

STRATEGIC GUIDANCE FOR THE NYC °COOLROOFS PROGRAM, 2017-2018

SAVE MONEY

REDUCE ENERGY USE

IMPROVE ROOF DURABILITY

COMBAT URBAN HEAT ISLAND

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NYC °COOLROOFS

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EXECUTIVE SUMMARY

NYC °CoolRoofs is a program of the New York City Department of Small Business Services (SBS) that provides workforce training and coats city rooftops with a white, reflective coating that reduces building energy use and mitigates the urban heat island (UHI) effect. Since its inception in 2009, the NYC °CoolRoofs initiative has coated over 6.6 million square feet of rooftop space, contributing to lower cooling costs and reducing an estimated 3,315 metric tons of carbon dioxide equivalent (tCO₂e) emissions in the city.¹ The City's 2014 greenhouse gas (GHG) reduction plan called for the future continuation and expansion of the NYC °CoolRoofs program.² However, the program has recently fallen short of its goal of coating one million square feet annually, as a result of delays caused by the program's restructuring in 2015 from a volunteer-based initiative to a workforce development training opportunity. SBS sought assistance in determining priority areas for coating and recoating rooftops over a two-year period from the beginning of 2017 through the end of 2018.

The following report was written by a team of Columbia University students working as a Capstone consultancy in the university's Master of Science in Sustainability Management program. The report details the Capstone team's methodology, findings, and recommendations, featuring a prioritized list of 2.7 million square feet of coatable rooftops that should allow NYC °CoolRoofs to meet its square footage goal for at least the next two years. The report also provides guidance in crafting an appropriate outreach strategy to encourage building owners to install cool roofs.

To craft its recommendations, the team first used the City's Heat Vulnerability Index (HVI) to identify the areas that would benefit most from °CoolRoofs implementation. The team then used a set of spatial criteria to narrow the geographic focus and identify a pool of potential buildings and associated owners from the City's tax records. The team identified the largest owners of roof space in these areas and conducted significant research on these property owners, including direct outreach to gauge interest in participation. Ineligible or uninterested owners were eliminated. The remaining owners were ranked based on their building characteristics and use, as well as on feedback from the team's outreach.

The analysis resulted in 2.7 million square feet of promising rooftop for °CoolRoofs coating. In addition to this main list, this report also contains two additional lists of coatable rooftop that can be used as alternative or supplemental square footage should SBS require: first, a list of 865,000 square feet that fit most, but not all, of the requirements for building participation; and second, a list of approximately 1 million square feet that were coated more than five years ago and thus would benefit from re-coating. The total square footage of all recommendations is thus nearly 4.6 million square feet of rooftop, with over 3.5 million square feet that have never before been coated.

The priority list of 2.7 million square feet represents a mix of ownership types, with roughly 40% representing publicly-owned buildings, 22% representing buildings owned by private, for-profit owners, and the remaining 38% representing buildings that serve a non-profit, affordable housing, or social service function. Owner contact information and records of any preliminary outreach were provided to SBS for detailed roof assessments and follow-up to secure these owners' participation in NYC °CoolRoofs.

To craft recommendations for program outreach, the team conducted supplementary research that will help make the case for building owner participation, and will allow the program to expand its reach to a wider audience. This included qualitative research into best practices followed by cities with similar programs, as well as quantitative analysis to create useful metrics for promoting °CoolRoofs. The team researched energy cost savings and Greenhouse Gas (GHG) emissions reductions impacts of °CoolRoofs coatings, and developed a simple financial model and emissions calculator that will allow potential participants to anticipate the impacts of coating their roofs. This building calculator is a key tool that the team developed for SBS to use in convincing building owners to participate in °CoolRoofs.

Beyond targeted outreach to the identified list of building owners in high HVI zones, there are other steps that SBS can take to promote °CoolRoofs more broadly. The team created a set of public-facing graphics and messaging materials that can be used online and across the city to build name recognition for the program and potentially bring in additional participants. The team also researched community organizations, elected officials, and compatible agencies or building-related programs that might play a role in future efforts to promote °CoolRoofs.

By compiling this list of priority neighborhoods, building owners, and specific buildings for participation in the program, the team will help °CoolRoofs meet its goal of coating one million square feet annually, at least through the end of 2018. The building calculator estimates that one million square feet of rooftop coated in 2017 will save \$101,120 in first year energy costs and 135 metric tons of carbon dioxide equivalents will be avoided. A typical roof for the program measuring 8,000 square feet will result in \$2,966 saved and 3.97 metric tons of carbon dioxide equivalents avoided over a five-year period. As the program expands to additional buildings, the cumulative impact of energy cost savings and emissions reductions also grows. Following these recommendations, the cumulative °CoolRoofs coatings from the inception of the program to the end of 2018 are projected to have offset total GHG emissions by 4,877 metric tons. This is equivalent to taking 1,030 passenger vehicles off the road in one year.³

The methodology followed by the team can be recreated for future coatings in 2019 and beyond, by moving on to other heat vulnerable areas of the city that do not fall into the highest category used for these recommendations. In this way, the team has provided NYC °CoolRoofs with a replicable process that can help the program continue to meet its goals and expand to larger areas of New York City over the next decade.

INTRODUCTION & CONTEXT

Project Scope

This project has been undertaken at the request of the New York City Department of Small Business Services (SBS). SBS has asked the Capstone project team to help the °CoolRoofs program achieve its goal of coating one million square feet per year over the next two years. The team's mandate is to provide strategic guidance to SBS by identifying priority areas for roof coatings for 2017 and 2018. The team was also tasked with developing a strategic outreach plan that SBS can use to effectively recruit building owners to participate in °CoolRoofs, and to communicate the benefits of the program to the city at large.

Cool Roofs Explained: Urban Heat Island Effect

Dense urban areas such as New York City experience the Urban Heat Island (UHI) effect. This phenomenon results in higher temperatures in the urban core compared to lower-density areas that have more vegetation and fewer dark, absorbent surfaces like roads and buildings.⁴ These elevated ambient air temperatures create health risks for vulnerable populations such as the elderly, and also increase the overall amount of cooling needed for all buildings in the affected area.⁵

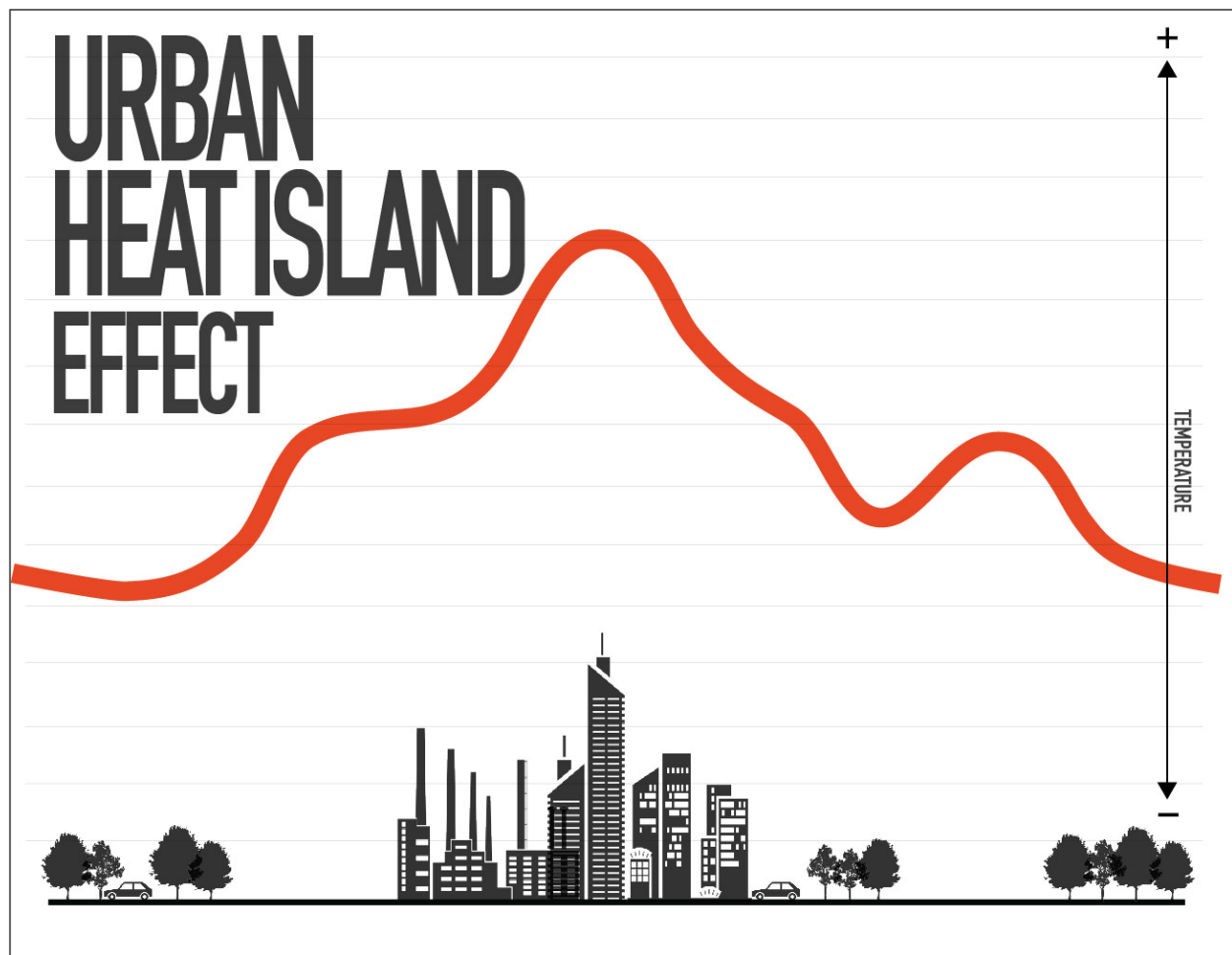


Figure 1. Graphic depiction of the Urban Heat Island Effect.⁶

NYC °CoolRoofs Goals and Benefits

NYC °CoolRoofs is a government-sponsored sustainability program, hosted through SBS. °CoolRoofs coats city rooftops with a white, reflective coating that reduces building energy consumption and lowers carbon emissions, while also training local jobseekers through a paid and transitional work-based learning experience. The program has an annual goal to coat one million square feet of roofs across the city while providing job training to at least seventy New Yorkers.⁷ White rooftops reflect sunlight and thereby decrease solar absorption which would otherwise increase the interior temperature of a building.⁸ By applying white latex coatings to rooftops, °CoolRoofs provides a low-cost method for reducing the temperatures of urban neighborhoods during the hottest months of the year. °CoolRoofs coatings produce several benefits – all of great interest to sustainability practitioners:

