capacity of the peaker power plants is different from the annual amount of power generated by the peaker power plants. Because the peaker power plants only generate electricity during peak demand from the grid, the annual amount of electricity generated is much lower than if the peaker power plants were running more frequently.

If solar panels were placed on most rooftops in the zip code area surrounding the peaker plants, the solar panel installations would be able to generate enough electricity to match the average annual amount of electricity produced by the peaker plants in the past 5 years (see appendix). This indicates that widespread installation of solar panels will be an important part of replacing the peaker plants.

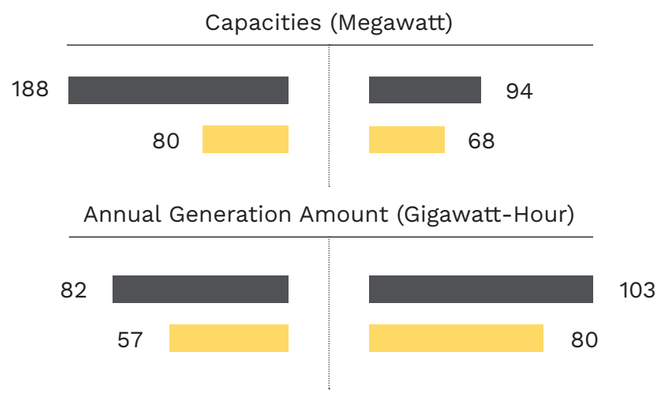
Port Morris
Rooftops in Zip Code 10454



Sunset Park
Rooftops in Zip Code 11220



Peaker Plant



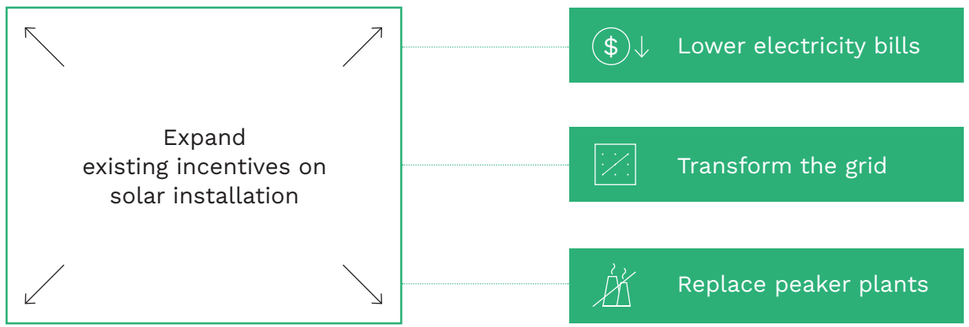
Peaker Plants Solar Panels

Data Source: Gold Book (2015-2019), Google Project Sunroof (2018)

Solar Strategies

Solar panel installations could also reduce electricity bills for the residents of "disadvantaged" communities. Rooftop installation of solar panels reduces a building's reliance on the grid and potentially reduces the building's electricity bill. However, landlords and building owners are reluctant to install solar panels due to up-front costs, and, even when building owners do choose to install solar panels, there is no guarantee the reduction in the electricity bill will be passed along to renters.

Thus, "benefits of spending" could be used to subsidize rooftop solar panel installation in "disadvantaged" communities in New York City. The subsidy could be conditioned upon passing a portion of the energy bill reduction along to renters and residents. Additionally, Juan Parra, a community solar representative in Sunset Park, believes that "benefits of spending" could be used to fund technical help and feasibility studies for landlords that want to install solar. "Benefits of spending" could also be used to subsidize the "hook-up" cost for new solar installations. There are existing programs at NYSERDA which would only need to be modified slightly to accomplish this.

