Building Blocks of a Just Transition:

Green Banks and Residential Building Decarbonization in New York

by

Lia Downing

B.A. in Anthropology, Chinese Language and Culture

Washington University in St. Louis

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Authored by: Lia Downing

Department of Urban Studies and Planning

May 14, 2024

Certified by: Janelle Knox-Hayes

Department of Urban Studies and Planning, Thesis supervisor

Accepted by: J. Phillip Thompson

Professor of Political Science and Urban Planning

MCP Committee Chair

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ABSTRACT

The existential threat of climate change has given rise to financial solutions aimed at transitioning global systems away from fossil fuels and towards clean energy. Green banks are one such solution as a specialty finance vehicle aimed at using public funds to induce private investment in climate energy projects such as residential building decarbonization. Given the recent increased investment and policy attention on green banks, we should assess whether the green bank model delivers their professed goals of socially equitable outcomes, market creation, and greenhouse gas emission reductions in line with Net Zero national policy.

This thesis seeks to understand the political and organizational dynamics of green bank models in the context of the Inflation Reduction Act and identify the existing project deployment gaps remaining for residential building decarbonization projects. Through a case study approach of New York Green Bank and New York Energy Efficiency Corporation, this study investigates green bank 1) additionality; 2) organizational structure; 3) scale; and 4) demand as considerations for green bank formulation to drive building decarbonization investments. These case studies combined with expert interviews provide strategy and programmatic recommendations for policymakers considering whether to create or expand a green bank in the wake of massive federal investment through the Inflation Reduction Act.

Thesis supervisor: Janelle Knox-Hayes,

Title: Lister Brothers Professor of Economic Geography and Planning

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I would like to dedicate my thesis to the Cambridge Public library, a thoroughly safe space to write and ponder.

I'm always grateful to my family for always believing in me and cheering me on, if sometimes from afar.

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1: Introduction

The growing recognition of climate change as a pivotal policy and economic concern in the United States has elevated the search for strategies that sustain economic growth while addressing the present and impending effects of climate change. The realm of green finance has emerged as a method to address these large scale problems through spurring project deployment across major industry sectors including the built environment. In the United States, buildings account for 40% of greenhouse gas emissions, and further, 80% of currently standing buildings will last until 2050.[1] Therefore, an important leverage point will be solving the complex project deployment challenges of decarbonizing existing buildings.

The unique challenges of inducing demand in residential building decarbonization, specifically for existing building retrofits, will be essential for green finance success. Across the United States, residential buildings contribute the most greenhouse gas emissions. Of note, the most significant increase in emissions in the United States last year came from homes and buildings.[2] In addition, people spend 90% of their time in buildings and spend substantial amounts on building energy costs, with residents in Low and Moderate Income (LMI) communities disproportionately likely to face energy insecurity. Figure 1 below shows the varied and complicated barriers to residential building decarbonization that severely impair a well-functioning building decarbonization supply chain and labor pool. The dual challenges of green finance and climate justice inform this thesis' analysis of green banks as a potential financial tool to build a residential building decarbonization market while providing socially equitable outcomes.

[1] Chang, Fornara, and Sanghvi, "Financing Building Decarbonization."
[2] Chen and Choi-Schagrin, "What's Holding Up New York's Climate Progress?"

Barrier	Considerations
Investment Constraints	High upfront investment costs Lack of feasible finance solutions
Climate Justice Concerns	Energy burden of electrification Racial disparities of clean energy deployment
Lack of Coherent Market	Insufficient comparable projects Complexity of early adoption projects
Heterogenous Buildings	Building age, typology, ownership Geographical feasibility differences
Regulatory Policies	Lack of consistent regulations Lack pricing emissions externalities
Infrastructure Constraints	Electrical grid technically unprepared Lack of planning for electricity system
Workforce Constraints	Lack of skilled workforce Capacity constraints
Lack of Information	Lack of technology choices and cost tradeoffs Lack awareness of problem and potential benefits
Utility Constraints	Demand management Opposition from gas utilities

