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Increasing Private Residential Uptake of Solar Generation in New York City

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FRANK BATTEN SCHOOL
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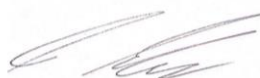
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Disclaimer

The author conducted this study as a part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author and are not necessarily endorsed by the Batten School, the University of Virginia, or the agency within.

"On my honor as a student of the University of Virginia, I have neither given nor received unauthorized aid on this Applied Policy Project"

A handwritten signature in blue ink, appearing to be 'M. Saha', is written over a faint, light blue circular stamp.

Executive Summary

Many of the current policy conversations surrounding the environment and sustainability planning from lawmakers in New York City are largely focused on what can be done during new building construction and how communities, not individual households can help the city transition to carbon neutrality. These conversations do not necessarily look at current land uses, specifically low-density housing (New York City Department of Buildings, n.d.). Since New York City will not likely meet its goal of megawatt production from solar power, incentivizing households to adopt solar generation may close gaps towards the intended benchmarks of solar energy production and carbon neutrality (Redelmeier, 2023).

This report looks at the creation of a policy initiative geared towards residential solar adoption at the household level. The problem is that ***right now too few homeowners in New York City's lower-density residential districts R1, R2, and R3 are adopting private rooftop photovoltaic (PV) panels as a means of alternative energy.***

A root cause analysis shows that low residential photovoltaic system (or PV system) adoption is largely hindered by capital, access, and maintenance costs, gaps in education, consumer behaviors, and regulatory barriers that stand in the way of potential adopters.

The first half of this report contextualizes the previously mentioned literature-based root causes, then focuses on accompanying contemporary policies surrounding these issues both in New York City and around the US. The second half projects economic figures, establishes criteria used to evaluate possible policy interventions and finally results in a policy recommendation and implementation strategy.

In addition to maintaining the status quo, public policy interventions analyzed included:

- *Authorizing regulatory reform using the mayor's Zoning for Zero Carbon Amendment*
- *Expand Economic Incentives via Zero Interest Loan, and*
- *A one-time mailer program to educate and frame PV for Homeowners*

These initiatives were assessed using the criteria of cost to the resident taxpayer, political feasibility, administrative feasibility, and equity. Using modeled projections, ***maintaining the status quo in the short run is the recommended course of action***, but it would be best for the Office of Management and Budget to create a long-term strategy to address the root causes discussed within this report.

Client Overview

This report is made in collaboration with the New York City Mayor's Office of Management and Budget (NYC OMB or OMB). NYC OMB is an executive agency within the mayor's office and is led by the Budget Director, Dr. Jacques Jiha (New York City Mayor's Office of Management and Budget, n.d.). The mission of the New York City Mayor's Office of Management and Budget is to be the city's "chief financial agency" that is responsible for ensuring initiatives are funded and implemented efficiently while also ensuring city resources are managed responsibly (New York City Mayor's Office of Management and Budget, n.d.).

OMB is responsible for advising the mayor on financial matters to ensure that projects are financially responsible for the city to undertake. Within the scope of this report, OMB may choose to utilize a policy or a group of policy recommendations outlined in later sections of this report as a means of long-term environmental and financial sustainability investment planning.



Source 1 - (New York City Mayor's Office of Management and Budget)

Orientation and Problem Statement

Both the City and State of New York unveiled a variety of initiatives to explore alternative energy to tackle the climate crisis and ultimately reach city-wide carbon neutrality by 2050. The focus and celebration of many policymakers regarding the adoption of photovoltaic systems (also known as PV systems or solar energy generation systems) in recently passed legislation, specifically provisions within the Climate Mobilization Act, is largely targeted at making systems more accessible to the highest density regions of the city or buildings, in newly constructed buildings, and existing building renovation (Berglund, 2019). Furthermore, past sustainability plans, like OneNYC 2050, focus primarily on community solar projects and commercial installation, not private households (OneNYC 2050, 2019).

Single-family dwellings, duplexes, and their relevant zoning overlays, also known in this report as low-density housing, are not being utilized to their full potential to make the City's transition to alternative energy (i.e., pivoting away from fossil fuel energy sourcing).

Low-density housing within this report will include land parcels zoned R1, R2, and R3 residential zones along with respective overlays, like R1-1, R1-2, R1-2A, R2A, R2X, R3-2, R3A, and R3X.

Though there are nuances between each zone and their respective overlays, this report will generalize these zones as the following:

- R1: Usually a single-family, detached home with a minimum lot area of 9,500 square feet (New York City Department of City Planning, n.d.),
- R2: Usually a single-family, detached home with a minimum lot area of 5,700 square feet (New York City Department of City Planning, n.d.), and
- R3: Usually single or two-family dwellings where detached dwellings have a minimum lot area of 3,800 square feet and semi-detached dwellings have a minimum lot area of 1,700 square feet (New York City Department of City Planning, n.d.).

Using contemporary literature and current policy as a guide, the problem is that ***right now too few homeowners in New York City's residential districts R1, R2, and R3 are adopting private rooftop photovoltaic (PV) panels as a means of alternative energy*** (Redelmeier, 2023).

Creating a policy at the local level cannot only be a means of alternative energy for the city, but it can also serve as a means to give residents living in low-density housing a greater opportunity to enter the market for solar generation systems and lower long-run energy costs for those who use it.

Root Causes and Evidence

Though not all-

encompassing, there are three primary causes of the problem of *too few homeowners in residential districts are investing in solar* that this report will consider:

costs, gaps in education, zoning/building code regulations, and consumer behaviors.

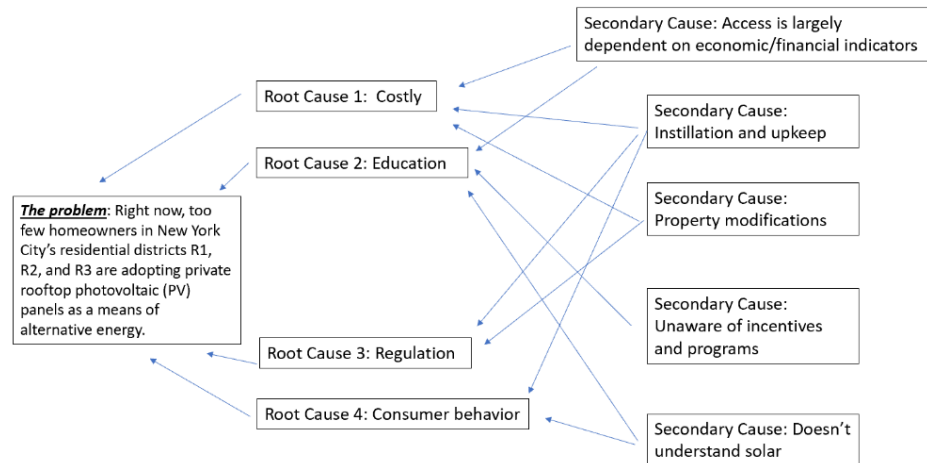


Figure 1 - Root Cause Analysis

Root Cause #1 – Barriers Around Costs

First looking at the root cause of cost barriers to solar found in *Figure 1*, inputs that create this problem included credit and financial health, the cost of installation, and the cost to change existing property.

The cost of a photovoltaic system ranges between almost \$9,720 for the smallest system and over \$32,000 for the largest (EnergySage, 2022). Recent studies show that sun exposure, known as irradiation, and costs are the primary factors in residential PV adoption while taking into account socio-economic and geographic factors (Kocakusak, Andrews, Michael, Shwom, & Senick, 2022).

Income inequities are one of the main drivers in the sharp disparity in residential PV take-up. Darghouth and colleagues (2022) looked at PV system take-up of about 1.9 million PV adopters (about 82% of all adopters between 2010 and 2019). Their research found both income inequality that depicts a left-skewed distribution and adoption inequity meaning higher-income households are overrepresented and amounted to a higher rate of PV adoption. In attempts to visualize the disparity, their paper states that the median income for the dataset was approximately \$64,000, whereas the median income for those adopting PVs was about \$120,000 (Darghouth, O'Shaughnessy, Forrester, & Barbose, 2022). Their research shows that though PV system costs are usually the attributing factor to low take-up, they suggest structural barriers such as home ownership in lower and middle-income households as an additional cost barrier to adopting private solar generation systems.