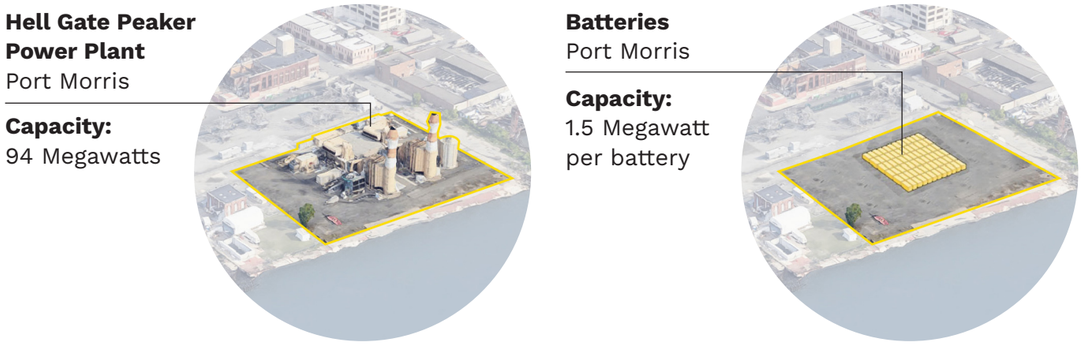


Repowering: Battery Storage

Feasibility Study

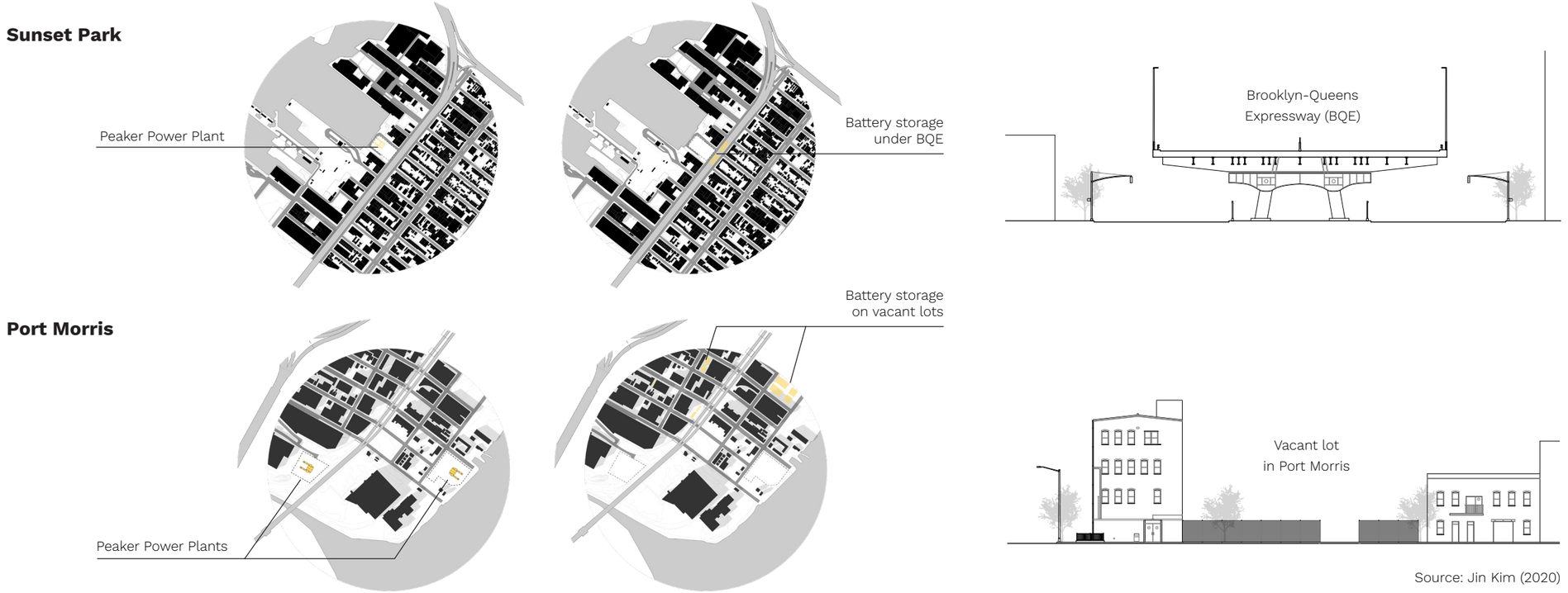
The eventual closure of peaker power plants in NYC presents an opportunity to transform current power plant sites to be more approachable and beneficial to surrounding communities. However, it is not possible to cease operations of peaker power plants without replacing its current electricity generation. In other words, electricity generated by peaker plants today must come from alternative sources in the future.

The generation capacity, spatial dimensions, and storage capacity of Tesla's Megapacks were analyzed, compared those to the area of the site, and then compared the generation potential of batteries on the site to that of peaker plants. 96 batteries will be needed on site to match the capacity (Tesla, 2019; Yamamura, 2019).



Alternative Battery Storage

Although batteries could sit on site to replace the peaker plants, they might be sited more effectively elsewhere, as the sites are liable to flooding and could be used more productively. Distributing the location of batteries also minimizes fire hazards. Placing them underneath highways in Sunset Park or in other vacant lots in Port Morris could be more effective than placing them at the current peaker plant sites. This means that the peaker plant sites could, and potentially should, be used for other uses that comply with the goal of energy transition.



Source: Jin Kim (2020)

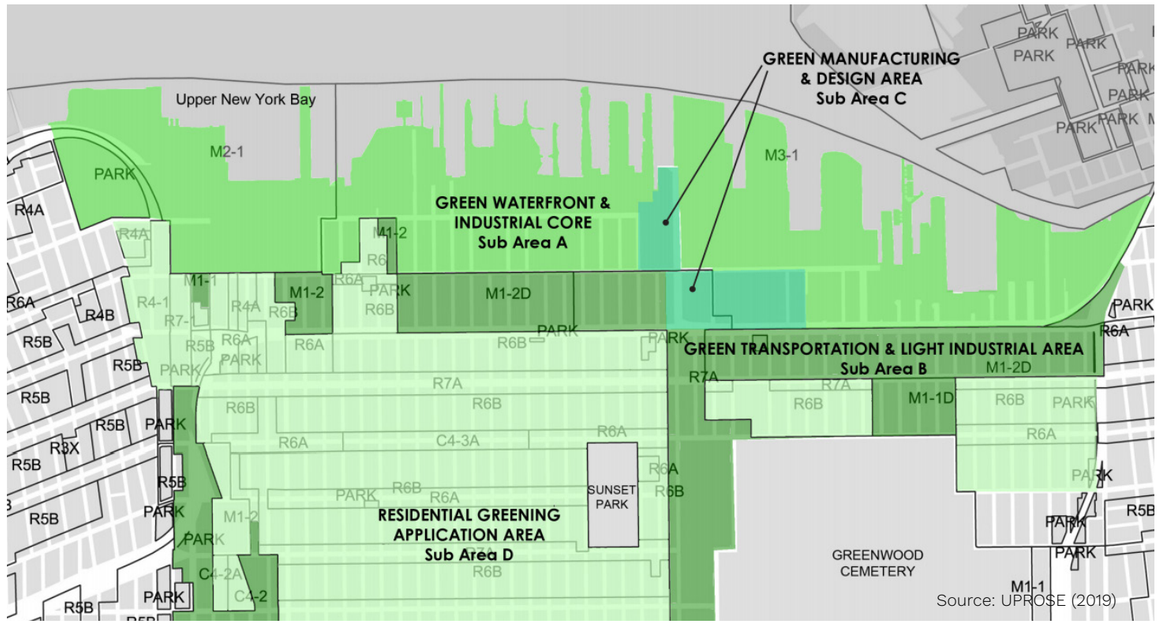
Repurposing

The peaker power plant sites in Sunset Park and the South Bronx will eventually transition to new uses, with or without intervention from our studio. The economic and regulatory forces in favor of battery storage as a replacement for fossil-fuel-burning peaker power plants should eventually release their grip on the city. But it's not enough to simply get rid of peaker power plants. Whatever replaces them should accelerate a just energy transition that maintains a working waterfront to ensure economic opportunities to local residents.