Building-level benefits: °CoolRoofs can significantly lower air conditioning use on hot summer days, when it accounts for up to 40% of daily electricity use, thereby lowering electricity bills for owners and tenants.⁹ Additionally, reduced roof temperatures prevent the thermal shock stress associated with large temperature changes, thus limiting a roof's expansion and contraction¹⁰ and prolonging the life of cooling equipment.¹¹

Neighborhood-level benefits: °CoolRoofs may help to reduce ambient air temperatures, thereby mitigating the Urban Heat Island effect, with positive public health impacts.^{12 13}

City-level benefits: °CoolRoofs contributes to greenhouse gas (GHG) emission reductions and aligns with the City's OneNYC initiative to reduce carbon emissions 80% by 2050.¹⁴

Socio-economic benefits: NYC °CoolRoofs' job-training and placement efforts create a benefit for un- and under-employed New Yorkers and their communities. Workforce participants work in teams to complete cool roof installations for individual buildings and are part of a 35-person cohort that undergoes a ten-week-long training program. The program connects them to full-time work at the end of the job training period.¹⁵ Furthermore, by providing coatings at no cost for social service organizations and low-income housing providers, the program indirectly benefits the underprivileged New Yorkers served by these organizations.

Program History and Recent Challenges

Since 2009, over 6.6 million square feet of roof have been coated in New York City. Roughly 40% of this square footage has been coated through NYC °Cool-It-Yourself, in which building owners coat their own roofs, often using discounted materials purchased through the program.¹⁶ In 2015, the NYC °CoolRoofs program and its °Cool-It-Yourself initiative were transitioned from the City's NYC Service initiative, a Mayoral office, to SBS. As part of this migration, the program was reorganized to focus on workforce development. Prior to this, the program had relied primarily on volunteer labor. The program is developing a strong track record in preparing unemployed and under-employed residents for jobs in the construction, building maintenance, energy services, and other sectors.

However, recently °CoolRoofs has coated fewer roofs than needed to meet its annual targets. SBS asked the project team to get the program back on track to achieve its annual goal of coating one million square feet, while maintaining the recent progress in workforce development.

SBS targets °CoolRoofs participants based on a mission of serving underserved and vulnerable populations and communities. SBS has communicated to the team that it seeks to meet three social objectives with the program:

To support energy efficiency and GHG emissions reductions in local non-profit, low-income housing, or social service organizations;

To produce socio-economic benefits for unemployed and under-employed New Yorkers and their communities via workforce training; and

To serve populations at risk to the impacts of extreme heat and the UHI effect, as defined by the City's HVI.¹⁷

The workforce objective is not within the team's scope of work for this project. Following these guidelines resulted in a prioritization of the following stakeholders:

Municipal organizations affiliated with the City that serve at-risk citizens;

For-profit organizations that provide low-income housing; and

Non-profit or non-government organizations which provide housing or other services to at-risk populations.

The team's goal was to produce a list of 2 million square feet of coat-able rooftops, with roughly sixty percent of this square footage belonging to the above types of organizations. These coatings will be fully funded and paid for by the City. Buildings owned by corporate or for-profit businesses were allowed to comprise up to forty percent of the team's final recommendations and will be identified as potential candidates for the °Cool-It-Yourself program.

RESEARCH METHODOLOGY & FINDINGS

Overview

The team approached the project by identifying key targets for NYC °CoolRoofs outreach and implementation in specific areas of New York City. The team's methodology included:

Mapping and Spatial Analysis to determine geographic focus areas with residents at-risk from heat-related impacts;

Participant Research and Surveys to identify and prioritize a list of potential program participants within the focus areas, and to determine the best way of securing their participation;

Energy & GHG Analysis to understand building-level energy impacts of °CoolRoofs coatings;

Financial Analysis to produce cost savings data that can be used to promote the program; and

Case Studies to understand and possibly adopt best practices from similar programs in other cities and to craft recommendations for broad outreach beyond the targeted recommendations.

The first two of these items are discussed below, along with key findings. The remaining three items are discussed in the Other Research section of this report.

Mapping and Spatial Analysis

Mapping and Spatial Analysis was performed using publicly available data from the PLUTO¹⁸ online database, via the New York City Open Data Portal.¹⁹ Additionally, the team utilized a database of existing NYC °CoolRoofs and °Cool-It-Yourself building locations provided by SBS and also available on the City's Open Data Portal. Spatial analysis and GIS operations were performed using ESRI's ArcGIS 10.4. ESRI ArcMap and ArcCatalog 10.4, which allowed for adequate processing using no third-party or add-on software or extensions.

The team relied heavily on MapPLUTO data, which provides data on ownership, building footprint size, number of vertical stories, street address, and longitude and latitude for every lot in the city. The team also relied on New York City's HVI, which describes community susceptibility to heat impacts.²⁰ This Index was developed using indicators on poverty, race, tree cover, local surface temperature, and household health.²¹ Two basic assumptions were used to identify the geographic hotspots for research and recommendations:

1. Cool roofs work by increasing the albedo,²² or amount of solar radiation reflected from a building's roof, therefore reducing the ambient interior temperature of a building.²³
2. SBS provides °CoolRoofs installation free of charge to qualifying non-profit entities and entities that serve public needs for at-risk communities.²⁴

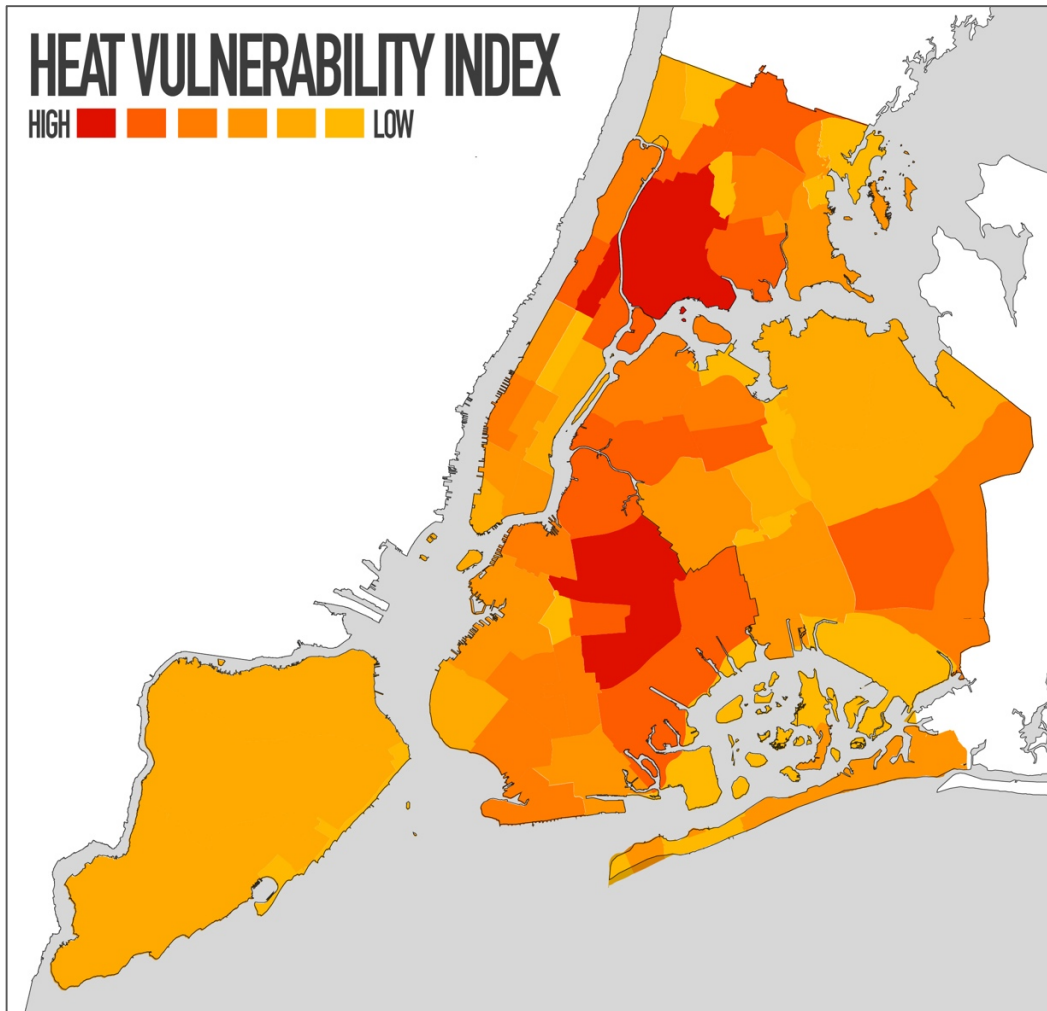


Figure 2. NYC Heat Vulnerability Index, by Community District.²⁵

Based on these assumptions, geographic priorities were selected for their fulfilment of the following criteria:

1. Selected area is within a zone designated “High Vulnerability” by the City’s HVI.
2. Selected area is within ¼ mile of existing °CoolRoofs installation.²⁶

The geographic focal points identified include portions of Central Harlem, the South Bronx, and Central Brooklyn as highlighted below. All entries in the PLUTO database that fall within these areas were identified. Then, a set of building-specific criteria was applied as follows:

1. Selected buildings are no more than 6 stories tall.
2. Selected buildings have a roof size of at least 3,000 square feet.