Credit and finances are just two additional inequities feeding into the costly nature of solar adoption. In many instances, households must finance their system if upfront payment is not financially attainable. If a homeowner would choose to adopt a solar generation system, they would likely take out a loan from either a financial institution or the system distributor. To receive such a loan or financing, the homeowners would need at least a 650-credit score, low existing debt, and would have additional interest charges to pay for financing services, which is based on the homeowner's credit score (EnergySage, n.d.).

Under the same principle, credit is associated with the cost of both solar panels and panel installation. As we will look at in later sections of this report, solar energy systems will likely cost thousands of dollars, and it is unlikely that those who wish to install solar will either be financially able to pay upfront costs, or they will be considered "financially healthy" or "credit worthy" to receive a loan. Those that do not fall within those financial standards will likely be unable to enter the market for residential PV systems.

Root Cause #2 – Education and Framing

Education is a tremendous barrier to the adoption of solar energy by way of financial education (e.g., resources are not in place to teach residents how to increase credit). In many cases, there are misunderstandings or ignorance of various government programs to lower costs, or overall misunderstandings of what solar is, how solar works, and the benefits of adoption (Darghouth, O'Shaughnessy, Forrester, & Barbose, 2022).

Competing data by researchers suggest that potential adopters of PV systems do not wholistically evaluate their purposes for solar energy generation. Rather, they find that two camps of thought around solar emerge: environmental or economic concerns.

Schelly (2014) believes consumer behavior and psychology, in many cases, are bigger influences than focuses that are purely economic or environmental. Schelly found that the return on investment for PVs is less important than overall household economic health, environmental altruism is of relatively low importance to adopters, and the satisfaction of being seen as an early adopter was not necessarily of importance.

Schelly's findings were reaffirmed and altered slightly when Schelly and Letzelter (2020) surveyed residential PV adopters in upstate New York looking to find threads in decision factors consistent with Schelly's 2014 findings. Schelly and Letzelter push back on the idea that uptake is purely economic.

Rather, they saw that PV adopters, on average, factored environmental impact over a reduction in energy costs and direct, up-front costs. This suggests that policymakers and advocates who frame PV technology solely as economic or environmental choices are not effective in swaying consumer behavior.

The split in potential adopters' purpose for adopting solar energy generation systems shows a policy window that allows policymakers to create an initiative to educate constituents that the benefits of solar generation can be both environmental and economic concerns.

Root Cause #3 – Regulatory Barriers

There are many complexities of land use policy, but the costs of rezoning, permitting, licensing, and surveying parcels to ensure planning and zoning standards are met prove to be some of the largest roadblocks to PV adoption (Burkhardt, Wiser, Darghouth, Dong, & Huneycutt, 2015; Shrimali & Jenner, 2013).

Burkhardt, Wiser, Darghouth, Dong, and Huneycutt (2015) analyzed regulatory policies, like permitting and licensing, which are deeply planted in local zoning ordinances or developed within a planning commission, affecting residential uptake PV uptake. They found rigorous and complex regulations have adverse effects on the uptake of residential PV units and increase the cost of adoption. Similar research by Dong and Wiser (2013) found the “most favorable” permitting practices can streamline development times by, on average, 24 days, which is approximately 25% of the median development time for a solar project. Streamlining the regulatory process, in this case, reduced costs and complexities of the regulatory landscape.

Furthermore, Cruce and colleagues (2022) wanted to look at PV take-up through the lens of regulatory barriers, but their research period was different from others – they looked at the data *during* the peak of the COVID-19 pandemic. The group found the pandemic moderately increased the timeline between contract signing and the final installation of PV units. Their findings suggest that much of the hold-up of the project time was stuck in the permitting phase before the pandemic. They suggest the pandemic might have catalyzed or accelerated a widespread adoption for online/e-permitting along with other efficiency improvements within local governments. As a result, overall timelines for residential solar projects decreased during the peak of the pandemic and continue to do so as the virus's effects taper (Cruce, O'Shaughnessy, Harmon, Geiger, & Cook, 2022).

Current Policies in New York City

Policies and Initiatives from the City Government

Over the last decade, each mayor created an initiative to make New York City “greener”. These initiatives include *PlaNYC* under the Bloomberg Administration in the 2000s and *OneNYC 2050* in the de Blasio Administration in the 2010s (The City of New York, Mayor Michael R. Bloomberg, 2007; The City of New York, Mayor Bill de Blasio, 2019). Now, Mayor Adams is creating sustainability initiatives in his Administration, including the proposed Zoning for Zero Carbon zoning code amendment (Amar, 2022).

In its simplest form, the Zoning for Zero Carbon amendment is a zoning code amendment that eliminates or changes specific zoning provisions to better accommodate green energy. Provisions of Zoning for Zero Carbon pertinent to this report eliminate current zoning code involving the location of PV panels, the height of rooftop PV panels, and the surface PV panels must be mounted on (Amar, 2022; New York City Office of the Mayor, 2022). Similar to the goal of this report, this initiative is intended to allow more communities and households the opportunity to adopt rooftop solar through decreased regulations stalling residential projects.

Though the mayor may adopt initiatives to achieve specific ends, in large part, facets of each portion of the initiative will have to be legislated through the city council.

Over the years, New York City Council codified portions of sustainability initiatives, including the Climate Mobilization Act, which established city ordinances to tackle greenhouse gas emissions in building new structures, and legislation creating the Solar Electric Generating Systems Tax Abatement Program, both laws coming from mayoral initiatives (New York City Mayor's Office of Climate and Sustainability, n.d.; The City of New York, Mayor Michael R. Bloomberg, 2007). Most recently, city council members introduced legislation to amend the current city fire code to ease regulations surrounding the proportion of rooftops solar panels are permitted to occupy (Simoes, 2023).

The introduction of these similar pieces of legislation can be used as a case study or precedent for future policies to determine whether or not future building or fire code amendment proposals could survive the city’s legislative process.

Policies and Initiatives from the State Legislature

Like local ordinances, the State Legislature passed legislation for clean energy, but more specifically energy sourced by PV systems. Proposed in 2012 and later codified by Governor Cuomo, the NY-SUN

initiative is a program directed by the New York State Energy Research and Development Authority to make household investments in the state more attainable (Burton & Fieldston, 2012). In February 2023, State Senator John Mannion proposed S4131. This bill will authorize a personal income tax credit for residential PV systems and almost unanimous support thus far indicates the measure will pass within this legislative session (The New York State Senate, 2023).

The mention and analysis of state policies in this section are valuable to assessing the political feasibility of future policies discussed in later portions of this report. Assuming the State Legislature is in congruence with the goals of New York City to be carbon neutral by 2050, legislation concerning sustainability may be seen favorably by state legislators.

Navigating Policies in New York City

There are unique challenges to navigate when governing in New York City. New York is a home rule state, which is a way for cities and municipalities to incorporate within the state and permit self-governance. However, a legal rule known as the “Dillon Rule” allows for the state legislature to permit actions of the local governments. The Dillon Rule essentially prohibits aspects of self-governance for New York City. The state legislature, on many occasions, intervenes in city matters, and is protected by New York State Supreme Court precedent, where there is a “substantial state interest that targets property, affairs or government” (Adler v. Deegan, 1929; McKinley, 2018).

In the context of this report, the implications of the Dillon Rule must be taken into consideration when evaluating policy alternatives and proposals. If state lawmakers determine that it is within the state’s interest to intervene in a proposed policy, it may be necessary for the Office of Management and Budget to lobby policymakers in Albany for the policy to cross the finish line.

Understanding the confluence of the Home Rule and Dillon Rule will help dilute the complexities of current policies at both the state and local levels, as well as the challenges of proposing and adopting future policies.

Policy Alternatives

The alternatives that will be analyzed within this report consist of three broad categories of initiatives like regulatory reform, economic incentives, and education campaigns while also evaluating the status quo. The goal of each is to increase household investment in PV systems by homeowners in specific residential zones within New York City.

Alternative #1 – Status Quo

Under the status quo, the Office of Management and Budget will not encourage the mayor to take additional action by way of an executive order, lobbying City Council, or lobbying the state legislature. The status quo takes into consideration existing policies at the federal level like the Inflation Reduction Act, at the state level like the NY-Sun program and various tax incentives, and New York City's tax abatement incentive. This alternative assumes that these existing policies at the various levels of government will not be expanded, repealed, and largely unchanged. This alternative must be considered during the evaluation of new policies as any projection to be made could be correlated with a new proposal while not taking into account other parallel policies, thus making the assumed result incomplete.