As NYC's waterfront has transformed, over the last few decades, from abandoned industrial sites and police impound lots (Silber, 1996) to luxury high-rises and busy parks, the city's industrial, working waterfront is increasingly at risk of disappearing as more profitable uses for the land emerge (Pratt Center for Community Development, 2012).

But in order to transition to renewable energy, the City's energy infrastructure requires access to the water, for small-scale local energy generation, to provide for onshore services for offshore wind power plants (Stamatis, 2019), for maritime freight transport that will take thousands of trucks off city roads (EDC, 2018) and for expansion of public transit (Chung, 2019). Peaker power plant sites must serve as working energy infrastructure for the city, but in a new way, serving to model the demands of a just energy transition.

Gowanus Peaker Power Plant in Sunset Park

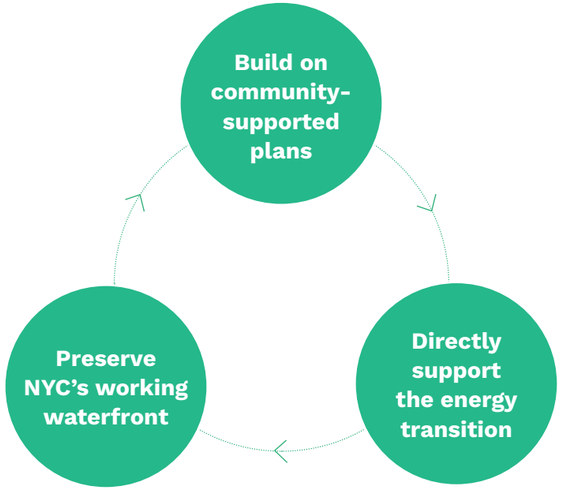


Green Resilient Industrial District (GRID)
Draft Proposal by UPROSE

New uses on these sites must also serve the cause of environmental justice. Although we couldn't talk directly to community members, this studio has studied plans that they've created and endorsed to learn how they'd advocate for the transition of these sites. Those community-driven plans are focused on health, open space and clean air, but also on jobs, and on concentrating economic activity in their neighborhoods by encouraging an active, working waterfront. UPROSE's GRID Plan proposes to leverage planned public investments in Sunset Park's waterfront to improve environmental conditions while at the same time creating thousands of green jobs in a new "Green, Resilient Industrial District" (UPROSE, 2019).

As we recommend ways that "benefits of spending" should be applied on our sites and in our neighborhoods, we've simply expanded on ideas and platforms that community-based organizations have been advocating for, for years.

Principles for Repurposing



Recommendations

Our recommendations for these sites reconsider ways that these communities -- and the city as a whole -- will interact with power. We envision, through this transition, a new relationship. Fossil fuel generation typically hides behind high walls and rusted fences. It's polluting and dangerous, domineering and hostile. Neighbors are supplicants, not participants in its creation. Renewable sources of energy are the opposite. Everyone will need to be involved in its generation, and in its preservation. We need to think in new ways about how we connect with power, how we generate power and how we manifest power, so that we can collectively understand what it takes to generate, store and renew, particularly for communities that have suffered most from the old relationships we had to fossil fuels. We will demonstrate how those new relationships might emerge as we explore the roles each of the selected peaker power plant sites could play.

Source: Thiago Lee (2020)

Sunset Park (Gowanus): Connecting to Power

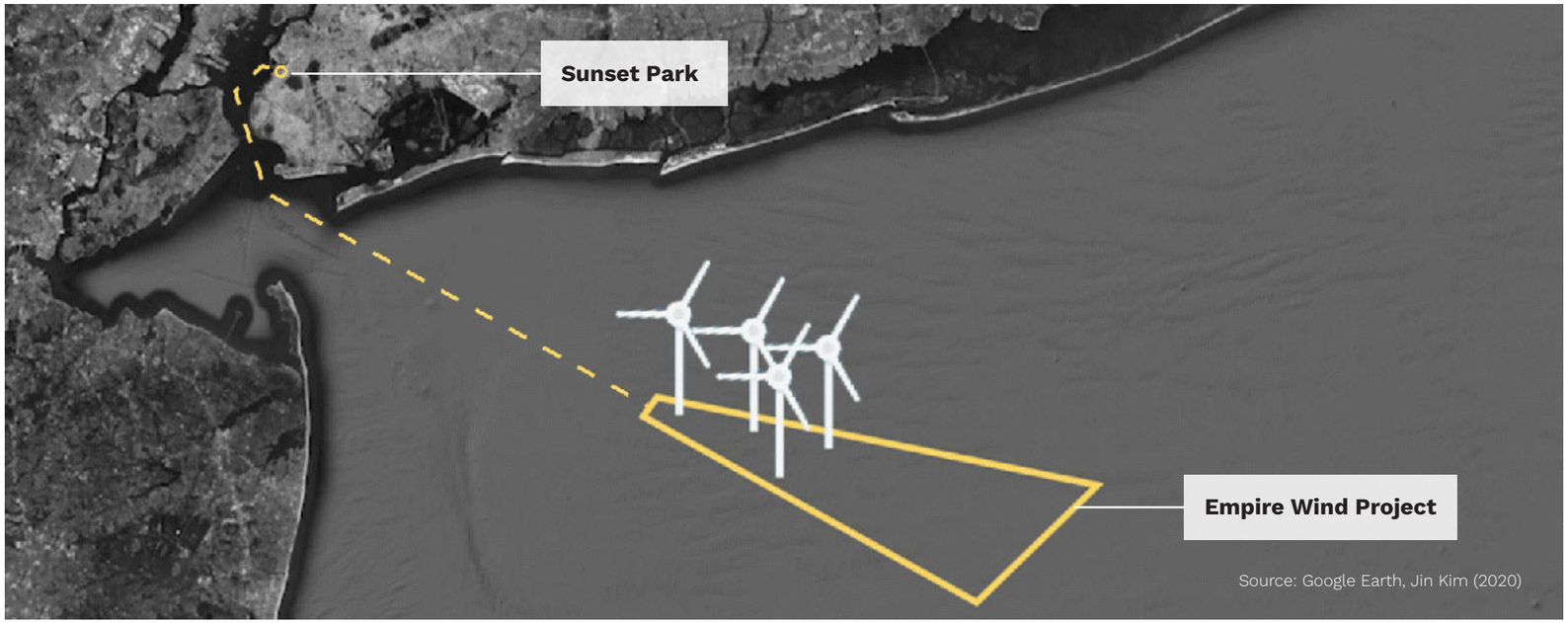
Port Morris (Harlem River): Generating Power