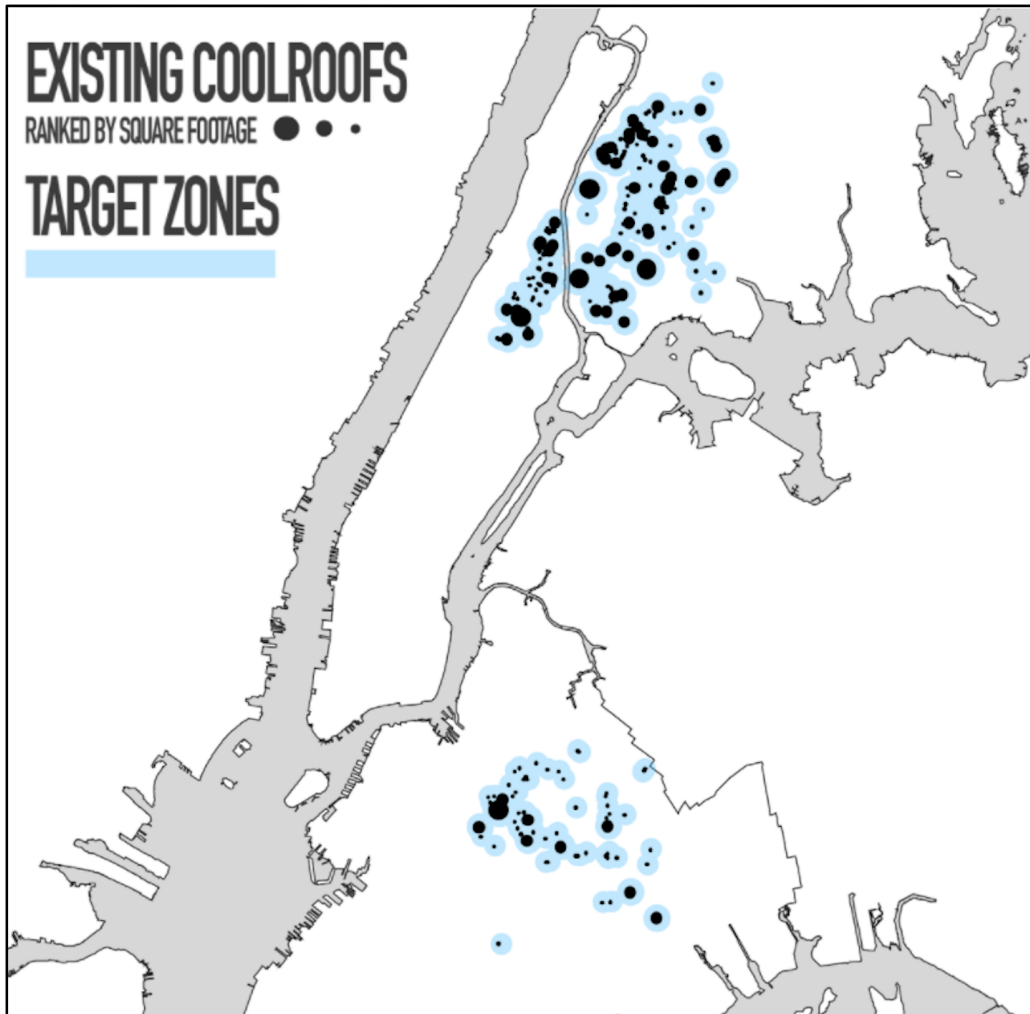


Figure 3. Target zones for analysis, based on existing NYC °CoolRoofs installations.

The output of this geographic analysis was a database of 50,814 building addresses accounting for 107,572,427 square feet of roof space. To translate these building addresses into potential partnership opportunities, the ownership of each building was further evaluated, as outlined in the following section on Participant Research and Surveys.

Additional details on the team's geographic analysis can be found in the Appendices. See Appendix M1 for a data dictionary and index of data acquired and used. Step-by-step operations can be found in Appendix M2, and additional detail maps of the suggested roof locations and existing roofs can be found in Appendix M3.

Participant Research and Surveys

The database of over 50,000 buildings provided by the initial mapping analysis was far too large to meaningfully analyze each address. To hone this list into a more manageable pool of potential NYC °CoolRoofs participants, the team conducted additional data analysis to reduce the pool of buildings.

First, every unique owner was identified on the list of 50,814 buildings within the reduced PLUTO database. Using Microsoft Excel, the number of buildings and total roof square footage associated with each unique owner was summed. Sorting by total square footage transformed the list from a set of building addresses to a target group of building owners, with the most promising owning the most rooftop

space. Building owners with the largest square footage included many municipal organizations such as the Department of Education (198 buildings; 5,127,037 square feet), the NYC Housing Authority (NYCHA) (395 buildings; 1,773,168 square feet) and the NYC Department of Housing Preservation (111 buildings; 240,023 square feet). Corporations, private entities and non-government organizations (NGOs) were also present on the list.

The team selected only the building owners with the largest amount of square footage from the list. From the original PLUTO dataset of over 1.2 million buildings, the team arrived at a list of the 181 largest private building owners within the targeted geographic zones, totaling 10.6 million square feet of roof space. These owners were targeted for direct outreach regarding the °CoolRoofs or °Cool-It-Yourself programs. An additional 21 public agencies were identified as owning more than 10 million square feet of roof space in the target zones. Because SBS already has established relationships with these agencies, a different set of criteria was applied for them, and the team's research efforts were directed towards the private owners.

Using available online search engines, the capstone team identified relevant details regarding each owner, including:

- 1. Organization type**
- 2. Building use**
- 3. Owner contact information**
- 4. Alternate, Management, or Parent Company Name**

The above information was primarily gathered via LavaMap,²⁷ NYC Planning's Zoning and Land Use (ZoLa) Map,²⁸ New York State's Corporate and Business Entity Database,²⁹ and Google search. Additionally, the team used Google satellite imagery to determine whether each owner's building roofs appeared to be strong candidates for cooling, according to the Building Participation Guide published by SBS.³⁰ For example, if a building showed up in the satellite imagery as clearly having a pitched roof, it was eliminated from consideration, as only flat roofs are eligible to be coated under the program.

The team developed a questionnaire for use in preliminary outreach to the targeted private building owners. This questionnaire was meant as a first-level screening to gauge owner interest in program participation, to collect data on why or why not an owner might want to participate, and to record a qualitative assessment of the next steps for engaging each particular owner or organization. The call script and email template used for the questionnaire can be found in Appendix A7 and Appendix A8.

Results of Initial Outreach

The team successfully contacted 34 of 175 non-government building owners. During this process, the team was able to eliminate thirteen building owners who said they were not interested in participating in the program. Twelve owners expressed interest in the program and nine owners were indifferent and asked for additional information. Indifferent owners, along with the 141 owners that the team was unable to contact, were included in the final results as "Maybe" interested in participating.

The initial outreach process highlighted the inefficiency of direct cold-calling outreach. The team found it difficult to connect with target organizations and were often met with "sales pitch skepticism." As such, the recommendations to SBS identify strategic alternate modes of communication with prospective participants, beyond cold-calling. This experience also made clear that many identified building owners are represented by management companies, who are empowered to make decisions regarding building maintenance and energy management. A given management company often manages significantly more buildings than those which the team identified, meaning that these connections are a potentially fruitful source for NYC °CoolRoofs expansion beyond the specific addresses identified in this report. Suggestions for targeting these types of relationships is discussed in greater detail within the Outreach Strategy section.

To finalize the list of target participants, a final set of ranking criteria prioritized buildings by:

Eligibility: Based on satellite image assessment, the following types of roofs were considered not eligible: no parapet, ballasted, significant coverage by equipment or HVAC, not flat (e.g.: slanted, pitched, domed, etc.)

Roof Color: Black, Dark Gray, Gray, Mixed (light and dark), Aged White, White

Square Footage of Rooftop: Over 10,000 total square feet

The building list was then filtered by High and Medium priority, as shown in the Table 1 below, for Residential, Schools, and Church building types. The resulting list comprises the final recommendations, as outlined in the following section. High priority Commercial and Industrial buildings were provided as an alternative list.

Roof Square Feet	Roof Color: Black, Dark Gray	Roof Color: Gray, Mixed	Roof Color: White, Aged White
25,000 - 50,000	High	Medium	Not Recommended
10,000 - 25,000	Medium	Low	Not Recommended
3,000 - 10,000	Low	Low	Not Recommended
< 3,000	Not Recommended	Not Recommended	Not Recommended

Table 1. Matrix of building ranking criteria for both public and private buildings.

FINAL LIST OF RECOMMENDED PARTICIPANTS

The team's ranking criteria provided a top tier of recommendations consisting of 2.7 million square feet of coatable roof spread across private non-profit, private for-profit, and public building owners. The recommendations exceed the requested 2 million square feet because the team expects that there will not be a 100% participation rate for the identified target owners and buildings. In addition to the top tier recommendations of 2.7 million square feet, the team identified an additional list of 865,000 square feet of second-tier recommendations, as well as 1.1 million square feet of potential re-coatings. The following sections provide additional detail for each of these recommendations.

Recommended Private Building Owners

The team's ranking criteria resulted in a list of recommended top-tier private participants totaling 34 owners with 53 buildings, covering 1.66 million square feet of roof space.