The status quo will serve as a baseline for additional policy proposals but will also be analyzed as a possible alternative. When evaluated, the projected market increase of the program will be taken into account when establishing baseline measurements for other alternatives.

Alternative #2 – Authorize Regulatory Reform Audit through the Zoning for Zero Carbon Amendment

This alternative recommends the mayor authorize the necessary agencies within the mayor's cabinet to audit current practices that consumers must endure to install residential photovoltaic systems. If the respective agencies deem that current practices are antiquated, inefficient, could be an automated process, or processes may be consolidated, later considerations should be analyzed and proposed that would best address such shortcomings. Such measures the city could take, but are outside the jurisdiction of this report, include a variety of digital software applications aimed at local governments to automate and streamline their PV application review process.

Homeowners interested in installing PV systems must complete a wide array of paperwork as well as partake in a laborious inspection process. These processes are largely housed within the jurisdiction of

the Department of Buildings (Buildings). For customers to adopt PV systems, a total of approximately eight forms must be completed, permits must be obtained, and over 20 construction codes must be met during the inspection process for both PV systems to be installed and for homeowners to collect the city tax abatement as a result (New York City Department of Buildings, 2013). Though the health and safety of the homeowners and community should be of the utmost importance, this alternative authorizes and encourages the New York City Department of Buildings to look at the procedures and policies that may stand as a barrier for potential consumers not currently in the market.

This alternative is inspired by findings from economic researchers like Burkhardt, Wiser, Darghouth, Dong, & Huneycutt (2015) who found that when local governments groom and streamline the permitting process reducing costs to consumers during installation. Lastly, a New Jersey case study found that when application processes for re-permitting were not standardized, households were disincentivized to take up PV systems, which further suggests that when application processes, permit fees, and inspections are standardized, costs surrounding installation will be reduced and more households will adopt PV systems. (Kocakusak, Andrews, Michael, Shwom, and Senick, 2022). For this analysis, it is assumed that when initial costs for access to PV are lowered, there will be additional households that will be able to enter the market for solar energy generation systems.

As mentioned earlier sections, the mayor's Zoning for Zero Carbon Amendment to the current building code could be used as a *possible* policy vehicle to help a green initiative cross the finish line. However, urging regulatory reform within this alternative should be used in conjunction with the mayor's amendment proposal. By the nature of the mayor's amendment proposal and this alternative – both aiming to strikethrough redundant, not-needed, or antiquated regulations – it would be most beneficial for the Office of Management and Budget to lobby relevant stakeholders to make both alternatives a bundled legislative package aimed at reforming the regulatory process.

Alternative #3 – Expand Economic Incentives via Zero Interest Loan Program

On many occasions, varieties of economic incentives are some of the most popular methods to increase PV system take-up. Recent literature suggests that policies encouraging PV take-up usually lead to adoption by lower and middle-income earners who would not have been able to adopt PVs in the absence of a financial incentive (Kocakusak, Andrews, Michael, Shwom, & Senick, 2022; O'Shaughnessy, 2022).

New York City “provides a four-year tax abatement for the construction of solar electric generation systems with residential and commercial buildings” (Solar Electric Generating Systems Tax Abatement Program, n.d.). This incentive provides a maximum abatement of \$62,500 per year for four years or the building’s annual tax liability. Simply, the current incentive allows building owners to deduct portions of solar installation from their property taxes.

As of 2021, around 46 state and local programs nationwide support low- and middle-income households to increase PV adoption, and of these programs, 41 are geared specifically to finance demand-side upfront costs (Paulos, et al., 2021). Common economic incentives could include expansions of the current tax abatement program, subsidies, and/or cash incentives. A blind spot of the current tax abatement program is the assumption that, in absence of the state’s NY-Sun’s Residential Solar Incentives and Financing program, many low and middle-income households will not have the capital necessary to finance the project for their taxes to be abated. Even when finance options are available to encourage PV system take up, interest rates to finance system purchases and installation is subject to interest rates as low as 6.49% for state-run Companion Loans, but interest rates as a part of NY-Sun’s Residential Solar Incentives and Financing program, as well as private financing, is determined by a borrower’s “credit qualification” via their credit score (New York Solar Program, n.d.). For many low and middle-income individuals, credit scores could be a tremendous barrier to entry for those hoping to join the market for solar energy.

The proposed economic incentive will be a direct-to-consumer incentive that will provide the capital needed to cover the cost of a PV system between 5 kilowatts and 7 kilowatts, or the average system size needed for residential use. In conjunction with the city’s tax abatement, this alternative will fully provide households the capital to cover the cost of purchase and install a 5kw PV system through a ten-year, no-interest loan to ensure that credit score or similar financial factors are not barriers to the market.

This alternative would take into account the March 2023 market cost after state and federal subsidies of a 5kW photovoltaic system, which cost approximately \$11,877 (EnergySage, 2022). The subsidy will be provided in full once inspectors conduct inspections under current regulations to ensure structural safety. Once the installation project is concluded, homeowners will have a ten-year repayment period where adopters can choose to pay in monthly increments for ten years or one lump sum every year for ten years. The projected costs of this program on a yearly repayment basis will be evaluated in future sections of this report using *New York City Open Data*.

This policy would be a joint effort between the Office of Management and Budget, the Department of Finance, the Department of Environmental Protection, and others as OMB would see fit at implementation.

Alternative #4 – A Mailer Program to Educate and Frame PV to Homeowners

The final alternative follows the guidance of recent literature by Rahardija and colleagues who found that by administering an educational program on the role of PV systems in conjunction with economic programs, there was a greater probability of PV uptake, especially in lower-income households.

(Rahardija, Chen, & Rahardja, 2022).

One of the less costly strategies that could be employed in conjunction with the Department of Environmental Protection is a one-time direct mailer campaign targeted toward residents in residential districts R1, R2, and R3 specifically.

The content of the mailer campaign would also be driven by recent literature. Studies show that drivers of uptake in PV systems are not exclusively economic or environmental concerns for many. Rather, both factors are important to most who take up residential PV systems, but there are other circumstances between the two conditions in the remaining participants where one may have a preference for a certain factor or another (Schelly & Letzelter, 2020; Schulte, Scheller, Slood, & Bruckner, 2022). In this instance, mailers will be used to inform and educate homeowners on what photovoltaic systems do and the current incentives provided by government entities. Additionally, these mailers will appeal to audiences who support solar energy for either economic *or* environmental purposes to ensure all baseline points of solar energy are accounted for.

When considering alternative education campaigns, a mailer campaign is likely the farthest-reaching and least costly for the OMB and/or Environmental Protection budgets.

Possible Policy Vehicle

A large assumption that must be considered is the mayor's *Zoning for Zero Carbon* will be passed and codified either before or in conjunction with one of the proposed policy alternatives below. Though no passage of the zoning amendment is not a poison pill for a recommended alternative, the assumption should be considered with each alternative. Current zoning codes include height restrictions for specific residential zones and can be considered an additional barrier prohibiting PV system uptake (Amar, 2022).

The Zoning for Zero Carbon amendment may be used as a policy vehicle for future policy proposals because, at the time of writing this report, the City Planning Commission and the New York League of Conservation Voters, at large, informally approve of the proposed amendment and it is likely that there will be broad public support (Rose, 2023a; Rose, 2023b). The Zoning for Zero Carbon is an amendment that needs to be approved by New York City Council, and if the timing of a proposed policy would coincide with a timeline similar to the proposed amendment on the council floor, it may be beneficial to have both measures voted on as a packaged piece of legislation.

Criteria for Evaluation

The New York City Mayor's Office of Management and Budget (OMB) is the main financial agency for the city tasked with the role of overseeing expense and capital budgets, as well as evaluating the cost-effectiveness of city services, programs, and proposals. In keeping with the tasks assigned to OMB, the weighted criteria by which the proposed alternatives will be evaluated consist of:

1. Cost to Resident Taxpayers
2. Political Feasibility
3. Administrative Feasibility
4. Equity

Cost to Resident Taxpayer

Evaluating the cost-effectiveness of capital and operating projects is one of the key roles of the Office of Management and Budget. Though the main duty of OMB is to ensure NYC programs are cost-effective, each initiative is subject to the mayor's discretion where cost-effectiveness may not be a basis for evaluation.