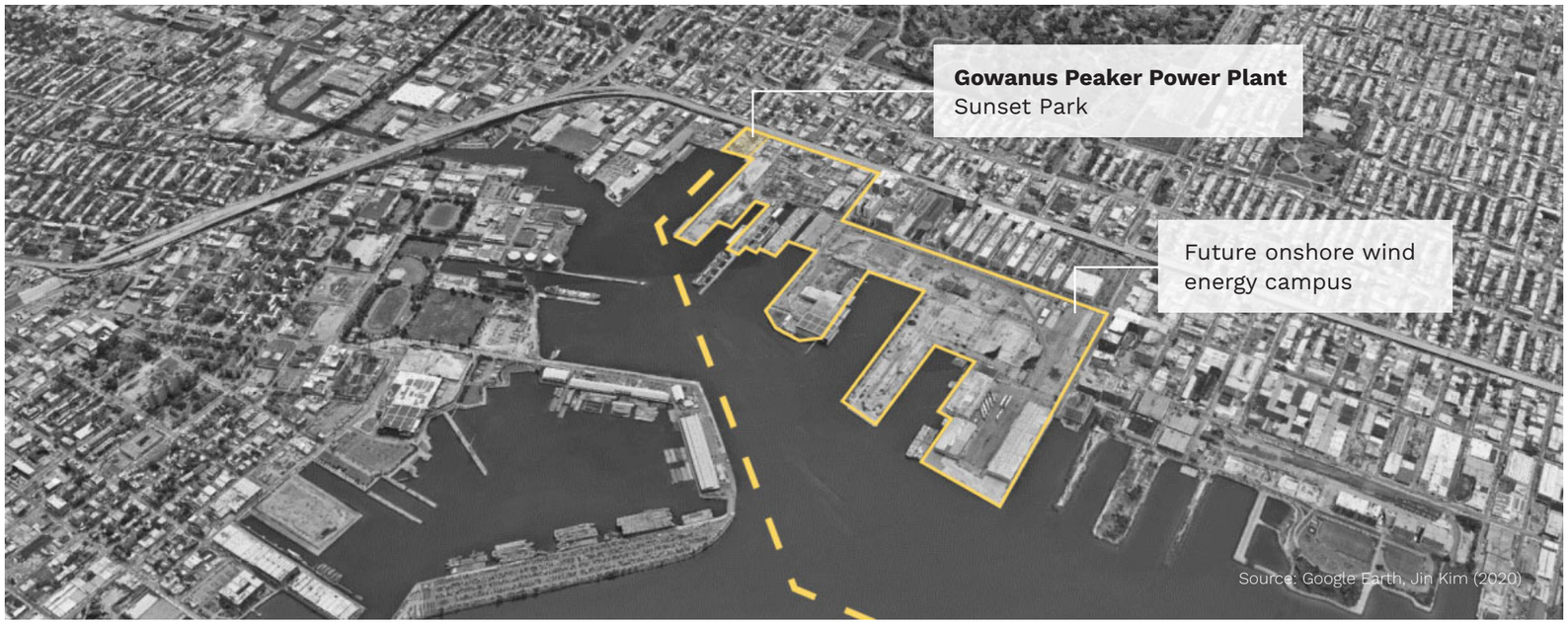
Port Morris (Hell Gate): Manifesting Power

Sunset Park (Gowanus): Connecting to Power

Sunset Park will serve a critical role in New York City's energy transition. 14 miles off the Rockaways sits the site of Empire Wind, a 816 MW utility-scale offshore wind farm that, when it's complete, will have the capacity to power more than a million homes (Equinor, 2020). This site is one of several new major investments in offshore wind in New York State (Srivastava, 2019). NYSERDA anticipates future growth of offshore wind 2.4 GW by 2030 (NYSERDA, 2018). All that new wind energy offshore will need onshore support: maintenance, operations, even potentially manufacturing of new parts and supplies. The Sunset Park peaker plant site sits right next to the planned center of that operation. The South Brooklyn Marine Terminal, which should provide hundreds of new jobs, and is, in the words of a promotional presentation about it, "the premier dedicated port facility and hub for the burgeoning new york offshore wind industry" (Stamatis, 2019). It's exactly the kind of new facility Environmental Justice group Uprose must have envisioned when they authored their "Green Renewable Industrial District" Plan for the neighborhood (Uprose, 2019).