Figure 1: Barriers to Residential Building Decarbonization

1.1 The Green Finance Challenge

As outlined in the most recent Intergovernmental Panel on Climate Change report, there is a call for a persistent role for both multilateral and national climate funds with the aim of reducing financing costs for underserved groups.[3] Despite the theoretical availability of sufficient capital to bridge substantial investment gaps in a decarbonized built environment, formidable obstacles persist in channeling private capital toward effective climate and energy solutions. Humans currently emit an estimated 38 billion tonnes of CO2

[3] Kreibiehl and Williams, "IPCC Chapter 15: Investment and Finance."

per year, and as the carbon budget shrinks and temperatures rise, global actors must choose between stranding fossil fuel assets or stranding the planet.[4]

In particular, domestic climate finance plays the main role in the flows of both public and private capital. The United States would need to invest up to $150 billion annually to retrofit existing buildings to meet climate and environmental objectives and net zero by 2050. In comparison, the main provision of the biggest climate bill in United States history amounts to a one-time allocation of $27 billion. Clearly current capital flows do not address the pressing needs of the global energy transition.

1.1.1 Market Failure

The current state of green finance provides insufficient approaches to financing for the scale required to decarbonize the built environment as part of a just transition. Empirical evidence reveals sub-optimal investment by firms in energy efficiency projects capable of reducing both energy costs and greenhouse gas emissions.[5] In addition to the externalities of greenhouse gas emissions, additional unintended consequences include rising electricity prices. Public programs with financial subsidies to private building decarbonization projects have proven not cost-effective or able to enhance final performance. For example, traditional approaches such as credit enhancement to protect the lender from risk (rather than enhance the borrower's long term credit) can lead to an overreliance on debt financing that can in fact harm the borrower's credit scores and balance sheet solvency in the long run.[6] Therefore, green finance alone, even with public subsidies, cannot solve the current market failure and correct runaway greenhouse gas emissions.

Many high-maturity, low-cost technologies already exist and merely require scaled deployment, where finance can play a main role to manage and complete these energy projects. Crucially, funding and financing are often the biggest barriers to local

[4] OECD, "Green Investment Banks Policy Perspectives."
[5] Buso and Stenger, "Public-Private Partnerships as a Policy Response to Climate Change."
[6] Coalition for Green Capital, "Green Banks & Catalytic Blended Finance."

decarbonization efforts.[7] The Inflation Reduction Act (IRA) is one of the largest climate investments in low-income and historically disadvantaged communities to date. However, federal, state, and local political environments can drastically influence the scale and implementation of decarbonization investments. Many cities and states have pledged climate action through extensive action plans intended to strategize and deploy new projects. However, without coordination to manage, spend, and track financing impact and alignment with allowable funding routes and equity values, many of these plans come up short of their intended impact. Government bodies need to identify existing funding sources and then propose specific long term funding sources or financing mechanisms.

1.1.2 Perceived Risk

The incumbent fossil fuel industry and the nascent renewable energy industry differ from a financial risk perspective. Consolidation, maturity, and implicit guarantees characterize the fossil fuel finance landscape. By comparison, renewable energy dictates a relatively diffuse, young, and rapidly changing market. In Global North countries like the United States, subsidies have been the primary policy tool for driving investment in clean energy tech in order to spark interest, improve economics, and bring markets to scale. However, subsidies have their downsides, as they are both expensive and don't cover all project costs. By comparison, major oil companies can tap into public debt markets and raise money at low interest rates. Overcoming this vast difference in access to capital and project risk will be one of the major challenges of the global clean energy transition.

Many policymakers and financiers think about clean energy investments in terms of project finance instead of a subsidy-based framework. Traditional finance frameworks tend to require a stream of returns to exceed upfront investment to make a project economically viable. Clean energy technologies may also be perceived to have fewer certain near-term market opportunities, which discourage conventional lenders and investors. Specific to building decarbonization, a huge barrier to deployment involves costs changing over time, and financiers haven't figured out how to incorporate operating costs.

[7] George, Kane, and Tomer, "How US Cities Are Finding Creative Ways to Fund Climate Progress."