Building Owner Name	Number of Buildings	Roof Square Footage	Borough	For/Non-Profit	Building Type
Boston Tremont Housing Dev. Fund Corporation	4	207,325	Bronx	Non-Profit	Res - Low Income
Hp Marcus Garvey Preservation Housing Company, Inc	6	175,193	Brooklyn	Non-Profit	Res - Low Income
Bronx Preservation Housing Development Fund Corp	2	98,235	Bronx	Non-Profit	Res - Low Income
Melrose Court Condominium	1	76,706	Bronx	For-Profit	Res
Dunbar Owner Llc	1	72,342	Manhattan	For-Profit	Res
Fordham University	1	60,000	Bronx	Non-Profit	School
Plaza Residences Lp	1	59,659	Brooklyn	Non-Profit	Res
The Crenulated Company Ltd	4	52,851	Bronx	Non-Profit	Res - Low Income
Prc Westchester Avenue Llc	1	48,536	Bronx	Non-Profit	Res - Low Income
Fordham Prep School	1	47,273	Bronx	Non-Profit	School
Willoughby Court Apartment Lp	1	47,255	Brooklyn	For-Profit	Res - Low Income
Sydney Engel Associates	1	43,435	Bronx	For-Profit	Res
975 Walton Bronx Llc	1	43,171	Bronx	For-Profit	Res - Mixed Use
Fulton Park Site 4 Houses,Inc	1	43,143	Brooklyn	Non-Profit	Res - Low Income
Chauncey Housing Inc	1	41,101	Manhattan	Non-Profit	Res - Low Income
Walton Ave Associates	3	38,870	Bronx	For-Profit	Res
St Marks Avenue Property Llc	1	38,258	Brooklyn	For-Profit	Res
H.E.L.P.-Bronx L.P.	1	37,602	Bronx	Non-Profit	Res - Low Income
South Bronx Job Corps	1	36,894	Bronx	Non-Profit	Res - Mixed Use
Diego Beekman Mutual Housing Association	3	36,023	Bronx	For-Profit	Res - Low Income
Related Retail Hub Llc	1	34,804	Bronx	For-Profit	Res - Mixed Use
Mt Carmel Church	1	33,739	Bronx	Non-Profit	School
Argus Community Inc	1	33,454	Bronx	Non-Profit	Res - Mixed Use
Surat Realty	1	32,392	Brooklyn	For-Profit	Res
Garden Court Housing Development Fund Corporation	1	31,503	Manhattan	For-Profit	Res
Prc Andrews Avenue Llc	2	31,279	Bronx	Non-Profit	Res - Low Income
Second Farms Neighborhood Housing Development Fund	1	31,037	Bronx	For-Profit	Res
789 St Marks Realtycorp	1	29,892	Brooklyn	For-Profit	Res
St Simon Stock Roman Catholic Church	2	25,697	Bronx	Non-Profit	School
Zevrone Realty Corp	2	22,690	Bronx	For-Profit	Res
Greater New York Corporation Of Seventh Day Advent	1	12,238	Bronx	Non-Profit	Church
Louis Reichardt Holdings Llc	1	12,233	Bronx	For-Profit	Res

Table 2. Tier 1 Private Building Owner Recommendations

The full list of private building owners along with related details can be found in Appendix A1.

Recommended Public Agencies

In the past, many public buildings have been coated by NYC °CoolRoofs. These buildings make up approximately one-third of all existing NYC °CoolRoofs coatings by square footage, as shown in the table below.

PUBLIC AGENCIES - TOTAL EXISTING °COOLROOFS		PUBLIC AGENCIES - TOTAL EXISTING °COOL-IT-YOURSELF	
Owner	Roof Square Footage	Owner	Roof Square Footage
NYPD	275,772	NYPD	35,737
NYCHA	216,614	NYCHA	57,408
The City University of New York (CUNY)	176,275	The City University of New York (CUNY)	70,670
NYC Department of Homeless Services (DHS)	235,132	NYC Department of Parks & Recreation	582,175
Brooklyn Public Library	81,502	NYC Department of Education	553,035
NYC Department of Housing Preservation and Development (HPD)	51,022	Con Edison	246,000
		NYC Department of Environmental Protection (DEP)	200,000
		NYC Department of Small Business Services	188,500
		Queens Library	74,952
		NYC Human Resources Administration (HRA)	24,000
		NYC Department of Citywide Administrative Services (DCAS)	22,500
		New York Public Library (NYPL)	19,300
		NYC Department of Transportation (DOT)	9,980
		NYC Fire Department	6,161
6 Owners	1,036,317	15 Owners	2,090,418

Table 3. Previous Public Agency Participants for °CoolRoofs and °Cool-It-Yourself

However, SBS informed the team that in the future, buildings owned by the City of New York will not be prioritized for NYC °CoolRoofs coatings using workforce development labor. Instead, these buildings will be recommended for coating either via °Cool-It-Yourself or via volunteer coating days, which are now offered in a more limited capacity compared to past years. As a result, the team's recommendations for public buildings focus on two agencies whose buildings are not owned by the City: The City University of New York (CUNY) and the New York City Housing Authority (NYCHA). These two agencies have 29 high- or medium-priority buildings totaling nearly 760,000 square feet of roof space.

Entity Name	Number of Buildings	Roof Square Footage	Recommendation
NYCHA	26	639,704	°CoolRoofs
CUNY	3	85,263	°CoolRoofs
DOE	9	307,306	°Cool-It-Yourself
HPD	3	54,034	°Cool-It-Yourself
TOTAL	41	1,086,308	

Table 4. Public Building Recommendations

Additionally, the team recommends pursuing °Cool-It-Yourself opportunities with the Department of Education (DOE) and the Department of Housing Preservation and Development (HPD), due to these agencies' past participation in the program and high volume of coatable, high-priority roof space within the target geographic areas.

The full list of public building owners along with related details can be found in Appendix A1.

Tier 2 Recommendations

The team's ranking criteria resulted in a list of second-tier recommendations for private participants. This list includes 20 owners with 20 buildings covering 865,000 square feet of roof space. This list should serve as a lower-priority supplement to the Tier 1 coatings recommended above.

Building Owner Name	Number of Buildings	Roof Square Footage	Borough	For/Non Profit	Building Type
Mestousis Realty Corp	1	26,083	Bronx	For-Profit	Industrial
Van Blarcom Closures	1	26,474	Brooklyn	For-Profit	Industrial
Church Of God Of East	1	28,476	Brooklyn	Non-Profit	Commercial
Nrp Property 2 Llc	1	29,216	Bronx	For-Profit	Industrial
Webster Holding Co / 1210 Webster Ave Llc	1	30,004	Bronx	For-Profit	Commercial
Renewal Arts Realty Co	1	30,560	Bronx	For-Profit	Commercial
Poe Affiliates L.P.	1	32,168	Bronx	For-Profit	Commercial
Mikal Management Co	1	32,603	Bronx	For-Profit	Industrial
Automotive Realty Corporation	1	32,658	Bronx	For-Profit	Commercial
Deleonardis Frank	1	37,832	Bronx	For-Profit	Industrial
940 Southern Boulevard Llc	1	38,315	Bronx	For-Profit	Commercial
Gostan Realty Corp	1	38,670	Bronx	For-Profit	Industrial
A.L. Eastmond & Sons	1	38,701	Bronx	For-Profit	Industrial
Midland Steel Warehouse Corp	1	39,379	Bronx	For-Profit	Industrial
Tori Realty Corp	1	44,000	Bronx	For-Profit	Industrial
Royal Third Ave Realty Co	1	55,225	Bronx	For-Profit	Commercial
Western Beef Properties	1	63,465	Bronx	For-Profit	Commercial
173Rd Street Realty Corp	1	73,522	Bronx	For-Profit	Industrial
Gladiator Realty Corp	1	78,084	Bronx	For-Profit	Industrial
Cross Bronx Plaza Llc	1	89,616	Bronx	Non-Profit	Commercial
TOTAL	20	865,051			

Table 5. Tier 2 Private Building Owner Recommendations

The full list along with related details can be found in Appendix A1.

Geographic Results

Taking all the above buildings together yields concentrations in the South Bronx, Central Brooklyn, and Harlem. The figure below summarizes the quantity of recommended roofs by specific neighborhoods and borough.

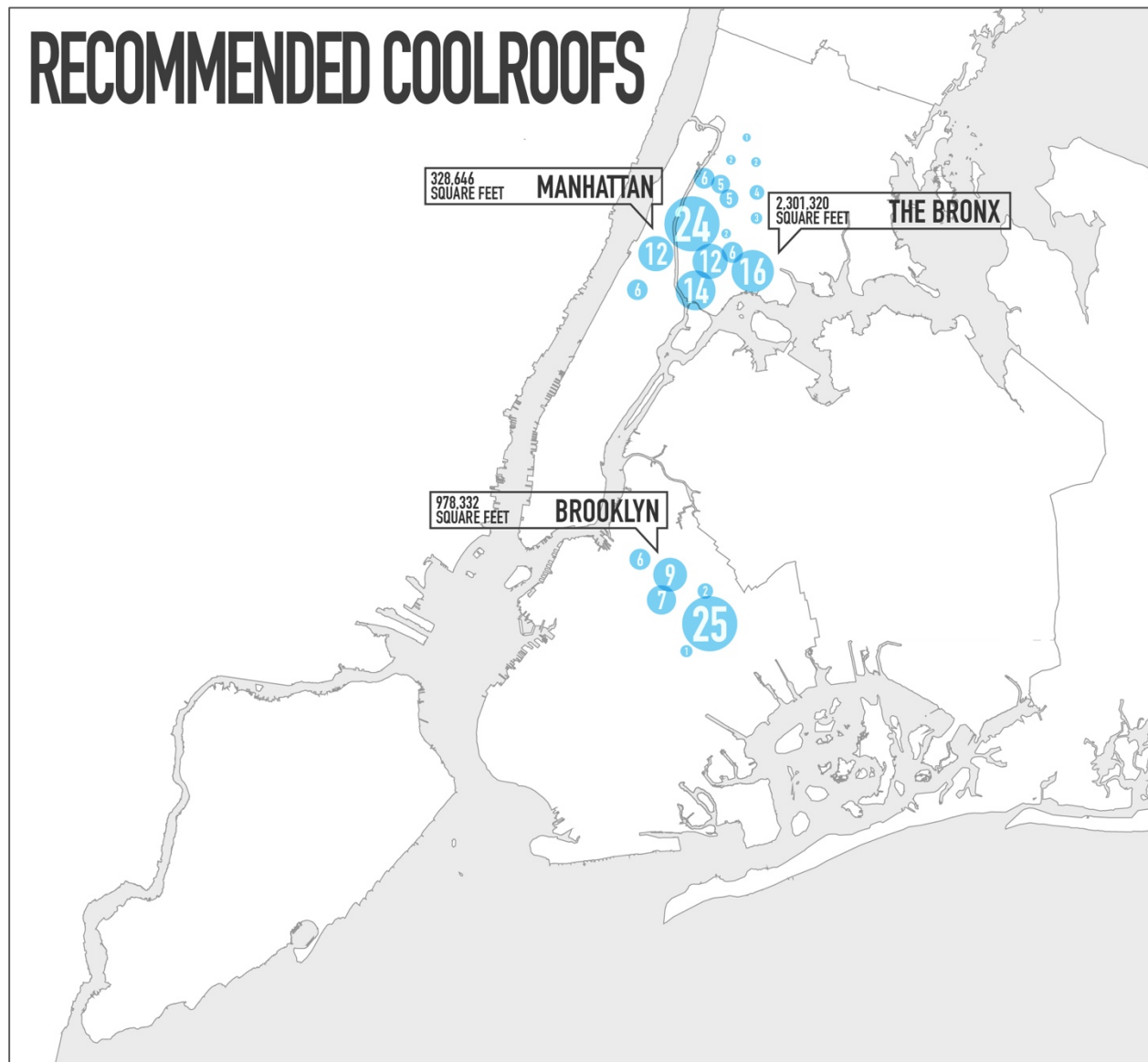


Figure 4. Number of recommendations by neighborhood for NYC °CoolRoofs and °Cool-It-Yourself, 2017-2018.