There are research gaps that measure the cost-effectiveness of similar policies scoped to a level similar to this report. Therefore, the cost to the taxpayer criterion will be used as a fiscal measure of the cost of each policy proposal.

Each project will be evaluated on a per-resident taxpayer basis. At this phase of the policy planning and analysis process, this criterion will evaluate the overall cost of each respective intervention and not assume levels of uptake projected and the associated costs for PV uptake to consumers.

The criterion of the cost to resident taxpayers will consider the sum of projected input costs relative to the number of resident taxpayers. In this case, the cost-to-resident taxpayer criterion will analyze the per-resident taxpayer cost using census data, historical operating budgets for the respective administrative agencies, and assumptions in some instances to project a monetary cost.

For cost to the resident taxpayer, lower scores will be looked upon more favorably than higher scores because the evaluation is meant to incentivize policies with lower costs attached to them. Projects with a lower projected cost will be considered more favorable because, in many instances, the cost of a policy initiative is often a great determinant as to whether or not it is politically feasible at the local level.

Political Feasibility

Political feasibility analyzes qualitative facets of the political landscape at the state and city levels like lawmakers, nongovernmental organizations, public opinion, as well as the relationships between the various stakeholders.

With New York City's unique position as the only Dillon Rule municipality in the State of New York, political feasibility for many measures of city government must have the support of lawmakers in both city hall and the state legislature (McKinley, 2018).

Not all alternatives will be evaluated with the necessity of lawmakers in Albany in mind whereas others may and will be noted accordingly.

Political feasibility will be evaluated on a scale of 1-5. A ranking of 1 means there is a low probability of passage because of opposition at both state and local levels. A ranking of 3 means that it is supported by one legislative body (either state or local) but not the other. Finally, a ranking of 5 means that the policy will likely have support from both state and local lawmakers with little or no chance of opposition.

Because of the Democratic Party's control of each legislative body and executive office, bipartisanship is encouraged, but it is not central to this analysis.

Administrative Feasibility

Administrative feasibility takes into consideration the ability of the agency, or agencies, tasked with implementing each proposed alternative.

Within administrative feasibility, the criterion will be evaluated on factors that are largely quantitative measures like budgetary constraints, but also qualitative considerations, like staffing, managerial considerations, and intergovernmental relations. Under this consideration, the analysis of administrative feasibility will also take into account initiatives like Mayor Adams' Eliminate the Gap program to address vacancies within essential agencies (New York City Comptroller Brad Lander, 2022). It is out of the scope of this report to weigh the specific policy within our analysis, but it is essential to consider both current administrative vacancies and how policies addressing the vacancies will impact future sustainability policy proposals

Administrative criteria will be evaluated on a scale of 1-5 with a score of 1 being "least administratively feasible" and 5 being "most administratively feasible".

Equity

Equity will broadly be defined as the ability of all residents in New York City's R1, R2, R3, and respective overlaid residential districts to have a greater ability to purchase a PV system regardless of neighborhood or borough residency, race, age, income, and credit status, or any other barrier barring individuals from PV markets.

Compared to other criteria, equity is largely a qualitative criterion, not quantitative. In keeping with this, the equity criterion will rely on past pieces of literature to provide a basis for projecting whether a policy alternative will likely be equitable.

In this analysis, equity as a criterion is not related to the effectiveness of the proposed policy initiatives.

How Criteria Will Be Weighed During Evaluation

Each alternative will be evaluated using the mentioned criteria, each with different weights representing the respective priorities of the New York City Mayor's Office of Management and Budget.

The cost to the resident taxpayer will be weighed at 35% of the evaluation. As the fiscal and budget advisors to the mayor, evaluating the cost of a policy is a primary task of NYC OMB. In keeping with their duties, accounting for the cost of each alternative is at least one-third of the entire evaluation process.

Since taking office a little over a year ago, Mayor Adams shows to prioritize components of equity within policy initiatives (New York City Office of the Mayor, 2023). To ensure equity has a greater consideration in policy evaluation, the criterion will be weighed at 25% of the total evaluation.

Lastly, political and administrative feasibility are both weighted at 20% respectively of the total evaluation. Not to be misinterpreted as least important, these criteria play an important role in total evaluation. However, the responsibilities and priorities of OMB must be best reflected during evaluation.

Assumptions Used for Evaluation

To project the most accurate costs and take-up rates for this problem, some assumptions need to be made.

It is assumed that all households will be purchasing a 5 kW PV system, which is the average size purchased among homeowners. The average market cost of a 5 kW system as of March 30, 2023, costs approximately \$16,000 per system and will be used in all costing measures (EnergySage, 2023).

Because there are gaps in data regarding the current number of dwellings zoned R1, R2, and R3 with accompanying overlays, estimates will be made for the numbers of households when hard data is unavailable. These assumptions are accompanied by *Figure 2*, a land use map of New York City where the following assumptions are built (Point2Homes, n.d.).

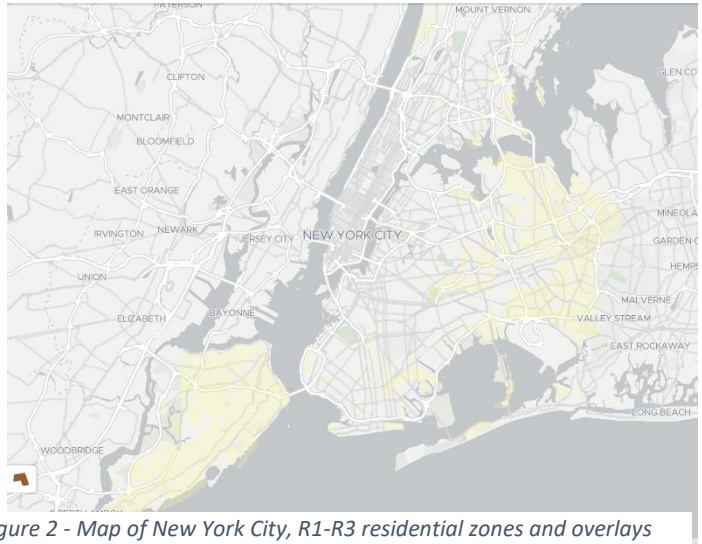


Figure 2 - Map of New York City, R1-R3 residential zones and overlays highlighted

Staten Island's homeownership rate is about 65% with about 113,000 owner-occupied homes (NYU Furman Center, n.d.) We will assume that 75% of owner-occupied homes are zoned R1, R2, R3, or a respective overlay (about 84,750 homes).

The Bronx homeownership rate is around 19% with about 103,800 owner-occupied homes (NYU Furman Center, n.d.) We will assume that 20% of owner-occupied homes are zoned R1, R2, R3, or a respective overlay (about 20,760 homes).

Brooklyn homeownership is around 30% with about 292,500 owner-occupied homes (NYU Furman Center, n.d.) We will assume that 20% of owner-occupied homes are zoned R1, R2, R3, or a respective overlay (about 58,500 homes).

Queens' homeownership is around 44.1% with about 360,800 owner-occupied homes (NYU Furman Center, n.d.) We will assume that 60% of owner-occupied homes are zoned R1, R2, R3, or a respective overlay (about 216,480 homes).

Manhattan will not be considered because of the low rate of R1, R2, and R3-zoned households.

Using these assumptions, the projected total number of R1, R2, and R3 owner-occupied homes in New York City is 380,490 homes and 64% of the NYC population is a part of the civilian labor force (will be referred to as NYC taxpayers) 5,634,681 people paying NYC taxes (U.S. Census Bureau, 2021). Projected Take-up rates can be found in *Figure 7* in the Appendix.

Lastly, many Fiscal Impact Statements on the city council's legislative database, Legistar, look at total compensation (salary and fringe benefits) as a main cost, and the same will be assumed in this analysis. For some alternatives, this is the main, or only, the cost associated with an alternative.

Evaluation Methodology

Outcomes will be evaluated on a scale of **Low, Medium, and High** with marginal scoring between each evaluative benchmark, and will be quantified later in this report.