This pattern exposes the potential inadequacies of traditional underwriting and credit risk appetites for driving deals that feature GHG reductions.[8] Private lenders also lack a deep understanding of future trends with the recent passage of federal funds, which is also coupled with a high interest rate environment.

Different stakeholders in building decarbonization approach risk differently. At the project level, real-estate developers must contend with risks including: underwriting risk, energy savings accountability, lack of technical expertise and track record, prerequisites to intervention, soft costs of project development, quality control, and resistance to on-bill financing.[9] At the building owner borrower level, some of the risks include credit risk, ability to repay, uptake and adoption, and building tenant split incentives. Capital providers must consider balance sheet equity, loan servicing platform, lack of credit enhancements, and generally a lack of climate impact reporting infrastructure. These simultaneous and often competing risks determine whether and which projects move forward.

1.1.3 Lack of Building Decarbonization Market

Decarbonizing buildings at scale is a key component of greenhouse gas emissions reduction (GHGR) strategies, but residential decarbonization efforts lack a coherent building decarbonization market. The fundamental causes include absent or inconsistent regulation at the state and local level as well as the heterogeneity of the real estate market.[10] In addition, building decarbonization efforts lack well-defined demand and supply chains, which inhibit private sector financing. To achieve scale, green finance requires standardization, but on the ground situations tend not to reflect this abstraction. Projects become very local, and hyperlocal concerns can dominate the conversation even at the regional level. Certain cities have the political will and financial and staff capacity to introduce different kinds of capital pools for climate projects. However, progressive taxes

[8] Muir and Bose, "The Green Bank Opportunity."
[9] O'Neill et al., "Environmental Financial Advisory Board Presentation."
[10] Chang, Fornara, and Sanghvi, "Financing Building Decarbonization."

are a political nonstarter in other cities.[11] Making green finance replicable across cities with efficiencies of scale or one-off investments will be crucial for green finance investing.

Residential decarbonization projects are a highly disaggregated and heterogenous industry. In the residential sector, every household makes individual home decisions, which provide a very different obstacle from other industrial policies with a set number of vendors. The challenge of building decarbonization requires changes in millions of homes with individual technologies such as heat pumps and weatherization. Larger banks have expressed discomfort navigating relationships related to heterogeneous, small, deal-sized projects. Much more familiar to these entities are standardized loan products that they can securitize and sell on capital markets, like a home mortgage or large-scale renewable energy project. These barriers to introducing private sector green finance to residential building decarbonization slow progress in project deployment.

1.2 The Climate Justice Challenge

The push for the clean energy transition occurs in the context of American cities that continue to face disinvestment in black and brown communities. Ongoing disinvestment in historically redlined neighborhoods has left many low-income families grappling with elevated costs of fuels and energy-inefficient homes. Structural racism, manifested in barriers such as a lack of qualifying credit and the inability to finance upgrades, hinders the access of low-income households to energy technologies. According to the Department of Energy (DOE), the national average energy burden for these households stands at 8.6%, a figure three times higher than the rest of the population.[12] Compounding these challenges, the urgency of the energy transition implies that the last consumers to shift away from fossil fuel-dependent homes and cars will encounter the steepest costs, intensifying the existing inequities faced by disadvantaged communities.

[11] George, Kane, and Tomer, "How US Cities Are Finding Creative Ways to Fund Climate Progress."
[12] State and Local Solution Center, "Low-Income Community Energy Solutions."

After George Floyd and the racial reckoning of 2020, environmental justice (EJ) became part of national attention. The Biden Administration introduced the Justice40 goals to nationally commit to ensure disadvantaged communities (DAC) receive benefits of new and existing federal investments.[13] The Justice40 goals require that 40% of the overall benefits of certain federal investments flow to disadvantaged communities.. The DOE working definition as part of Justice40 initiative established indexes of disadvantaged designation using census tract level cumulative burden across 36 indicators. The IRA intends to support low-income populations, so the main problems consist of seeking the product and the approach to a scalable finance mechanism for decarbonizing buildings in DACs.