The transmission lines from this new source of energy will terminate at ConEd's Gowanus Substation (Anbaric, 2020). which is already connected to our Sunset Park Peaker Plant site. As we consider re-use potential for this site, we believe it could serve as the converter station that connects the new offshore transmission line to the grid. This station would fit on our fairly small, 1.6 acre site, and would lend itself to an attractive, non-polluting, relatively quiet, neighborhood asset (Simko, 2019).





Sunset Park (Gowanus): Proposal

Our proposed facility would have three functions. It would house the cable infrastructure, connecting directly to the ConEd Substation on the neighboring lot, bringing New York City one step closer to our energy goals. But beyond that necessary role, we believe the site should do more.

First, access. Walking along 3rd Avenue now, underneath the Brooklyn Queens Expressway (BQE) and hemmed in by high walls and fences. It's a long walk to a view of the water. A viewing platform can be built, turning the site into a ramp with the converter station below a public ramp leading to a viewpoint out over the harbor. From the top, neighbors could take in views of downtown Manhattan, Governor's Island, and the increasingly active boat traffic on the water. They would also take in views of the energy campus next door.

We believe that renewable energy infrastructure should welcome, should demonstrate its value, and connect neighbors and visitors to the crucial task that each part of this new system performs. We want neighbors and visitors to understand, as they stand on top of the viewing platform on this site, the importance of their own connection to power. Energy infrastructure of the past was polluting, messy, disruptive and necessarily shrouded in rust and mystery. New energy future must engage with residents, and that tells a story on the process of a just energy transition.

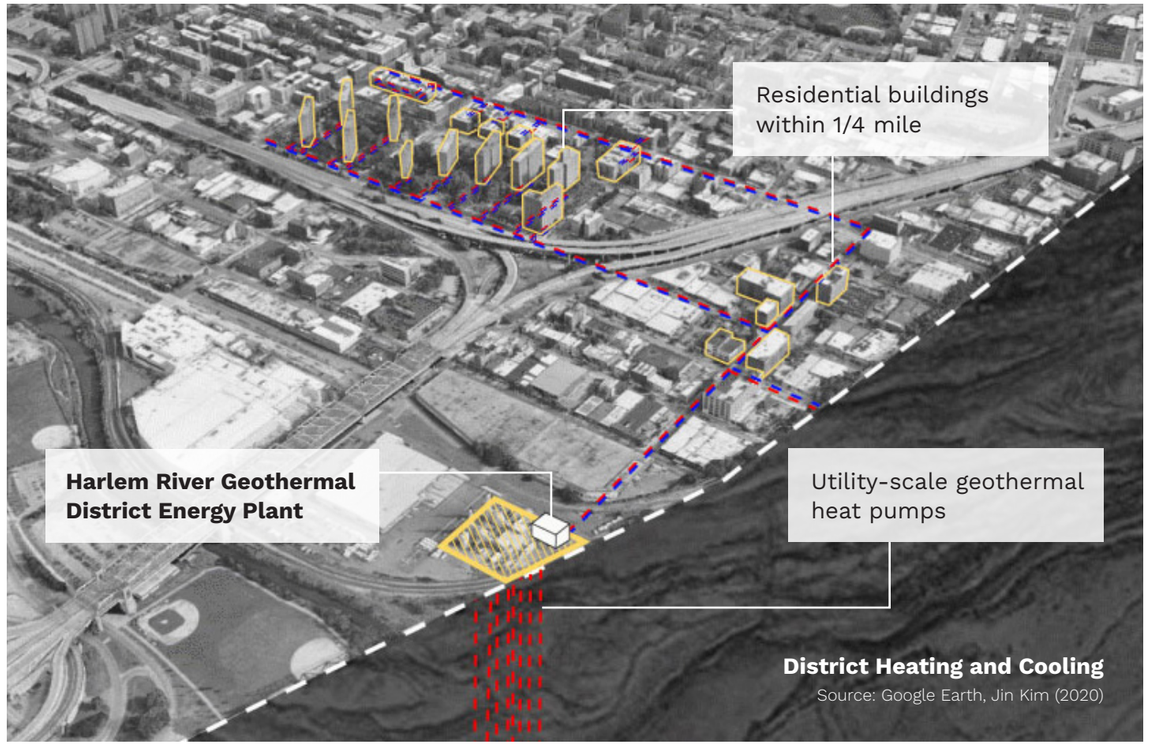
Source: Jin Kim (2020)

Port Morris (Harlem River): Generating Power

As this studio has worked to find new sources of energy, like offshore wind, we also need to figure out how to use energy more efficiently. Heating and cooling our buildings accounts for 68% of NYC's GHG emissions (NYSERDA, 2017; NYC Mayor's Office of Sustainability, 2014). Drastically reducing carbon pollution from current heating and cooling systems, which relies on fuel and natural gas, can make significant progress towards a just energy transition.

The Harlem River Peaker Plant site could help make that progress, by utilizing a well-established but little-used-in-the-US approach to heating and cooling: Geothermal District Heating and Cooling. European cities have been heating and cooling their buildings using Geothermal District Energy for decades (Rishi, 2015). We envision the Harlem River Peaker Plant site serving as a pilot project, the beginning of a conversion of buildings across the city to a new way of operating.

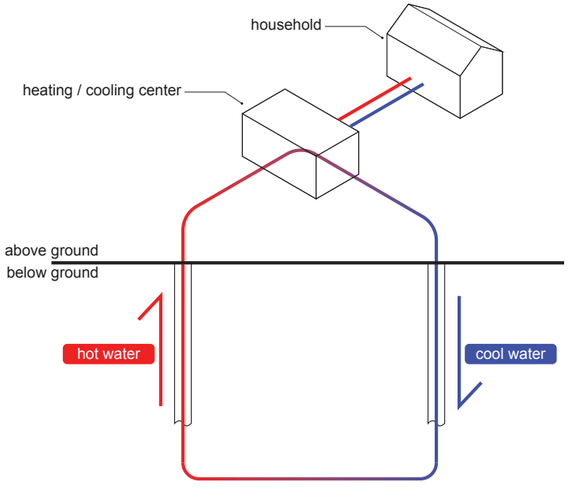
This proposal includes two separate concepts: District heating & cooling, and Geothermal Energy. Both ideas are important on their own, but could become crucial to NYC's goals when considered together.