The complete list of these neighborhoods is provided in Appendix M4.

Re-Coatings Strategy

Over time, the effectiveness of a °CoolRoofs coating diminishes significantly. This albedo loss is due to various factors, including the accumulation on the roof surface of soot and dirt, rainwater ponding, and runoff from roof infrastructure.³¹ SBS requested a strategy for re-coating the roofs of past participants as part of the team's overall recommendations for 2017 and 2018.

Research shows that thoroughly washing a coated roof can restore its reflectivity.³² Due to this fact, and the team's findings of many more potentially higher-impact roofs, re-coatings are recommended as a lower priority for the program in the next two years.

The team recommends that SBS consider re-coating any roof over 3,000 square feet that was coated more than five years ago in areas ranking high on the City's HVI. The two tables below show the list of potential re-coatings for each year.

Building Owner Name	Number of Buildings	Roof Square Footage	Borough
NYCHA	28	187,314	Multiple
Bronx Pro	16	130,605	Bronx
HELP USA	2	52,880	Bronx
NYC Department of Homeless Services (DHS)	3	41,478	Multiple
Parkadon Building Management	2	33,384	Manhattan
Fordham Bedford Housing Corp.	3	26,668	Bronx
Pratt Area Community Council (PACC)	3	18,186	Brooklyn
Getz Obetsfeld	2	17,744	Brooklyn
New Bedford Management Company	1	17,096	Manhattan
YMCA	1	14,300	Brooklyn
The Bridge	2	11,500	Bronx
Bedford Stuyvesant Restoration Corp.	1	8,000	Brooklyn
Democracy Prep	1	6,270	Manhattan
Rocking The Boat	1	6,000	Bronx
Lemle And Wolff	1	4,045	Bronx
West Side Federation for Senior and Supportive Housing (WSFSSH)	1	3,500	Manhattan
PSCH	1	3,226	Brooklyn
Mutual Housing Association of New York (MHANY)	1	3,012	Brooklyn
TOTAL	70	585,208	

Table 6. Recommendations for re-coating in 2017.

Entity Name	Number of Buildings	Roof Square Footage	Borough
Harlem Congregations For Community Improvement Inc (HCCI)	11	67,903	Manhattan
The City University of New York (CUNY)	1	57,700	Bronx
Noonan Plaza Llc	1	48,580	Bronx
Marcus Garvey Nursing Home	1	27,590	Brooklyn
Community Access	4	26,671	Multiple
Bedford Stuyvesant Restoration Corp	2	22,610	Brooklyn
Nos Quedamos	2	20,850	Bronx
Bethlehem Of Harlem LP	5	18,000	Manhattan
Pratt Area Community Council (PACC)	3	16,552	Brooklyn
NYPD	1	16,500	Bronx
Madison Square Boys & Girls Clubs	1	14,420	Bronx
Fordham Bedford Housing Corp.	1	12,230	Bronx
Kyrous Realty	1	9,828	Manhattan
TOTAL	34	359,434	

Table 7. Recommendations for re-coating in 2018.

OTHER RESEARCH – METHODOLOGY & FINDINGS

To formulate a strategic outreach plan, the team researched several areas critical to the understanding the impacts of NYC °CoolRoofs, including:

Strategy Case Studies & Past Participant Surveys to understand and possibly adopt best practices from similar programs in other cities, and to craft recommendations for broad outreach beyond the targeted recommendations.

Energy & GHG Analysis to understand building-level energy impacts of °CoolRoofs coatings;

Financial Analysis to produce cost savings data that can be used to promote the program.

Outreach Case Study Review

Over fifteen case studies on cool roof initiatives inside and outside the United States were reviewed to determine best practices for program operations and communications strategies. Comparable cities such as Washington DC, Los Angeles, Houston, Toronto, and Melbourne were included in the analysis. The team attempted to determine whether NYC °CoolRoofs is the largest such program in the United States. However, due to the lack of standardized metrics used to measure program results in different cities, this analysis was inconclusive. The full list of case studies and results of this research is provided in Appendix R2.

Based on this research, the team identified five strategies for successful outreach:

Key Strategy	Benefits			
	Improves Program Visibility	Develops Trust in the Program	Increases Efficiency	Reduces Barrier to Entry
Availability of Tools		X		X
Public Awareness	X	X	X	
Incentive Program			X	X
Legislative Policy*			X	X
Strategic Partnerships	X	X	X	
*New York City has already implemented legislation to support cool roofs including LL21, LL84, and LL87.				

Table 8. Outreach Best Practices matrix.

1. Increase Availability of Tools

The majority of successful cool roof programs have comprehensive toolkits for building owners, which help to communicate the benefits of cool roofs.³³ Publicly available tools include consumer-facing energy savings calculators and neighborhood maps that allow building owners to compare heat vulnerability in their vicinity. Cities like Los Angeles have tools such as the Lawrence Berkeley National Laboratory Roof Savings Calculator readily available on their websites.³⁴

2. Improve Public Awareness

Targeted public awareness and education programs have been used in a number of cities to improve visibility and garner credibility for the program. Campaigns include hands-on workshops and meetups, videos and direct mail, public demonstration projects, and resident outreach in partnership with public schools.³⁵ New Orleans and Tucson are two cities that have used public projects to increase visibility to the potential for cool roof applications. In New Orleans, the Louis Armstrong International Airport was one of the city's first major roof cooling projects.³⁶ In Tucson, the main fueling facility for the city was coated with a cool roof, resulting in a 50% reduction in energy used.³⁷ Baltimore pursued a different strategy by

partnering directly with schools to educate residents on ways to save energy through coating.³⁸ These types of initiatives can be leveraged to educate the community and industry leaders about the benefits of cool roofs and garner excitement around the effort.

3. Implement Incentives for Private Owners to Participate

A number of cities have implemented financial incentives to encourage private building owners to implement cool roof coating on their own. By reducing the cost of coating, private owners are more likely to participate in the program. Financial incentive strategies that cities have used include grant support, rebates or incentive programs, loan programs, and preferential permitting. These incentives can accelerate adoption of the program by °Cool-It-Yourself participants.

4. Improve Legislative Policy to Require Coating

Legislative policy requiring re-coating for residential and commercial buildings has been leveraged to encourage program adoption. The City of Los Angeles' Cool Roof Ordinance requires all residential properties to use roofing materials that meet specified solar reflectance and thermal emittance values. Residential building owners are also encouraged to complete rebate eligibility forms to qualify for rebates for purchasing these cool roof coating products.³⁹ Primary motivations for cities to pursue legislative action include building energy savings and public health impacts.⁴⁰ New York City has already implemented legislation to support cool roofs including Local Laws (LL) 21, 84, and 87.

5. Find the Right Strategic Partnerships

Strategic partnerships have also proved successful in increasing momentum of program adoption. An example is the City of Atlanta's partnership with the Urban Climate Lab at Georgia Tech and local utility companies. This partnership has been successful because the university provides research guidance into areas of need, while local gas and electric utilities provide implementation funding for community properties, leveraging capacity and resources strategically.⁴¹ Moreover, in a study of cool roofs programs across the United States, it was found that "interconnected initiatives" and "partnering with a university" were two of the main factors that contributed to cool and green roof adoption, suggesting that partnerships can be a key driver in program success.⁴²

Strategic Partnerships and Broad Outreach

Given the above findings, the team researched the potential for expanding broad outreach efforts for °CoolRoofs, including investigating strategic partnerships that could help increase the reach of the program and build recognition. This involved identifying and researching compatible programs, agencies, and organizations that may align with NYC °CoolRoofs' mission. Such programs and organizations include:

NYC Department of Environmental Protection's Green Infrastructure Program⁴³
ConEdison
National Grid
New York State Energy Research & Development Authority (NYSERDA)
NYC Retrofit Accelerator

The team also identified community organizations and elected officials within the targeted high HVI zones that might share an interest in promoting °CoolRoofs to their constituencies. The team researched ways for SBS to best collaborate with these programs, organizations, and elected officials. Details can be found in the Implementation Strategy section of this report.

Participant Research: Past Participant Survey

A Past Participants Survey was developed to collect responses from building owners and organizations who have participated in the NYC °CoolRoofs program since 2009. This survey sought to collect information on the main reasons for participating in NYC °CoolRoofs and benefits that have been realized. The survey also asked about challenges in joining the program and whether any buildings were not eligible to participate and why. This information was helpful in developing strategic messaging for new

program participants and will be useful for SBS to maintain relationships with past participants and understand ways to improve the program. The survey and survey results can be found in Appendix R3 and Appendix R4.

SBS disseminated the Past Participant Survey to 60 building owners. The response rate was 25%, with 15 prior program participants providing information on their experiences. Of the 15 respondents, 33% initially heard about NYC °CoolRoofs via word of mouth and 40% directly from a program spokesperson. These were the most effective outreach strategies and helped shape the team's recommendations.

Respondents highlighted eligibility requirements as the primary reason for not including other owned buildings in the program. This suggests that further educating prospective participants would be valuable in increasing opportunities to coat more properties.

While respondents value the program, they remain sensitive to coating costs. Although 23% would have participated if they had to pay, almost 70% said their decision to participate would depend on the associated costs. Addressing cost sensitivity is a crucial part of the recommended outreach strategy for °Cool-It-Yourself participants.