Two factors determine the concern for energy equity and climate justice : 1) a moral, values-based imperative to ensure the benefits of electrification are fairly distributed and 2) widespread inclusion to rapidly reduce emissions. When measuring whether energy equity goals have been met, entities must consider which variables are or are not counted as costs as well as who is at the table during decision-making processes.

1.2.1 Energy Burden

Because of historic racism and current racial inequalities around energy equity, the reality of electrifying buildings could exacerbate inequality for black and brown communities. In America, black households' energy expenditures remain significantly higher than white households'.[14] Because natural gas for heating homes was designed to be cheaper due to utility regulation, electrifying residential buildings may lead to higher energy bills in the short term. This dynamic will change over time as the grid moves to renewable energy sources, but if LMI communities are left behind in building electrification, they will be saddled with the additional energy burden of rising costs of a stranded natural gas system. In addition, negative health impacts of building emissions disproportionately affect people of color, who experience exposure to 90% higher rates of

[13] The White House, "Justice40 Initiative."
[14] Aufhammer, "Consuming Energy While Black."

harmful indoor air pollution.[15] These historic inequalities and projected future burdens represent a hidden problem of recent federal legislation.

LMI communities have been subject to predatory energy companies advertising energy savings. Even companies that tout social equity in their mission do not always deliver financial benefits promised to their consumers, and in fact sometimes saddle households with long-term leases and vastly higher prices.[16] At the same time, there is a huge opportunity to solve for energy burden and introduce energy efficiency and electrification for low-income households. Within the energy transition, building decarbonization has the most immediate connection to people's everyday lives. Effectively planned efforts to decarbonize buildings have the potential to result in accompanying effects such as supporting community resilience and creating high-quality local jobs. Research has shown that federal housing policies addressing the human dimensions of energy implications accelerate energy efficiency participation by LMI households.[17] Through carefully crafted policy and program implementation, climate and environmental justice concerns may begin to be addressed through residential building decarbonization projects.

1.2.2 Residential Decarbonization Economics

Due to the current high electricity prices and low natural gas prices, the economics of building decarbonization often do not result in energy savings for all consumers without large upfront investment in specific energy efficiency and energy use reduction measures. Many low and moderate income households have several barriers to building decarbonization, starting with the state of homes. To reach GHGR of 50% or greater, project costs must often amount to $40-50,000 per home.[18] Also, many prerequisites to a whole home decarbonization such as health and safety issues persist. These processes are

[15] Department of Energy, "Decarbonizing the U.S. Economy by 2050."
[16] Harris, "Energy Insufficiency."
[17] Asensio et al., "Housing Policies and Energy Efficiency Spillovers in Low and Moderate Income Communities."
[18] Walker and Casquero-Modrego, "Pathways to Home Decarbonization."

inherently linked to building codes and building inspection processes, which may provide opportunities to require or encourage retrofits or impede processes with additional remediation costs. This process is also known as a deep energy retrofit, a whole-building analysis and construction process that achieves much larger energy cost savings. In addition, enhancements like weatherization, insulation, new windows, and heat pumps would unlikely qualify to serve as collateral for financiers. Finally, private lenders remain hesitant to finance building decarbonization retrofits where they deem credit risks uncertain.

Private lenders and investors tend to evaluate a project's expected rate of return and size of opportunity through a project finance lens. But as mentioned above, the economics behind building decarbonization have not been entirely solved, creating a market failure. Investments in decarbonization may be crowded out from both ends of the residential development market. Asset managers of market rate real estate development have a suite of projects in which they can invest their marginal dollar, and many of these projects offer higher returns and greater familiarity compared to decarbonizing buildings. On the other side, affordable housing developers lack the upfront capital to consider additional projects, and allocating these scarce dollars to decarbonization can become contentious if it limits the amount of affordability in a given project.

Even with all currently available technology for on-site renewable energy generation and battery storage, any fully decarbonized building will still require connection to the electrical grid. The cost of running an air-source heat pump breaks even with heating a home with gas due to high electricity costs, and thus the specific type of retrofit intervention informs whether significant financial energy savings goals are achieved. A better financial accounting and valuation of the potential economic and public health value of non-energy benefits such as indoor air quality and occupant comfort would benefit the proposal, given that energy efficiency savings alone may not be sufficient drivers. These benefits must also accompany a residential building decarbonization market that values them appropriately.