District Heating and Cooling
Source: Google Earth, Jin Kim (2020)

District Heating and Cooling

A district heating and cooling project considers the heating, cooling and hot water needs of an entire campus, neighborhood or town, and provides those as shared services, benefiting from economies of scale and collective action. A district system at Hudson Yards provides heating and cooling to 14 million sq feet of mixed-use space (Sheehan, 2017) which means that the buildings there do not need their own separate boilers and chiller plants. ConEd's steam system in lower Manhattan, which serves 1800 buildings, is one of the original district heat projects (Con Ed, 2019). While this approach is easier when led by a single developer or on a single institutional campus (King, 2012), there's no reason that New Yorkers couldn't begin to consider heating, cooling and hot water as collective services, accessible to all.



Geothermal Energy System

Geothermal Energy

District heating and cooling becomes more powerful when paired with a renewable energy source like Geothermal energy. Geothermal energy takes advantage of the temperature difference between the air and the ground (or deep water) to generate heat, which then heats water, which flows through a network of pipes and into heat exchangers within buildings. Those heat exchangers then distribute heat throughout the building. In the summer, the system can be run in reverse, to cool buildings rather than heat them (Harvey, 2006). Cornell's tech campus on Roosevelt island has a geothermal system buried under their west lawn, providing resilient, nearly zero-carbon heating and cooling (CommArch, 2018).

In 2018, The Mayor's Office of Sustainability and The Department of Design and Construction created a mapping tool that compiled data on every building and lot in the city, to assess its potential for geothermal energy generation (NYC Mayor's Office of Sustainability, 2018). They found that this Harlem River Peaker Plant site has the potential to generate enough geothermal heating and cooling to serve over a thousand apartments nearby. Building on that potential, this studio envisions building a pilot project: a district heating and cooling plant on Harlem River site that serves apartments in the surrounding community, providing a heating, cooling and hot water service that building owners will be subsidized to connect to. The "benefits of spending" on increased building efficiency would go directly to the local residents, who have borne the burden of "progress" for decades.

Port Morris (Harlem River): Proposal

The Harlem River site would house the geothermal district energy system to serve as a demonstration project. A small building on the site can house the pumping system and areas for operations and maintenance. Most of the system itself will be underground, either in loops, or in deep, vertical wells, depending on the technology approach selected, passively drawing heat from the earth. The selected Building owners would get a subsidy to support any conversions necessary for them to connect to this new service. Most importantly, neighbors who have been, until now, living with significant rent and energy burden, would receive, at a cost well below their current expenditure, reliable heating, hot water, and importantly, cooling. The city's grid would significantly benefit too, perhaps even obviating the need for peaker plants, since the temperature-driven spikes in cooling demand in the summer would simply disappear from the grid.

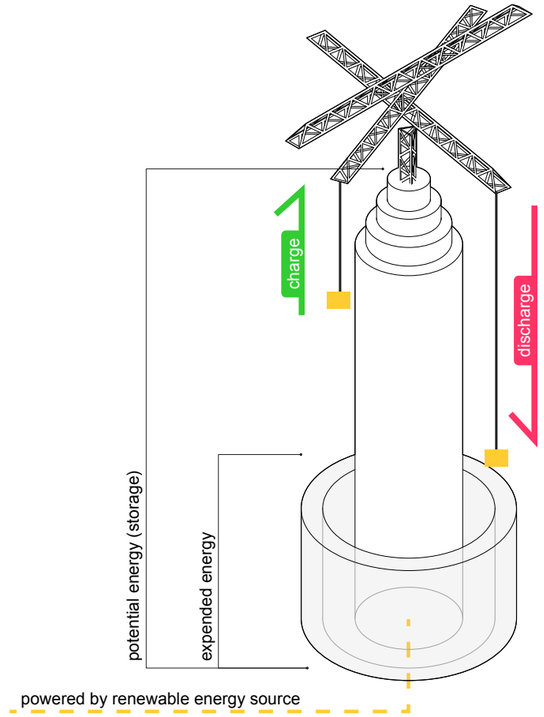
The site, with its buried piping, could be mostly covered in plantings, with an interpretive guide located on the Randall's Island Connector pathway (NYRP, 2020). This pathway is part of a larger network of green spaces and investments in the quality of life in the South Bronx.

Source: Jin Kim (2020)

Port Morris (Hell Gate): Manifesting Power

Investigations and projects serving the quality of life in the South Bronx have centered on the area around our last site, the Hell Gate peaker plant site. It looks out over the East River towards Rikers Island and the massive Astoria Generating Station in Queens. However, those expansive views from the waterfront have been inaccessible to local residents. As part of New York Restoration Program's Haven Project, designers imagined a new park next door to the Hell Gate plant, one built around the water, and highlighting historic gantries, remnants of a once-active port (NYRP, 2015). The Haven Project envisions a radical increase in the quality of life of the residents of Port Morris and the South Bronx - street trees, open spaces and safer pedestrian access to important points in the neighborhood. As this studio considered a reincarnation for the Hell Gate Peaker Plant site, we want to ensure that our proposed use fits within the larger Haven Project plan, while ensuring that the site retains its role in New York City's energy transition.