A conversion of the rankings is as follows:

- **Low (1)** = The probability of the given alternative being adopted is very unfavorable when evaluating a piece of criteria when considering a specific policy initiative.
- **Low-Medium (2)** = Used to capture a marginal ranking where the probability of an alternative being evaluated more favorably than a low ranking, yet still being less favorable than a medium ranking when considering a specific criterion.
- **Medium (3)** = The rank of medium can have two uses. First, the ranking of medium could be used as a baseline if there is a high level of uncertainty when evaluating an alternative on a specific piece of criteria. Second, the rank of medium could be used if there is conflicting evidence about a certain alternative on a specific outcome. When using a ranking of medium, the author will note as to which use is intended.
- **Medium-High (4)** = Used to capture a marginal ranking where the probability of an alternative being evaluated more favorably than a medium ranking, yet still being less favorable than a high ranking considering a specific criterion.
- **High (5)** = The probability of the given alternative being adopted is very favorable when evaluating a piece of criteria considering a specific policy initiative.

Note: The cost to resident taxpayers criterion will be evaluated on a scaled inverse that of the accompanying three criteria. This means that a ranking of **Low** is the most favorable outcome and is weighed the highest since the analysis incentivizes minimal cost burdens placed on taxpayers. In comparison, a ranking of **High** is the least favorable outcome and weighted the least as a sweeping, costly initiative would not only put a large burden on taxpayers but would likely also make it more difficult for the initiative to be legislated.

Evaluation of Alternatives

Alternative #1 – Status Quo

Cost to Resident Taxpayers

After taking into consideration various assumptions, the cost to resident taxpayers for the status quo ranks **Low**.

Table 1 - Cost to Resident Taxpayer for Status Quo, Source: (New York City Mayor's Office of Management and Budget, 2023)

Budgeted FY2024 Sustainability Enforcement	3 positions	\$223,606
Budgeted FY 2024 Inspectors	7 positions	\$795,550
		(\$1,019,156)
Cost Per Taxpayer	Approx. 5,634,581 taxpayers	(\$0.18)

A handful of assumptions can be made using Mayor Adams' budget estimates for the fiscal year 2024 as a benchmark.

First, we will assume that the costs projected for FY2024, which in large part include cuts to nearly every department in the New York City government, will be agreed to during the budget process. All positions in *Table 1* are budgeted for the fiscal year 2024.

Second, we can assume that there will be no staff or salary changes made to sustainability enforcement by way of increasing or decreasing manpower for those tasked with inspecting and enforcing solar installation practices. The final figure can be found in *Table 1*, which encompasses the largest, and one of the only costs incurred by the city when residents install solar. All eleven positions found in *Table 1* are already accounted for in the mayor's FY2024 budget (New York City Mayor's Office of Management and Budget, 2023).

There are gaps in data and research that analyze the projected market change in response to programs like the New York City Solar Electric Generating System Tax Abatement program, the NY-Sun program, and the provisions of the Inflation Reduction Act.

Because of present gaps in data and the assumption that there will be no additional cost incurred to the city and the tax base, any increase in adoption by low-density homeowners can almost be seen as a "bonus". The Solar Energy Industries Association projects that the market will grow under current policies at a rate of 8,160 MW over the next 5 years in New York State (Solar Energy Industries

Association, 2022). Though it is unclear what proportion of this growth will take place in residential zones in New York City, it can be assumed that a substantial, but unquantifiable, share will be taken up in the city's residential spaces.

When dividing the primary costs associated with the status quo (staff salaries) by the estimated number of resident taxpayers of approximately 5.6 million, not just those living in R1-R3 dwellings, the approximate cost of the status quo is \$0.18 per taxpayer (U.S. Census Bureau, 2021).

Political Feasibility

This alternative ranks **High** for political feasibility because it is assumed that the programs currently in place will not be repealed or replaced upon future election results.

Administrative Feasibility

This alternative ranks **High** for administrative feasibility because it is assumed that the agencies within the New York City government can carry out existing programs at the city level, like the Solar Electric Generating Systems Tax Abatement Program.

Equity

This alternative ranks **Medium** on the baseline when accounting for equity concerns.

Though there are more government programs to encourage residential PV system uptake, the Inflation Reduction Act, New York State's NY-Sun Program, and New York City's Solar Electric Generating Systems Tax Abatement Program, each has economic incentives that are taken into account once PV systems are installed and does not fully address equity barriers (H.R.5376 - Inflation Reduction Act of 2022; Solar Electric Generating Systems Tax Abatement Program; New York Solar Program).

Out of the three programs listed, the NY-Sun Program is the only one to offer to finance for upfront costs associated with PV installation, which can provide capital to those who cannot self-finance. However, financing is contingent on credit qualifications, which could create inequitable and predatory financing practices for those with lower credit scores.

Because of increased levels of uncertainty, the equity criterion is ranked medium to capture both ideas of providing financing options while also considering that such financing can still keep large groups of residents out of the market for PV systems.

Alternative #2 – Authorize Regulatory Reform through the Zoning for Zero Carbon Amendment

Cost to Resident Taxpayers

The cost to taxpayers for this alternative takes into consideration projected costs for an internal audit and does not capture the possible benefit of recommendations coming from the audit. After evaluation, this alternative ranks **Low** in cost to resident taxpayers.

Table 2 - Cost to Resident Taxpayer for Alternative #2, Source: (NYC Jobs, n.d.)

Hiring Code Development Specialists (\$90,000 total compensation)	5 positions	\$ 450,000.00
		\$ (450,000.00)
Cost per Taxpayer	approx. 5,634,681 taxpayers	\$ (0.08)

The largest and likely only cost of this alternative is hiring five additional Code Development Specialists to conduct the audit. These five specialists will take into account one hire from each of New York City's five boroughs to ensure the audit shows no bias. Costs associated with the status quo and administrative costs are not captured within the projected total. There will be five inspectors hired to reflect one being assigned to each of the five boroughs of New York City

The salary for Code Development Specialists among various New York City government agencies ranges between \$65,000 and approximately \$118,000 (NYC Jobs, n.d.). For this alternative, we will project five Code Development Specialists to be hired for a one-year contract to audit the regulatory policies previously mentioned. These five hires will be budgeted for FY2024 with a total compensation of \$90,000.

When taking into account the distributed cost among the residential tax base of New York City, the cost projected cost to taxpayers is approximately \$0.08.

Political Feasibility

Based on political feasibility, this alternative ranks **Medium-High**.

Assuming an audit would signify the city government has the need and ability to repeal or consolidate various building codes or inspections, the political feasibility of this alternative would be relatively high.

Under New York City Charter, the mayor is authorized to “establish and maintain such policies and procedures as are necessary and appropriate to accomplish this responsibility including implementation of effective systems of internal control by each agency and unit under the jurisdiction of the mayor”

(New York City Charter). Under this clause, there is likely no need for the OMB to lobby on behalf of the mayor to state or local legislatures for the authority to implement such an audit initiative with the goal of agency rule changes.

The tradeoff confronted with making this alternative not **High** on political feasibility is the political resistance the policy change may face concerning household safety. Political counterparts may suggest that a policy encouraging less regulation hinders the safety of residents, but such political points must be addressed early in implementation if this policy is adopted.

Administrative Feasibility

This alternative ranks **Medium** for administrative feasibility based on uncertainty.

This alternative does not receive a **Medium-High or High** because the audit that would be necessary to understand what may be able to be repealed or consolidated would add an increased burden on an already depleted city government workforce.

In December of 2022, New York City's Comptroller, Brad Lander, released a report outlining a mass staffing vacancy across New York City governmental agencies. Within the city departments that have roles within residential PV system installation regulation, each had at least 17% vacancy within their department (Buildings, 22.7%; Planning, 20.7%; Environmental Planning, 17%) (New York City Comptroller Brad Lander, 2022).

Though this vacancy adversely affects the efficiency of the city departments and thus stretches a depleted department even thinner, if the result of the audit would find that the permitting and regulatory processes from the city's perspective can be repealed or consolidated, this could alleviate the burden on certain agencies in the long run. Under this model, it is assumed that the Department of Buildings would likely be the most impacted by repealing and consolidating regulatory processes meaning their trained building code inspectors would be able to inspect more property sites in shorter amounts of time. However, it is understood that administrative challenges will be prevalent in the short run.

Equity

This alternative can be estimated to have a **Medium-High** rank when taking into account equity concerns for consumers.