As cities and states increase their climate ambitions, they will increasingly turn to requiring building owners to make energy upgrades. However, these upgrades can result in displacement of tenants, such as increasing rents to attract higher income renters or forcing local owners to sell properties to outside investors.[19] Additionally, the energy retrofit process can be physically disruptive to residents.[20] Black and Hispanic majority households installed less rooftop solar compared with white households.[21] Stakeholders must consider the unintended consequences of climate action to protect those most vulnerable and empower black and brown communities to take part in the energy transition.

1.2.3 Ownership of the Just Transition

Energy efficiency and building decarbonization efforts often place cost burdens on frontline communities, but a community wealth building approach could support net zero transitions while addressing deep energy inequity in the United States. Solutions for the just transition should focus on structural change, including anti-displacement policies such as renter protections, inclusionary zoning, and right to return policies.[22] In addition, affordability policy components that help to limit household energy bills and moving away from energy assistance subsidies and towards ownership of clean energy assets and energy efficiency will be especially effective. Bottom-up alternatives outlined by the community wealth building approach provide actionable solutions that should have project deployment implications for organizations tackling the building decarbonization challenge.[23]

The Biden administration's building electrification plan breaks with neoliberal market-led tendencies of the past. These values espoused by Justice40 and the Inflation Reduction Act are reminiscent of New Deal era values such as long-range planning, public

[19] Anguelovski et al., "Green Gentrification in European and North American Cities."
[20] Steven Winter Associates, "City Playbooks for the Equitable Electrification for Multifamily Buildings."
[21] Sunter, Castellanos, and Kammen, "Disparities in Rooftop Photovoltaics Deployment in the United States by Race and Ethnicity."
[22] Schaefer, "Comprehensive Building Blocks for a Regenerative & Just 100% Policy."
[23] Lacey-Barnacle, Smith, and Foxon, "Community Wealth Building in an Age of Just Transitions."

investment, and public health. These values begin to address energy equity as a core element of ensuring the energy transition prioritizes climate justice and distributive justice. In particular, prevailing-wage jobs to build infrastructure under public ownership, required under the administration's plan, will be especially vital for distributional justice of the benefits proposed by the energy transition. There will be a dramatic need for building retrofits and heat pump conversions to decarbonize buildings, and this potential for high-quality jobs offers an opportunity for municipalities and community based organizations to create jobs and training for underrepresented individuals and build wealth for LMI communities. However, these social equity goals may also introduce tension with climate goals, such as the prevailing wage requirements preventing affordable housing developers from participating in climate federal funding.

1.3 Introduction to Green Banks

Green banks provide a potential financing vehicle to drive capital into clean energy projects by addressing and alleviating financing barriers. Green banks are public, quasi-public, or nonprofit institutions that use both public and philanthropic funds to leverage private investment for clean energy projects. Despite the word "bank" in the name, green banks do not take deposits or issue consumer loans. Instead, they function similarly to a loan or investment fund to finance clean energy projects. The market-oriented institutions seek to achieve returns on their investments (often at least a 1:3 ratio of public to private capital), in part to demonstrate to private investors that attractive returns are possible.[24] These organizations have parallel goals of rapid deployment and access to underserved markets.

Green banks' special focus on energy and scalable solutions helps to demonstrate innovative financing structures for successful projects that other investors can replicate. By stacking or blending with other public funding incentives, green banks have the power to boost investment strategies, improving product interest rates and making applications

[24] Coalition for Green Capital, "Market Insight: The Nonprofit Model for Green Bank Development."

more competitive. By 2022, US-based green banks in aggregate made $4.63 billion investments in clean energy projects, made up of a 1:3 ratio public to private capital ratio. Of these investments, 26% occurred in low-income communities.[25] Green banks have the flexibility to draw on diverse national capital sources such as the Inflation Reduction Act. Balancing the future threat of ecological crisis with current energy equity concerns, green banks seek to address a just transition to a clean energy economy. This broad goal is implemented differently during project deployment. Therefore, the green bank industry across the country has looked very different in different localities.