Lastly, many past participants experienced challenges with the program. A total of 44% noted difficulty learning more about the program or reported delays in scheduling of inspections or work. While resources should be focused on driving new program participation, improving education and scheduling is a clear opportunity for program improvement.

Energy & GHG Analysis

To better understand and convey program benefits, the team undertook a detailed technical analysis of the greenhouse gas and energy cost impacts of NYC °CoolRoofs. The original NYC °CoolRoofs GHG impact analysis was developed by the NYC Mayor's Office in 2009 and refined in 2014. The 2014 analysis took into account emission factors for the grid purchased electricity from the PlaNYC Inventory of New York City Greenhouse Gas Emissions from December 2013.⁴⁴

The capstone team updated the °CoolRoofs GHG Calculator and developed a Building Calculator to improve the accuracy of GHG estimates by making three important changes:

1. The calculation now takes into account the surface albedo of a coated roof during the initial year (Year 1) and the decrease in efficacy of an aged roof coating (Year 2+). The original calculation only took into account the albedo of an aged roof coating.
2. The cooling energy savings and heating energy penalty has been updated with factors specific to Harlem. The original calculation uses the New York State average.
3. The New York City annual grid purchased electricity carbon dioxide equivalents (CO₂e) has been updated from the 2012 emission factors to the most recent 2015 emission factors from the 2016 Inventory of New York City Greenhouse Gas Emissions.

See Appendix A2 for more information about the overall GHG calculations.

The °CoolRoofs GHG Calculator provides an annual and total GHG reduction and one-time surface albedo offset based on the total cumulative impact of the NYC °CoolRoofs and NYC °Cool-It-Yourself programs. See Appendix A3 - °CoolRoofs GHG Calculator for more information. The team also developed a Building Calculator, which can be used to provide GHG emission reduction (tCO₂e) and energy savings based on the parameters for a specific building in one year. See Appendix A4 - Building Calculator for more information.

1. Surface Albedo and Calculations

A cool roof with a high surface albedo minimizes solar absorption and maximizes thermal expansion to reduce the heat flow from the roof into the building.⁴⁵ Aligned with NYC local law for new roofs and substantial replacements, SBS requires that every vendor provides coatings which meet the Cool Roof Rating Council (CRRC) and Energy Star Rating surface albedo minimum of 0.7.⁴⁶ The average rating of CRRC's 267 rated bright white acrylic paints has a surface albedo of 0.848 in Year 1, and a reduced rating of 0.715 by Year 3.⁴⁷ The original °CoolRoofs calculations used a static, conservative albedo of 0.55 throughout the life of the roof.

To make a more accurate estimation, the team consulted with Dr. Hashem Akbari, who serves as an advisor to the NYC °CoolRoofs program and is the founder of the Heat Island Group at Lawrence Berkeley National Laboratory. Based on Dr. Akbari's guidance, the team created a new calculation to include an initial Year 1 and aged Year 2+ albedo. The new model uses a higher albedo of 0.75 for Year 1 and the conservative albedo of 0.55 for an aged roof for Year 2+.⁴⁸ Updating the City's original surface albedo of 0.75 to include the higher albedo for initial coating results in more energy saved during Year 1.

The updated °CoolRoofs GHG Calculator uses the original GHG emissions coefficient (metric tons of carbon dioxide equivalent offset for every square foot of coated roof) for representing the change in surface albedo from a cool roof. The research shows that 65-75 kg CO₂e are offset for every coated square meter of roof that increases albedo by 0.1.⁴⁹ As per Dr. Akbari's recommendation, the calculation assumed an initial Year 1 surface albedo of 0.75 and a typical black roof surface albedo of 0.15, meaning the initial change in surface albedo as a result of a cool roof is 0.6. The change in surface albedo is then used to help calculate the energy and GHG emissions reduction in the cooling energy savings and heating penalty calculations.

2. Cooling Energy Savings and Heating Penalty Calculations

The cooling energy savings and heating energy penalty coefficients are used to estimate the energy saved and GHG emissions reduced per area of coated roof. Cooling energy savings (kWh/m²) is a reduction in electricity used for cooling during the summer months, and the heating energy penalty (therm/m²) is the increase in annual heating load during the winter months.⁵⁰ The original analysis used the New York State average building type coefficients, which are less accurate than the New York City specific coefficients. Ronnen Levinson, an expert in UHI effect, provided localized coefficients to use for the updated analysis that use four types of building data specific to Harlem, NY (zip code: 10025).^{51 52} The four building types included coefficients for old retail, new retail, old office, and new office buildings. The updated calculation adjusted the cooling energy and heating penalty coefficients for the four building types and their averages to reflect the increase in albedo for the initial coating in Year 1 and the aged coated roof in Year 2+.

Roof Size (square feet)	GHG Emission Reduction (tCO ₂ e)	Energy Savings (5-Year Average)
4,000	0.398	\$253
8,000	0.795	\$507
16,000	1.591	\$1,013
32,000	3.182	\$2,026
50,000	4.971	\$3,166
100,000	9.942	\$6,333

Table 9. 5-Year Emissions Reduction and Energy Savings by Roof Size, assuming average building type using natural gas.

3. Updated Emissions Factors

The team updated the electricity emissions coefficients with New York City's most recent GHG Inventory emission coefficients for grid purchased electricity from 2015.⁵³ As NYC continues to meet GHG

emissions reduction goals of 30% by 2025, the grid is becoming cleaner. The original calculator used the fixed 2012 emission coefficient for every year, while the updated calculator includes the emission coefficients from 2009 through 2015, in order to account for realized emissions reductions during each year. The updated figures allow a more accurate calculation of the net GHG emissions reductions (tCO₂e/ft²) for the decrease in energy consumption due to the higher albedo of a coated roof.

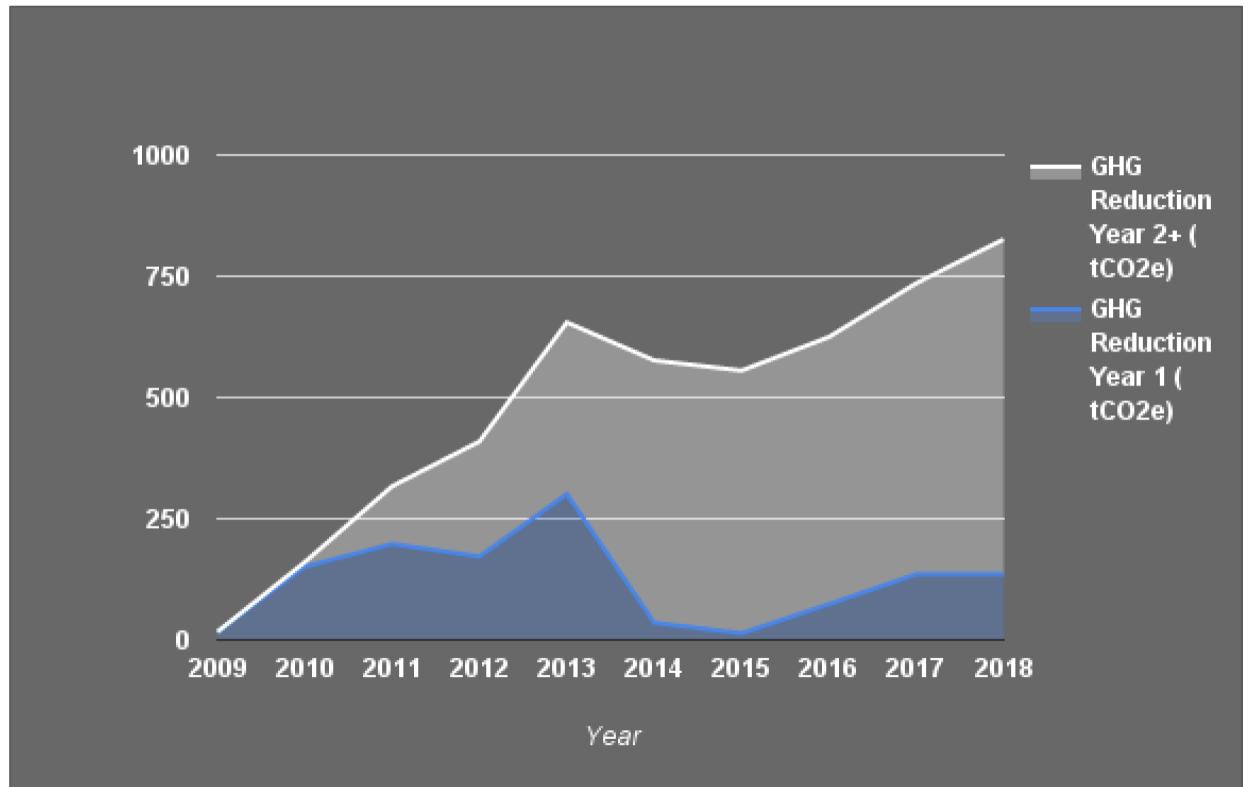


Figure 5. 2009-2018 Annual GHG Reduction for Year 1 and Year 2+ Coated Roofs

The recommended energy and GHG analysis provides a more accurate assessment of emissions reductions realized from the NYC °CoolRoofs program. Prior to this analysis, SBS estimated that every 2,500 square feet of roof coated would result in one metric ton of emissions reductions. However, the updated analysis suggests the savings is 2,003 square feet per one metric ton of reductions. This figure is lower than the original projection because it takes into account the higher albedo for Year 1 of the freshly coated roof and the cumulative Year 2+ albedo of the aged coated roofs.

Meeting the goal of an additional two million square feet by the end of 2018, for a total of 8,639,725 square feet coated, will result in a total of 4,877 tCO₂e reduced throughout the 10-year life of the program. This reduction in GHG emissions is due to the reduction of energy needed for cooling during the summer months. This is equivalent to GHG emissions from 1,030 passenger vehicles driven in one year.⁵⁴ Assuming the average building type and natural gas as a heating source, the Building Calculator estimated that in 2018 all NYC °CoolRoofs will reduce the annual energy demand for New York City by 4.7 million kWh, which can result in an annual energy savings of \$547,113, assuming an average cost of electricity at 13 cents/kWh.