Numerous economic studies look at the effects of utilizing the “most-favorable” permitting processes, streamlining regulatory processes through online/e-permitting, and the costs of backlogged permitting (Burkhardt, Wiser, Darghouth, Dong, & Huneycutt, 2015; Cruce, O'Schaughnessy, Harmon, Geiger, & Cook, 2022; Dong & Wiser, 2013). When comparing these studies against one another, there is a commonality in that when the regulatory environment is more intuitive to applicants, easier to file, more accessible, and generally more efficient, costs associated with permitting and regulation within the installation process are reduced.

With costs reduced for consumers, we can assume that the price reduction will allow for more households to enter the market who may otherwise not. However, this alternative does not rank **High** because though it would likely lower costs for lower-income households looking to adopt PV systems, regulatory changes within the studies show a decrease in “soft costs”, or costs not associated with the hardware of solar installation, which at one point accounted for close to two-thirds of the cost of residential PV systems (Freidman, Ardani, Feldman, Citron, & Margolis, 2013).

Though this alternative does not account for access to capital for low-income households, it is a start that could be built upon to lower costs for residential PV systems.

Alternative #3 – Expand Economic Incentives via Zero Interest Loan Program

Cost to Resident Taxpayers

This alternative’s cost to resident taxpayers is **High** since it poses a rather large burden on taxpayers.

In this case, the measure of the cost to resident taxpayers of this alternative will only encompass the cost of the program for various sensitivities of program uptake and not necessarily the administrative costs and salaries of those carrying out the program.

A set of assumptions can be found in prior sections of this report that are needed to evaluate this alternative alongside models used to calculate this alternative. Additionally, a robust model outlining the methodology of this alternative can be found in *Figure 6* in the Appendix.

Using the 2023 cost of a 5kw PV system, the model shows that, over the 10-year zero-interest payback period, the city would incur a cost ranging from about \$4,900 and \$5,100 per household using varying levels of discounted sensitivity. When taking into varying discount rates as well as projected take-up rates ranging from 5% to 30%.

General Loss Incurred by New York City when accounting for various take up and discount rates						
	5% take up	10% take up	15% take up	20% take up	25% take up	30% take up
Loss Incurred (3%) discount	\$ (33,210,652.84)	\$ (66,421,305.68)	\$ (99,631,958.51)	\$ (132,842,611.35)	\$ (166,053,264.19)	\$ (199,263,917.03)
Loss Incurred (5%) discount	\$ (51,478,307.51)	\$ (102,956,615.01)	\$ (154,434,922.52)	\$ (205,913,230.02)	\$ (257,391,537.53)	\$ (308,869,845.03)
Loss Incurred (7%) discount	\$ (67,253,361.63)	\$ (134,506,723.26)	\$ (201,760,084.90)	\$ (269,013,446.53)	\$ (336,266,808.16)	\$ (403,520,169.79)
Cost Per Taxpayer when accounting for various take up and discount rates						
	5% take up	10% take up	15% take up	20% take up	25% take up	30% take up
Loss Incurred (3%) discount	\$ (5.89)	\$ (11.79)	\$ (17.68)	\$ (23.58)	\$ (29.47)	\$ (35.36)
Loss Incurred (5%) discount	\$ (9.14)	\$ (18.27)	\$ (27.41)	\$ (36.54)	\$ (45.68)	\$ (54.82)
Loss Incurred (7%) discount	\$ (11.94)	\$ (23.87)	\$ (35.81)	\$ (47.74)	\$ (59.68)	\$ (71.61)

Table 3 - Cost to Resident Taxpayer for Alternative #3

The figures represented in *Table 3* showing the general losses incurred by the city when accounting for sensitivities of uptake and discount rates, as well as the cost to the resident tax pater for various take-up and discount rates are determined using the calculations found in *Figure 6* and *Figure 7* of the Appendix. For instance, the cost per resident taxpayer is found by multiplying the figure representing the 5% take-up rate (19,025) and the loss incurred per household at a 3% discount rate (\$1,745.68) to which the total cost incurred would be \$33,210,652.84. Then, the total loss incurred (\$33,210,652.84) would be divided by the projected number of resident taxpayers (5,634,681) to where it is projected that the zero interest loan with a 5% take-up rate and a 3% discount rate would cost approximately \$5.89 with the burden placed on resident taxpayers. Figures in *Table 3* utilize the same methodology discussed above.

Since this alternative could pose a relatively large and generally unpredictable burden on taxpayers, this alternative is too costly when accounting for the general loss the city would incur because of the time value of money.

Political Feasibility

Because of the downstream effects of the cost to resident taxpayer criterion and political hurdles needed to enact the policy, this alternative receives a **Low-Medium** ranking for political feasibility.

There are a few layers that need to be pulled back to address political feasibility at the local and state levels.

This alternative would have to originate in New York City Council meaning much of OMB's role would be strictly lobbying and projecting the cost-effectiveness and cost to the resident taxpayer for the program. There have been legislative victories in past council sessions aiming to increase renewable energy systems via sustainable energy loan programs. In 2019, City Council passed Local Law 96, which created a sustainable energy loan program with 18 council members sponsoring the legislation (The New York City Council, 2019). The main difference between Local Law 96 and this alternative largely involved

funding sources. According to its fiscal impact statement, the only expenses incurred by the City under Local Law 96 are administrative fees and the salary of a dedicated policy analyst with the program being funded by state and federal funds. By comparison, this alternative, unless an alternate funding stream is found, would be funded using revenues raised through levied taxes.

At the state level, New York case law shows a strong precedent of the state legislature to intervene in city matters when a “substantial state interest” to “property, affairs or government” (Adler v. Deegan, 1929). In this case, if this alternative would be recommended, it should be assumed that the state legislature may choose to intervene and effectively nullify the policy.

Overall, recent legislation (Local Law 96) shows that similar programs can be proposed and implemented. However, with OMB’s role being limited to lobbying, the assumed funding stream associated with the alternative, and the state’s power to intervene, this alternative is not politically feasible, but with additional crafting, a similar alternative may be proposed. Because of these factors, this alternative’s political feasibility is **Low-Medium**.

Administrative Feasibility

For shortcomings similar to alternative number two, this alternative ranks **Low-Medium**.

With the projection of administrative feasibility using Local Law 96 and the New York City Comptroller’s report as a reference point, it is unlikely that the necessary government entities tasked with implementing and executing the policy will have the administrative capacity to do so.

Staffing within city government agencies is already at a depleted level (New York City Comptroller Brad Lander, 2022). Drawing assumptions from the report, the respective agencies likely do not have the staffing levels necessary to effectively carry out the tasks associated with implementing and carrying out the day-to-day functions of the program. This conclusion supports the initial thought that it is not administratively feasible to carry out this alternative in the short run.

However, according to Local Law 96’s Fiscal Impact Statement (2019), Local Law 96 includes the hiring of only one Senior Policy Advisor to supervise the program. Using the precedent of past legislation to hire the staffing needed to carry out such a program marginally increases the likelihood that this alternative would be administratively feasible.

Equity

When taking considerations of equity into account, this alternative can be ranked **Medium-High**.

Relative to the other alternatives being evaluated, this alternative is offered with the most equity in mind. This alternative provides full, up-front payment for the cost of solar generation systems. This means that more residents, regardless of household income, can use the benefit of the program.

Research by Kwan (2012) showed that the availability of financial incentives was a factor influencing the adoption of residential solar energy systems and is echoed by O'Shaughnessy (2022) by finding that incentives prove to be effective for lower and moderate-income households.

Based upon the criterion of equity, this alternative provides a great tool for all residential homeowners to adopt rooftop solar. However, this alternative is not ranked high because this policy can be seen by many as inequitable to residential taxpayers who do not own their own homes. Under this assumption, this alternative can be seen by non-homeowners because they will not see the economic impact that those who own their home with rooftop solar (e.g., electric bill fluctuations or various tax benefits) will be burdened as a taxpayer for the project. Therefore, this alternative is not equitable to *all* New York City residents but only those who are homeowners.

Alternative #4 – A Program to Educate and Frame PV to Homeowners

Cost to Resident Taxpayers

When accounting for costs incurred to send mailers to residents in R1-R3 households, this alternative ranks **Low-Medium**.