The Haven Project seeks to turn the barriers created by Port Morris' rusting industrial heritage into an asset, building cultural and recreational spaces around them. But the neighborhood could look in both directions, back to the past, and into the future. On the Hell Gate site, we envision a spectacle of power, a functional battery storage design that serves to absorb and deliver energy to the grid as needed, presented in a way that demonstrates the state of the grid at any given moment, and the process of storing and releasing energy.



Gravity Storage Tower

The Energy Vault gravity storage tower is, on its face, low-tech. It uses gravity and recycled concrete blocks to store and release energy, lifting blocks up the tower at times of low energy demand, or when the grid needs to release excess energy (Hodari and Ballard, 2020). When energy demand peaks, the pulley systems above lower the blocks, converting the kinetic energy generated from the falling block into electricity (Energy Vault, 2020). The software control system arranges the blocks into precise positions to create a structurally sound tower.

The pulley systems are designed to prevent pendulums and sudden drops, meaning that the blocks won't suddenly swing out, and that they are lowered quietly (Gross, 2020). Gravity storage solutions have advantages over more traditional lithium ion batteries we discussed earlier. Lithium ion batteries wear out within 10 to 15 years, they depend on non-renewable resources like lithium and cobalt, and there is currently no way to recycle them. A system like the Energy Vault could last 30 years, and can be built and deployed much less expensively per kilowatt/hr (Gross, 2020).

Port Morris (Hell Gate): Proposal

The Hell Gate peaker power plant site in Port Morris can be reimagined to house the new Energy Vault gravity tower and expand on the Haven Project plan. As the blocks rise and fall, the tower advertises the state of the grid. It illustrates the demands on it and how long those demands have been made. As the tower grows it communicates the potential being stored. Originally designed to serve in remote windfarms and utility-scale solar facilities, we believe that a smaller scale version of this tower could serve an important role in manifesting our move to renewable energy, serving as a monument to the transition.

Protected, but at the center of a new park complex that includes walkways and bikeways that connect residents to the waterfront, the tower can serve as a functional attraction. The investments made in removing the peaker power plant and replacing it should include funding for the surrounding park and greenways as well, incorporating the gravity tower into a larger park plan, one that celebrates what the Bronx once was, and what it could be.

Source: Jin Kim (2020)

Epilogue

Closing Remarks

Achieving environmental justice as New York City (NYC) transitions to renewable energy is easier said than done.

Through our preliminary research, we found that there are a number of existing problems, especially air pollution, that have been affecting the community without much needed attention. These historically-disenfranchised communities, where most power plants are located, must benefit from the energy transition. We showed how to identify these communities through the NYC Communities and Environmental Screening (NYC CES) Index and how to ensure investments by recommending “benefits of spending” strategies.

Our research also proved that adapting to climate change is not as easy as replacing fossil-fuel burning peaker power plants to renewable energy sources. If so, there are a lot of limitations and lost opportunities to think outside-the-box. We hoped we have shown alternative visions as we explored solutions from placing solar panels and battery storages in strategic locations, and to proposing innovative clean energy infrastructures that provide benefits to residents and preserve the working waterfront of neighborhoods.

We do recognize vulnerability comes in multiple scales. This studio has proposed actions, ranging from transforming a small site to recommending state-wide policies. We also acknowledge the challenges of the temporal scale; there are actions that should be implemented immediately and also those that need to be carried over time. As the studio progressed, we decided to envision the energy transition in stages, from studying immediate replacements for peaker power plants to proposing innovative energy infrastructure that could be implemented in the long run. All of these actions, despite differences in spatial or temporal scale, should serve to accelerate a just energy transition.

Keep in mind that replacing peaker power plants is just one problem among a multitude of challenges facing climate change. The complexity of this one single problem indicates that the process to achieve an equitable and environmentally-friendly future will be an extremely difficult one.

As stated in the preface, we must implement strategies to stay ahead of the curve, before we suffer the dire consequences of climate change. Let’s keep a goal in mind and consider those who have been suffering the most. Then it is possible to find solutions towards a more equitable, cleaner, and resilient future.

Thank you,

The Grey-to-Green Energy Transition Studio

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Appendix

List of Abbreviations

CARB	California Air Resource Board
CCI	California Climate Investment
CD	Community District
CDBG	Community Development Block Grant
CDC SVI	Center for Disease Control and Prevention, Social Vulnerability Index
CLCPA	Climate Leadership and Community Protection Act
CMA	Climate Mobilization Act
ConEd	Consolidated Edison, Inc.
EPA EJScreen	Environmental Protection Agency's Environmental Justice Screening and Mapping Tool
GGRF	Greenhouse Gas Reduction Fund
GHG	Greenhouse Gas
GND	Green New Deal
GWh	Gigawatt-hour
MW	Megawatt
NYC	New York City
NYC CES Index	New York City Communities and Environmental Screening Index
NYC-EJA	New York City Environmental Justice Alliance (studio's client)
NYISO	New York Independent System Operation
NYPA	New York Power Authority
NYS	New York State
NYSERDA	New York State Energy Research and Development Authority
PEAK Campaign	Peak Energy Alternative Kilowatt Campaign
SEQRA	State Environmental Quality Review Act
Solar PV	Solar Photovoltaic
US	United States

Interview with Client - Carlos Garcia (Energy Policy Planner at NYC Environmental Justice Alliance)

(Feburary 25th, 2020)

Question list:

1. We are selecting Gowanus 5-6 (Joseph Seymour) and Hell Gate and Harlem River. What are your thoughts on this approach?
2. We are a little concerned about picking newer, less polluting sites as our targets. Do you share that concern?
3. When you consider goals of the peaker power plant replacement project, what are the risks you see to that effort?
4. What projects do you know about that you think are doing a good job of helping focus on ej communities related to CMA or CLCPA or elsewhere?
5. Vulnerable communities working group status update information: when do those meetings happen? Is it possible for us to attend these meetings?