Financial Analysis

To supplement the analysis provided by the team's Building GHG Calculator, a financial analysis of NYC °CoolRoofs was developed based on program costs and benefits. Separate analyses were developed for private entities that pay for their own coating, versus the city government that funds coating free of charge for non-profit organizations. The financial model allows building owners to better

understand the savings resulting from program participation. The model provides results in the form of Net Present Value (NPV) and Internal Rate of Return (IRR). Results are oriented towards SBS's goal of coating one million square feet of roof per year and providing financial metrics to be used as part of the outreach strategy. This approach will show potential participants how much money they can save by participating in the program, as they obtain figures on a per square foot as well as annual basis.

The model attempts to quantify the environmental and social benefits of the program using financial data provided by SBS and the team's updated findings. Environmental benefits were quantified using projections of carbon dioxide emissions reductions and energy consumption decreases. The model includes direct savings such as electricity bill reductions, as well as indirect savings such as the extension in roof life, and other related benefits. The cost of the program includes supplies and labor needed to coat rooftops, as well as other costs such as marketing and miscellaneous expenses, and the cost of physical degradation of the coating over time. Appendix A5 presents a breakdown of the coating cost.

The values identified for the above cost and benefit factors were used to create a Discounted Cash Flow (CF) model. The CF incorporates the estimated amount to be invested by the City government annually. The Present value is calculated from the future CF using the formula,

$$\text{Present Value} = \text{Future Value} / (1+r)^t$$

where r is the discount rate and t is the time (in years).⁵⁵

Based on preliminary results, the financial benefit for a fully-funded NYC °CoolRoofs participant is estimated to be \$2.10 per square foot (at a discount rate of 12%). The financial model uses a budget estimate provided by SBS of approximately \$850,000 per year. Based on this figure, \$8.5M is the total budget required for the program in its 10-year life, which in turn provides a net social benefit of \$10.4M (at a discount rate of 3%). The overall Net Present Value for building owners participating in the NYC °CoolRoofs program is estimated to be \$7.8M.

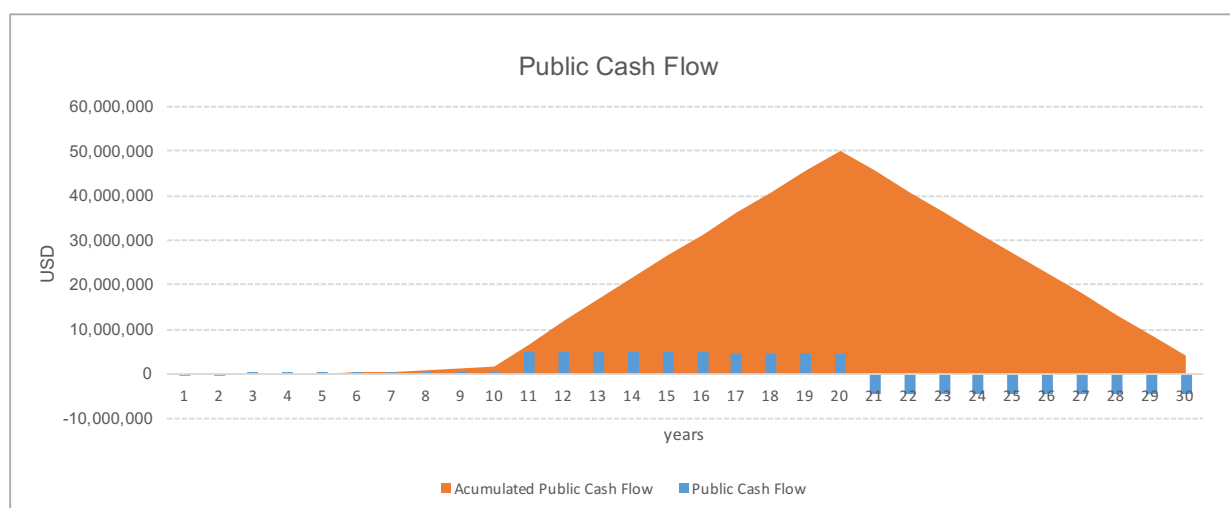


Figure 6. Public Cash Flow & Social Net Benefit

NYC CoolRoofs			
System Private NPV	7.8m USD	Public NPV	10.4m USD
Private NPV	2.1 USD/sqf	Public Payback	5y
Cool-It-Yourself			
IRR	22%	NPV per sqf	0.8 USD

Table 10. Financial Model Main Results

Using the GHG calculator developed for this report, the team calculated whether the °Cool-It-Yourself program makes financial sense for building owners who would pay for the coating themselves. The team found that even though the IRR is positive over a ten-year period, the energy savings are not enough to balance the cost of coating, due to the expected degradation of the coating in less than ten years. The annual savings of 14.1 cents per square foot in the first year and 9.4 cents per square foot from the second year onwards does not justify the initial cost of applying the coating for most private building owners paying for materials and labor themselves. Using a 12% of cost of capital for a typical private owner, the owner's required investment should not exceed 98 cents per square foot for the °Cool-It-Yourself coating to be financially feasible. The team's financial findings indicate that SBS should consider providing a subsidy for private owners participating in the °Cool-It-Yourself program of 46 cents per square foot.

The team's full financial analysis can be found in Appendix A5.

IMPLEMENTATION STRATEGY

Targeted Outreach

The team recommends a total of 34 private building owners and 4 public agencies for °CoolRoofs implementation in 2017 and 2018.

Owner Type	Number of Targeted Building Owners
City Owned Organizations (Fully Funded)	4
Non-Profit Organizations (Fully Funded)	18
For-Profit Owners (°Cool-It-Yourself)	16
Total	38

Table 11. Targeted Outreach by Owner Type

1. Publicly Owned Buildings (Fully Funded)

The prioritized list of building owners includes four municipal organizations. Because all of the recommended public agencies have previously participated in the program, NYC °CoolRoofs should use existing channels of communication to work directly with these participants.

2. Private Organizations (Fully Funded and Cool-It-Yourself)

The prioritized list of property owners includes eighteen non-profits, social service organizations, or providers of affordable housing and sixteen for-profit organizations. Thirty-four of these owners were successfully contacted and twenty-one expressed interest in participating in °CoolRoofs. To effectively connect with these organizations, SBS should use several different outreach methods, including calling and emailing using the contact information provided in Appendix A1. SBS can use the prospective owner call script and email template that the team has developed to begin the process of contacting those owners who have not yet been successfully contacted. See Appendix A7 and Appendix A8 for details.

In the next three months, the °CoolRoofs program manager should:

1. Contact building owners who have expressed interest in the program and develop a timeline for sending out a roof assessor to each.
2. Reach out to building owners on the list who have not yet been contacted for initial outreach.
3. Make contact with the appropriate staff at the four public agencies identified as top-tier recommendations. The program manager should propose to coat the buildings identified in this report and provide each agency with a list of their target buildings.

Each owner successfully enrolled in the program should be asked whether they have additional buildings beyond the addresses identified in their report that they would like to have coated.

Broad Outreach

Beyond targeted outreach to the prioritized list of building owners in high HVI zones, there are other steps that SBS can take to promote NYC °CoolRoofs more broadly. Our team has developed a three-pillar outreach strategy:

1. Education

Educating stakeholders is key to promoting the °CoolRoofs program. Educating city residents, building owners, and community organizations about the benefits of NYC °CoolRoofs will help garner credibility for the program and generate interest and future participation. In order to strengthen these efforts in the future, the team has created an Outreach Messaging Kit with tools that include a GHG calculator and a financial model to facilitate these public education sessions and discussions with various stakeholder groups. The team also recommends NYC °CoolRoofs participate in targeted promotional and networking events that will expose interested parties to the program. Some examples include:

- Sponsoring city-wide Earth Day or Climate Week events,
- Encouraging existing partners to share their experiences with new building owners online or via open houses, and
- Having a physical presence at real estate conferences and meetups.

2. Strategic Partnerships

Engaging and partnering with non-profits and other organizations that serve local communities can help NYC °CoolRoofs reach a broader group of potential participants. This would enable °CoolRoofs to connect directly with new building owners through more seamless and unobtrusive messaging opportunities, as an alternative to cold-calling prospective participants. For example, partnering with local utilities such as ConEd to include flyers with existing utility bills, or working with major philanthropic organizations like New York Cares to connect directly with private companies would connect °CoolRoofs to a very large pool of private building owners. Furthermore, the team's past participant survey results identified word of mouth as a successful approach to increasing program participation. The team recommends leveraging existing relationships with former participants to make new introductions.

3. Targeted Marketing

Targeted marketing includes establishing a strong social media presence, integrating with developer messaging platforms like Real Estate magazines, and encouraging word of mouth through incentive programs like referral bonuses.

The broad outreach strategy is further broken down depending on whether the target audience is eligible for no-cost °CoolRoofs coating, or whether they would have to participate via °Cool-It-Yourself.

Owner Type	Education	Strategic Partnerships	Targeted Marketing
City Owned Buildings (Fully Funded)	X	X	
Non-Profit Organizations (Fully Funded)	X	X	
For-Profit Owners (°Cool-It-Yourself)		X	X

Table 12. Broad Outreach by Owner Type

Outreach Strategy: Non-Profit Organizations (Fully Funded)

To effectively connect with organizations qualifying for °CoolRoofs, the team recommends utilizing several outreach channels. First, SBS should host quarterly education sessions about the NYC °CoolRoofs program that are open to the public. Second, SBS should connect with City Council Members and Community Board Chairs. These partners should be given a thorough review of the program, its goals, and how the program can benefit the communities that they represent. The outcomes from the °CoolRoofs program likely will align with individual goals of City Council Members and

Community Boards. SBS should also use its pre-existing relationships to connect with local community development organizations. These organizations tend to work with the most vulnerable members of the community and can be great assets in expanding the program to additional non-profit and affordable housing buildings. For a comprehensive list of names and contact information for these organizations, see Appendix R1.

The team recommends the following actions be taken while engaging with these entities:

- Request a link to the °CoolRoofs program website be placed on the partner's website.
- Share the 'Outreach Messaging Kit' included as part of this report.
- Request dissemination of the 'Outreach Messaging Kit' to building owners.