Average cost of USPS marketing postcard	\$ 0.62
Average cost of USPS marketing letter	\$ 0.67
USPS estimated cost to mail 10,001 - 50,000	\$ 32,000
Estimated total number of R1-R3 households that are owner occupied	380,490
Estimated cost to USPS to mail to all R1-R3 owner occupied homes	\$ 243,200
Cost to NYC tax payers	\$ 0.04

Table 3 – Projected Costs to Resident Taxpayers for Alternative #4, Sources: (United States Postal Service, n.d.)

Though this alternative is less expensive compared to other alternatives, the direct mailer campaign ranks medium-high because the measure takes into account both the relatively inexpensive cost while also considering unpredictability associated with the effectiveness. In this case, effectiveness does not

take into consideration PV system uptake as a result of the policy, but rather the effectiveness of the direct mailer getting to, or being received by, the intended homeowner. Though there is extensive literature that analyzes the effectiveness of private sector campaigns, there are gaps in data as to how this is considered in governmental initiative spaces.

Political Feasibility

It can be assumed that an education initiative spearheaded by OMB would not be overly political, which gives this alternative a rank of **Medium-High**.

After rigorous research concerning past initiatives from the mayor's office, no evidence of past mail campaigns is in the public record. From that standpoint, we can assume that since there would not be a reason to include the city council in legislation, the likelihood of the alternative being politically feasible is marginally increased.

Administrative Feasibility

This alternative ranks **Medium** based on uncertainty.

Relative to other others, this alternative would likely use less staffing from employees within the respective city agencies. However, it is uncertain whether an initiative has the administrative feasibility to implement an education campaign via mailers at this stage of the policy process.

Equity

This alternative is ranked **Medium-High**.

There are two main components surrounding equity that give this alternative a medium-high ranking.

The ranking is anchored high at first because of a tailored mailer because of the widespread ability this education campaign could contact. However, the ranking falls when taking into account equity concerns similar to those of the second alternative. This alternative may create more informed citizens on the environmental and economic impacts of residential PV system adoption, but it does not decrease or address the financial burden associated with system installation and upkeep.

Outcomes will be evaluated on a scale of **Low, Medium, and High** with marginal scoring between each evaluative benchmark.

A conversion of the rankings is as follows:

- **Low = 1**
- **Low-Medium = 2**
- **Medium = 3**
- **Medium-High = 4**
- **High = 5**

Note: The cost-to-resident criteria will use the following ranking: Low = 5, Low-Medium = 4, Medium = 3, Medium-High = 2, and High = 1. This scale reflects the attempt to make sure that given alternatives are not overly costing to taxpayers carrying the cost burden

Each alternative will be evaluated using the previously mentioned criteria and weighed in the following manner:

- *Cost to Resident Taxpayers (35%)*
- *Political Feasibility (20%)*
- *Administrative Feasibility (20%)*
- *Equity (25%)*

	<i>Alternative #1 – Status Quo</i>	<i>Alternative #2 – Authorize Regulatory through Zoning for Zero Carbon</i>	<i>Alternative #3 – Expand Economic Incentives via Zero Interest Loan Program</i>	<i>Alternative #4 – Education and Framing of PV to Homeowners</i>
Cost to Resident Taxpayers	Low	Low	High	Low
Political Feasibility	High	Medium-High	Low-Medium	Medium-High
Administrative Feasibility	High	Medium	Low-Medium	Medium
<u>Equity</u>	<u>Medium</u>	<u>Medium-High</u>	<u>Medium-High</u>	<u>Medium-High</u>
<u>Weighted Total</u>	<u>4.5</u>	<u>4.15</u>	<u>2.15</u>	<u>4.15</u>
Weighted Rank	1	T2	3	T2

Figure 4 - Outcomes Matrix for Alternatives and Criteria

Assuming and Assessing Probable Benefits

Presumably, there are benefits tied to each of the proposed alternatives. For example, streamlining the regulatory processes at a local level can produce a PV price decrease of about \$0.18 per watt, and more broad regulatory reforms can produce a PV price difference ranging from about \$0.65 per watt to almost a dollar per watt (Burkhardt, Wiser, Darghouth, Dong, & Huneycutt, 2015).

For other alternatives, we can assume that there will be longer-term cost savings for households as they will likely see decreases in monthly electric bills, but at this time, variables such as the rate of monthly household electric usage, time pricing by service providers, and PV system capacity adopted by homeowners make an all-encompassing figure difficult to calculate but should be accounted for in future measurements.

In addition to monetary costs, it is important to note that there are presumably benefits that may have monetary ties, but their benefits are largely nonmonetary. Examples include the downstream effects of lower emissions from coal-fired power plants like air and water pollution, adverse health effects, and adverse ecological effects.

New York City already committed to achieving net neutral carbon emissions by 2050. A major facet of this goal is the adoption of alternative energy sources such as hydropower, offshore wind, and industrial-sized solar (OneNYC 2050, 2019). If private homeowners have increased opportunities to invest in solar energy, carbon neutrality may be reached at a faster pace because of the contracting demand from power suppliers, like ConEd, whose grid is approximately 85% dependent on fossil fuels (New York City Mayor's Office of Climate and Environmental Justice, 2021). Quite simply, private supplementation of energy will lower the demand for ConEd energy and may ultimately slow dependence on fossil fuels.

Though it may be considered a fallacy, an externality of clean energy is a reduction in loss of life because of the burning of fossil fuels. In a joint effort between Harvard University, the University of Birmingham, the University of Leicester, and University College London, researchers found that eight million people died in 2018 from fossil fuel pollution. Their findings say that about one in five deaths were the result of burning diesel fuel and coal (Vohra, et al., 2021). Though this data is worldwide, the premise of the argument stays the same – lives will be saved and there will be greater health outcomes in New York City and beyond if society becomes less or non-dependent on fossil fuels.

Recommendation

After evaluating tradeoffs and projected outcomes for each policy alternative, *maintaining the status quo in the short run is the recommended course of action.*

Maintaining the status quo was the most beneficial course of action because, even though our evaluation weighted political and administrative feasibility relatively lower than other criteria, the high rank in each, respectively, ranked higher in each of the latter three alternatives.

One of the largest factors in this policy decision was the heavily weighted criteria of cost to taxpayers. Both the status quo and audit of regulatory reform were lower in cost relative to the cost of a zero-interest loan program. The education and framing alternative though relatively inexpensive, received a low-medium rank because it can be assumed that the success rate (i.e., reaching their intended audience) would be about 2% using relevant data (Richards, n.d.). It could be assumed that there would be a greater cost that is not evaluated within its current measurement than a mailer campaign would pose to be relatively more costly.

In the short run, it would be most beneficial for the Office of Management and Budget, in partnership with other respective agencies, to analyze the effects of current programs at the state, local, and federal levels. Most specifically, it will be important to analyze market trends for residential PV systems as a result of the Inflation Reduction Act that was passed in August of 2022. In the long term, it could be beneficial for the OMB to further consider projected outcomes for regulatory reform and increased education efforts for homeowners.

A guide to the implementation of this policy can be found in the following section of this report.

Adoption and Implementation

Though the recommended policy is to evaluate the status quo in the short run, this section will create a long-term implementation and adoption strategy taking into account both recommendations one and two. The timeline below integrates phased, soft deadlines for when each goal is set to be complete. Fiscal years within the New York City Government begin on July 1st and conclude on June 30th each calendar year (e.g. FY2023 – July 1, 2022-June 30, 2023).