Interview questions to Uprose and the Point

(This interview was attempted, but did not happen)

Question list:

UPROSE Specific Questions

1. What kind of tools and partnerships does the organization need for the transition of Sunset Park Industrial area?
2. Please tell us about where you are in the process of development regarding the climate adaptation and community resilience plan.
3. Are there any resources or research results our studio can provide (e.g.: GIS mapping, generating visuals, assisting in research, outreach) that can help UpRose facilitate these engagements?
4. Are there any resources or research results our studio can provide (e.g.: GIS mapping, generating visuals, assisting in research, outreach) to help you coordinate the allocation of community resources when responding to the future severe weather events?
5. How can we help you to increase the capacity of local indigenous leaders?
6. Are there anything we can provide to facilitate their engagement and leadership in the decommissioning;
7. in repurposing/repowering process;
8. in terms of active agents in environmental management?

The Point Specific Questions

1. Has the issue of peaker plants come up in your community/advocacy work currently or in the past?
2. From what we have read regarding your community resiliency agenda, resilient energy and management of hazardous substances are priority areas of your work.
3. Can you tell us a little bit about what progress has been made thus far;
4. and potential ways our studio could use the resources we have (GIS, visualizations, research, etc.)

1. to assist the organization in meeting its goals?
2. The power plant sites are located within your key focus areas, do you have any plan for these sites if the power plants are decommissioned in the future?
3. Please tell us a little bit more about the Hunts Point Community Solar Project. (in terms of implementation, completion, etc.)
4. How do you view solar power in the context of energy transition and the relationship to your communities?
5. What is the scale of the project? Are there any plans for expansion of panel area/capacity for power generation in the long term?
6. Can you tell us more about the CAMP-EJ project, maybe some examples of your citizen science projects?
7. We have read about some of the work being done by policy agencies as well as grassroots orgs/ CBOs in the context of environmental air quality initiatives in NYC. In this research, we have encountered a lot of discussion around particulate matter and potential community health impacts exposure to fine particles can have. We noticed that The Point defined PM 2.4 levels in their CAMP-EJ work. Is there a specific reason the study chooses to focus on P.M 2.4 instead of P.M 2.5?

Interview with SolarOne - Here Comes Solar Juan Parra (Community Solar Program Manager)

(April 21st, 2020)

Question list:

1. Can you tell us more about SolarOne and here comes solar's works?
2. How do you view Community Solar as an important role in energy transition?
3. What are SolarOne's history and some key programs?
4. What are some recent projects ongoing?
5. What are some key partnerships?
6. What do you view as the most important projects/approaches to do energy transition?
7. Are there any current barriers present in your works?
8. We have noticed some incentives programs of NYSERDA and your collaboration with NYCHA for ongoing projects. How do you view the partnership with these public agencies and their help?
9. How does the financing for your projects work?
10. Are there any solar roof siting strategies for best solar panel locations? And is it easier to work if they are on one building?
11. Can you describe some experience and benefits from the community members' perspective?
12. Can you describe what does the spectrum of subscribers to community solar look like?
13. How does the subscription work? Any pros and cons?
14. Our studio has been looking into the newly passed CLCPA and its impact.
15. Is there any CLCPA impact on your works?
16. Is there any change happening due to CLCPA in your works?
17. Any thoughts from your perspective?
18. Any recommendations for CLCPA to bring benefits to communities?
19. Other thoughts?
20. Major obstacles for community solar's works
21. Thoughts and comments on NYSERDA funding

Area data from GIS data set

Sites	Site Area (Acres)	Rooftop Areas (Acres)
Port Morris (10454)	1.7 (Harlem River)	257.34
	4.5 (Hell Gate)	
	6.2 (Combined)	
Sunset Park (11232)	1.6	183.3

Source: DCP, 2019; DoITT, 2019

Reference data for solar calculation

Area	Estimated Rooftop Area feasible for solar panels (Acres)	Solar Energy Capacity (MW)	Annual Solar Generation (GWh)
Port Morris (10454)	80.35	49.2	56.9
Sunset Park (11232)	110.2	68.4	79.6
New York City	13,567.49	8,400	9,700

Source: Google Project Sunroof, 2018

Annual Net Energy Generation for selected peaker power plants

	2018 (GWh)	2017 (GWh)	2016 (GWh)	2015 (GWh)	2014 (GWh)	Average
Gowanus 5	71.7	52.2	60.9	60.8	31.3	55.38
Gowanus 6	48.9	37.6	55.4	57.9	40.1	47.98
Hell Gate 1	26.2	16.2	21.7	23	24.7	22.36
Hell Gate 2	14	12.7	20.2	23	20.9	18.16
Harlem River 1	26.4	12.7	22.8	21.3	31.0	22.84
Harlem River 2	15.1	10.9	23.4	20.7	23.3	18.68

Source: NYISO Gold Book [Table III-2: Existing Generating Facilities], (2015 - 2019)

Generating information for selected peaker power plants

Owner, Operator, and/or Billing Organization	Station Unit	PTID	Name Plate Rating MW	2019 Capacity MW (Sum & Win)	2018 Annual Consumption	In-Service Date	Fuel
New York Power Authority	Gowanus 5	24156	47	40	71.7	August 1st 2001	Natual Gas
	Gowanus 6	24157	47	39.9	48.9	August 1st 2001	Natual Gas
	Hell Gate 1	24158	47	39.9	26.2	August 1st 2001	Natual Gas
	Hell Gate 2	24159	47	40	14	August 1st 2001	Natual Gas
	Harlem River 1	24160	47	39.9	26.4	August 1st 2001	Natual Gas
	Harlem River 2	24161	47	40	15.1	August 1st 2001	Natual Gas

Source: NYISO Gold Book [Table III-2: Existing Generating Facilities], 2019

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