Outreach Strategy: Private & Corporate Owners (°Cool-It-Yourself)

Two outreach strategies are recommended for private for-profit and corporate owners. First, the NYC °CoolRoofs program manager should focus on encouraging word-of-mouth to increase program adoption. °CoolRoofs may consider implementing targeted discounts or free coatings to private owners in heat-vulnerable neighborhoods. This could take several forms, including:

- "Bring a friend, get a discount": Provide financial or other incentives for building owners that share information about the program or sign up new buildings.
- Referral rewards: Provide referral bonuses for building owners that successfully refer other building owners in key neighborhoods.
- Open houses: Open roofs or open houses for past participants of cool roofs, especially during "cool roofs month" in September.

Second, since the past participant survey results highlighted cost sensitivity as a crucial factor with almost 70% of respondents saying their decision to participate and pay for coating would depend on the associated costs, NYC °CoolRoofs should try to achieve the following in order to gain greater participation:

- Recoating discounts: Incentivize continued communication with past participants through engagement incentives.
- Subsidize costs: Subsidize material and labor costs on a case-by-case basis. As discussed in the Financial Analysis, °CoolRoofs should consider providing a subsidy of 46 cents per square foot so that private building owners do not exceed a total coating cost of 98 cents per square foot.
- Rebate program - Provide financial rewards for coating a specified volume of total square footage (for example, 50,000 square feet).

Other Broad Outreach Recommendations

The team identified several additional strategies that SBS should pursue for improving the reach of NYC °CoolRoofs:

- The team recommends that NYC °CoolRoofs establish relationships with the property management companies identified in this report's list of target recommendations. Management companies can be an efficient way to gain access to many buildings with different owners.
- NYC °CoolRoofs should target trade associations, such as the National Association of Residential Property Managers, via conventions and educational webinars.
- NYC °CoolRoofs should continue its tradition of developing strategic corporate partnerships with large organizations. Companies such as Deutsche Bank, Goldman Sachs, JP Morgan, and UBS have committees dedicated to philanthropic or community-based initiatives which often have annual budgets allocated for activities. These organizations could fund NYC °CoolRoofs coatings. Some of these companies, like Deutsche Bank, have previously partnered with the program and sponsored multiple volunteer days. These partnerships are worth reviving. Activities around Earth day and Climate week are particularly popular for this type of corporate event.
- NYC °CoolRoofs should target private owners via local real estate conferences. Building owners attend these events to share ideas and learn about new industry best practices. Securing a presentation opportunity or an information booth would help grow interest in the program.
- Additionally, NYC °CoolRoofs should build relationships with complementary programs in order to

promote NYC °CoolRoofs. This should include, at a minimum, providing links to each other's programs on the website of each partner. Potential partners include:

- Con Edison⁵⁶
- NYC Department of Education⁵⁷
- NYC Department of Environmental Protection (DEP) Green Infrastructure Program⁵⁸
- New York State Energy Research & Development Agency (NYSERDA)⁵⁹
- United States Department of Energy⁶⁰
- National Grid
- NYC Retrofit Accelerator

The full list of recommended partnerships is provided in Appendix R1.

Outreach Messaging Kit

The Outreach Messaging Kit is a toolset that NYC °CoolRoofs can leverage as part of the outreach strategy, particularly for building owners that are new to the program. The toolset includes the following:

- Energy and GHG Calculator
- Summary of Financial Benefits
- Maps and Graphics
- General Marketing Materials
- Call Script and Email Template
- Website & Social Media Refresh

1. Energy and GHG Calculator

The Building Calculator developed for the program is an easy to use tool that provides GHG emission and energy reduction savings for individual °CoolRoofs and °Cool-It-Yourself buildings. The tool takes into account up-to-date metrics used in the GHG and energy analysis, while using more specific data related to a particular building's age, type, and energy use.

The building's roof square footage must be entered into the tool and the user selects building specific data or city averages for the building type, heating source type and cost per unit, and cost per kWh of electricity. This information is used to estimate the potential annual GHG emission reduction (tCO₂e) of cooling that roof due to the reduction in electricity from summer cooling of that building. The tool also provides an estimated reduction in kWh of electricity and the potential annual energy savings for year 1 and year 5. This tool is useful for providing partners with an annual energy savings due to a coated roof. For more information on how to use and update the Building Calculator, see Appendix A4.

2. Summary of Financial Benefits

The program should advertise to potential participants that NYC °CoolRoofs benefits include an estimated savings of \$2.10 per square foot of coating. This includes 14.1 cents per square foot saving in the first year and 9.4 cents per square foot from year 2 onwards, for 10 years.

A complete analysis by building owner is provided in Appendix A5.

3. Maps and Graphics

A map series detailing the impact that heat and heat vulnerability has upon at-risk communities can be used for prioritizing areas for potential participation. These maps and graphics illustrate the City's HVI and highlight areas of geographic importance in combating and mitigating the urban heat island effect.

The complete map series is provided in Appendix M4.

4. General Marketing Materials

As part of the public awareness and education campaign, NYC °CoolRoofs should leverage a broad set of marketing materials to improve recognition for the program. This includes using new informational flyers, such as those provided in this report's Appendices.

The marketing materials are provided in Appendix A6.

5. Call Script and Email Template

In conducting outreach, the NYC °CoolRoofs program manager will need to provide consistent messaging to potential participants and reasons for participating in the program. The team developed a call script and email template for reaching out to these building owners that describes the benefits of the program and next steps for participating if there is interest.

The full prospective participant materials are provided in Appendix A7 and Appendix A8.

6. Website & Social Media Refresh

The team recommends an updated website and social media refresh to improve program communications. First, the SBS Facebook page mainly includes summary stories of what the team has conducted. It should also include posts to inform residents and businesses about the incentives associated with the installation of cool roofs. This can be further developed through the inclusion of news articles and case studies. Additionally, to aid broader adoption of cool roofs, the program's social media should inform residents and businesses about financial incentives that exist for the installation of a cool roof, where applicable.

CONCLUSION

The recommendations in this report will help NYC °CoolRoofs achieve its goal of coating 1 million square feet of rooftop per year for the next two years. The top-tier recommendations consist of 2.7 million square feet of highly promising, coatable rooftop. The supplemental recommendations provide nearly 2 million additional square feet, for a grand total of 4.5 million square feet of recommendations. The owners of these roofs represent dozens of organizations across neighborhoods in the South Bronx, Harlem, and Central Brooklyn. By helping the City meet its coating goal through 2018, these recommendations will benefit the most heat vulnerable areas of New York City, while also allowing SBS to continue its mission of training 70 under-employed New Yorkers each year with green job skills.

By coating 2.7 million square feet over the next two years, °CoolRoofs will have reduced an estimated 488 metric tons of carbon dioxide equivalent, which is equivalent to 103 passenger vehicles removed from the road for one year.⁶¹ Furthermore, approximately 38% of the top tier recommendations represent buildings used by non-profit or social service organizations, or for low-income housing. The energy savings produced by these coatings will generate tens of thousands of dollars in savings for these organizations, allowing them to better serve their constituents. The outreach strategy outlines the team's proposals for how to best reach these target participants, as well as a set of recommendations that, if implemented, will help SBS expand the reach and name recognition of NYC °CoolRoofs.

At the same time, the project has produced results that will continue to provide value to SBS beyond the two-year scope of this project:

- A data-driven partner identification method;
- A GHG building calculator;
- A custom financial benefit model; and
- Newly designed outreach materials.

These are tools that the City can continue using as long as the °CoolRoofs program exists. The team is confident that these recommendations will help SBS provide multiple sustainability benefits to some of New York's most underserved communities for the next two years and beyond.

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APPENDICES

Type	Name	Description	Reference
MAPPING	Data Dictionary	Listing and source data for all mapping and spatial analysis	M1
	Operations Manual	"How To" Manual for Mapping and Spatial Analysis Procedures	M2
	Maps	All maps used for the analysis	M3
	Coating Recommendation by Neighborhood	Data sets by neighborhood	M4
RESEARCH	Broad Outreach Contact List	List of potential partners	R1
	Case Study Summaries	Summary of all case studies reviewed for outreach best practices	R2
	Past Participants Survey	Survey distributed to past participants for program feedback	R3
	Past Participants Survey Results	Results of survey distributed to past participants	R4
RECOMMENDATIONS	List of Recommended Building Owners	List of tier 1 and tier 2 recommended building owners	A1
	Overall GHG Calculations	Calculations for cooling-energy savings, heating-energy penalty, and surface albedo	A2
	NYC CoolRoofs GHG Calculator	Calculator for estimating annual GHG emission reduction from the coated SF	A3
	Building Calculator	Calculator for individual building owners to use	A4
	Financial Analysis	Complete financial analysis and savings potential	A5
	Marketing Materials	Updated program flyer	A6
	Call Script	Sample call script to use for contacting prospective participants	A7
	Email Template	Sample email template to use for contacting prospective participants	A8

Table 13. List of Appendices

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ACRONYMS & DEFINITIONS

Acronyms (in alphabetical order)

CF: Cash Flow
CRRC: Cool Roof Rating Council
CUNY: City University in New York
FV: Future Value
GHG: Greenhouse gas emissions
GIS: Geospatial Information System
HVI: Heat Vulnerability Index
IRR: Internal Rate of Return
NPV: Net Present Value
NYCDEP: New York City Department of Environmental Protection
NYCDOE: New York City Department of Energy
NYCHPD: New York City Housing Preservation Development
NYCHA: New York City Housing Authority
NYSERDA: New York State Energy and Research Development Authority
PV: Present Value
SBS: Small Business Services
tCO_{2e}: Metric Ton Carbon Dioxide Equivalent
UHI: Urban Heat Island

Definitions (in alphabetical order)

Albedo: The proportion of the incident light or radiation that is reflected by a surface, typically that of a planet or moon.

Emissivity: The emissivity of the surface of a material is its effectiveness in emitting energy as thermal radiation.

Cool Roof: A cool roof is a roofing system that delivers higher solar reflectance (the ability to reflect the visible, infrared and ultraviolet wavelengths of the sun, reducing heat transfer to the building) and higher thermal emittance (the ability to radiate absorbed, or non-reflected solar energy) than standard designed roofing products.

ESRI ArcGIS & ArcMap: Tools for working with maps and geographic information.

FOOTNOTES

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