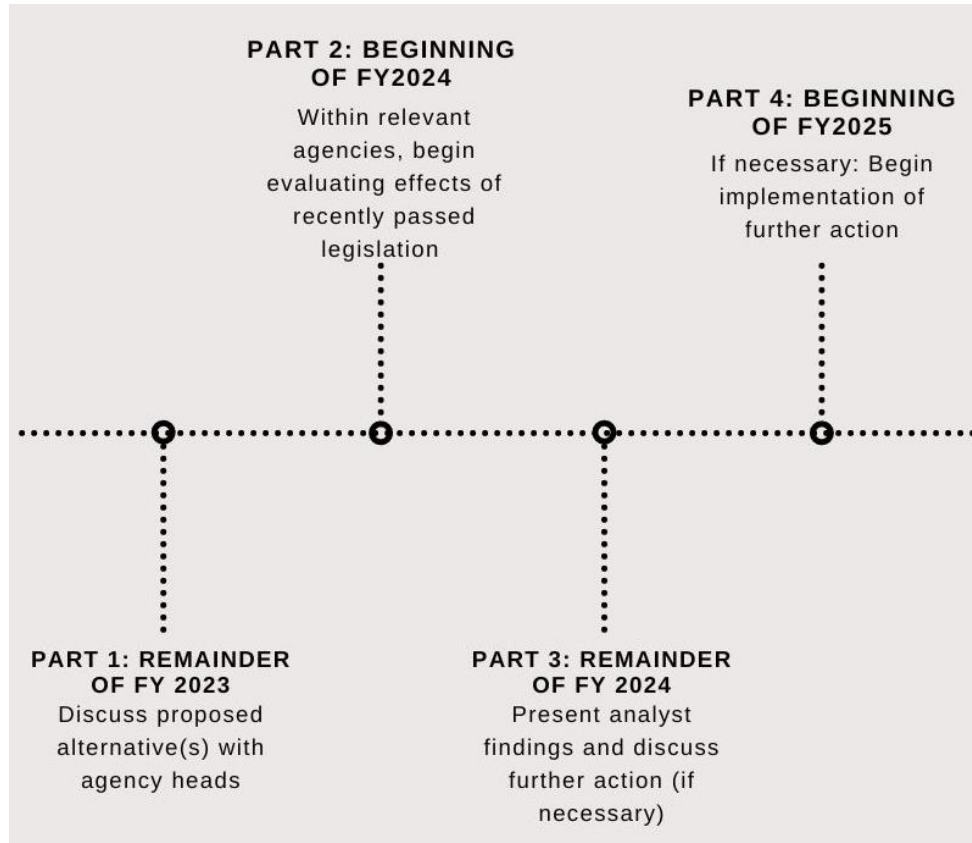


Figure 5 - Implementation Timeline

Phase 1: In partnership with agency heads, the mayor, along with representatives of the Office of Management and Budget, should engage in multiple rounds of discussion concerning each of the proposed alternatives with the most emphasis being placed on the highest-scoring policies. Throughout these discussions, it is pertinent that the head of each agency thoroughly evaluates each alternative to best represent the needs and specialties of their respective mission. Though the following list is not all-encompassing, the following directors or senior-level representatives of the following agencies should participate in such dialogue:

- **Mayor Eric Adams:** It is within the executive powers of the mayor to order a city initiative
- **Office of Policy and Planning, Department of City Planning, and the City Planning Commission** would ensure that any proposed or enacted policy would meet General Project Plans (GPPs) and adequately meet the development needs of the city
- **Department of Buildings Acting Commissioner Kazmir Vilenchik** would possess a heightened specialty regarding safe construction and zoning regulations found within a proposed policy
- Many offices within the jurisdiction of the **Deputy Mayor for Operations like the Chief Climate Officer, the Office of Climate and Environmental Justice, the Department of Environmental Protection, and the Department of Sanitation** would all ensure that any part of a policy enacted that falls within their jurisdiction, no matter if the policy is all-encompassing or hardly within, would ensure it complies with local codes as it pertains to their respective offices
- **Director Roberto Perez of the Office of Intergovernmental Affairs:** Director Perez would be able to continue the dialogue at the local, state, and federal levels of government concerning the policy the mayor's office will aim to implement

Phase 2: Within the aforementioned agencies, analysts should begin to analyze the effect of the status quo (i.e., previously/recently passed legislation with provisions to incentivize private photovoltaic system uptake).

The findings of this phase will be imperative to the long-term timeline of increased uptake of private PV system adoption. Most importantly, these findings will inform the mayor and pertinent directors of agencies as to what next policy initiatives may be needed.

Phase 3: Using the findings from Phase 2 as a guide, Phase 3 will determine the long-term strategy for private PV system adoption. If upon justification from phase 2, relevant stakeholders determine that the status quo is not enough to achieve the goal of increasing residential PV system uptake, additional policy initiatives – like regulatory reform – may be explored during the waning months of the fiscal year 2024.

Phase 4 (if necessary): Lastly, if analysts, agency directors, and the mayor deem it necessary to take action to further incentivize residents in the relevant residential zones to adopt private PV systems, this action should begin to take shape at the beginning of the fiscal year 2025.

An example of an action that could take place during this phase may take the form of an initiative coming from the desk of the mayor, analysis teams may begin to take shape, and necessary meetings with both governmental and nongovernmental entities will begin to discuss further actions

Implementation: Because the recommended policy in the short term is to maintain the status quo, implementation will largely consist of creating working groups of analysts to evaluate PV market trends, changes in the initial problem, and trends in PV uptake as a result of recent pieces of legislation.

For possible additional interventions to take place at the local level as soon as possible, analysis teams should be assembled to begin in the early weeks of the fiscal year 2024 and conclude in the waning weeks of the same fiscal year.

Appendix

3% Discount Rate			
Projected Cost in 2025			
Average Cost of 5 kW PV system in NY	\$16,050		
Average Cost of 5 kW PV system in NY after state and federal incentives	\$11,877		
Cost	(\$11,877)		
Customer payment per year	\$ 1,187.70		
Assuming 3% Discount			
Year	Amount	Discount Factor	NPV
1	\$ 1,187.70	0.9709	\$ 1,153.11
2	\$ 1,187.70	0.9426	\$ 1,119.52
3	\$ 1,187.70	0.9151	\$ 1,086.91
4	\$ 1,187.70	0.8885	\$ 1,055.26
5	\$ 1,187.70	0.8626	\$ 1,024.52
6	\$ 1,187.70	0.8375	\$ 994.68
7	\$ 1,187.70	0.8131	\$ 965.71
8	\$ 1,187.70	0.7894	\$ 937.58
9	\$ 1,187.70	0.7664	\$ 910.27
10	\$ 1,187.70	0.7441	\$ 883.76
Total	\$ 11,877.00		\$ 10,131.32
Loss incurred for each household by NYC	\$ (1,745.68)		
Cost			
Assuming 5% Discount			
Year	Amount	Discount Factor	NPV
1	\$ 1,187.70	0.9524	\$ 1,131.14
2	\$ 1,187.70	0.9070	\$ 1,077.28
3	\$ 1,187.70	0.8638	\$ 1,025.98
4	\$ 1,187.70	0.8227	\$ 977.12
5	\$ 1,187.70	0.7835	\$ 930.59
6	\$ 1,187.70	0.7462	\$ 886.28
7	\$ 1,187.70	0.7107	\$ 844.08
8	\$ 1,187.70	0.6768	\$ 803.88
9	\$ 1,187.70	0.6446	\$ 765.60
10	\$ 1,187.70	0.6139	\$ 729.14
Total	\$ 11,877.00		\$ 9,171.10
Loss incurred for each household by NYC	\$ (2,705.90)		
Cost			
Assuming 7% Discount			
Year	Amount	Discount Factor	NPV
1	\$ 1,187.70	0.9346	\$ 1,110.00
2	\$ 1,187.70	0.8734	\$ 1,037.38
3	\$ 1,187.70	0.8163	\$ 969.52
4	\$ 1,187.70	0.7629	\$ 906.09
5	\$ 1,187.70	0.7130	\$ 846.81
6	\$ 1,187.70	0.6663	\$ 791.41
7	\$ 1,187.70	0.6227	\$ 739.64
8	\$ 1,187.70	0.5820	\$ 691.25
9	\$ 1,187.70	0.5439	\$ 646.03
10	\$ 1,187.70	0.5083	\$ 603.77
Total	\$ 11,877.00		\$ 8,341.91
Loss incurred for each household by NYC	\$ (3,535.09)		

Figure 6 - Cost of Alternative #3 at Various Sensitivities, the average cost of a 5 kW system from EnergySage

Staten Island projected R1-R3 homes	84,750
The Bronx projected R1-R3 homes	20,760
Brooklyn projected R1-R3 homes	58,500
<u>Queens projected R1-R3</u>	<u>216,480</u>
Estimated total number of R1-R3 households that are owner occupied	380,490
5% take up	19,025
10% take up	38,049
15% take up	57,074
20% take up	76,098
25% take up	95,123
30% take up	114,147

Figure 7 - Projected Number of Resident Homeowners in NYC and Sensitivities of Projected Take-up Rates, Projections calculated from Furman Center at NYU data

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