While green banks are not tied to specific sectors, the majority of existing green banks have found most success in wholesale renewable energy markets and building decarbonization. This thesis focuses on residential building decarbonization as a high impact intervention point for both climate justice and green finance reasons.

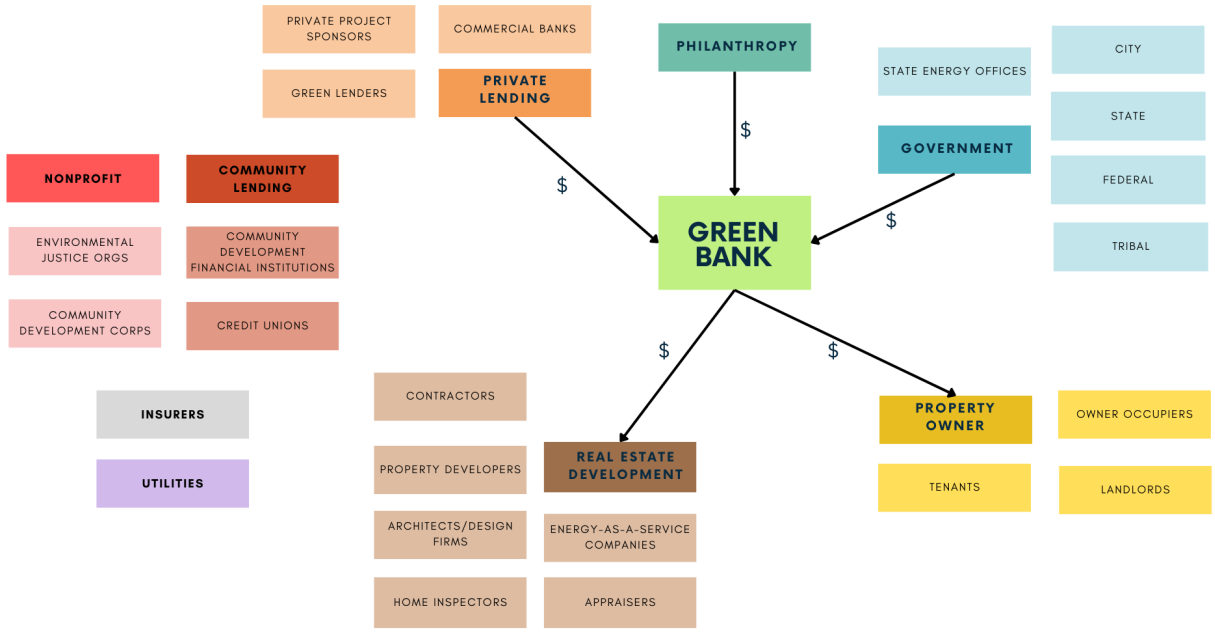

Figure 2: Green Bank Building Decarbonization Stakeholder Map with Capital Flows[26]

[25] Coalition for Green Capital, "Green Banks in the United States Annual Report 2022."
[26] Climate Action Tracker, "Decarbonising Buildings."

1.3.1 Green Bank Structure

Green banks have a narrow mandate to focus on mobilizing private investment using interventions to mitigate risks and enable transactions. Most green banks operate via board committee structure, with an executive director and HR, audit, and finance departments. Green banks largely lack regulation and act as independent authorities with a degree of latitude to design and implement financial mechanisms. Without public shareholders, green banks operate without the pressures of creating shareholder value and meeting expected growth targets. Disconnecting legally from government ties may provide increased flexibility to a green bank in pursuing its mission, although this may limit the local government's ability to direct the green bank in specific ways to achieve policy goals.[27]

1.3.2 Green Bank Tools

While green bank structures and pools of capital differ greatly across the country, a common set of financial tools tend to define options for green bank financial interventions. Not all green banks employ the full comprehensive set of tools, depending on local political context and capacity for implementation. The following financial tools specifically focus on building decarbonization. Similar tools may apply to capital stacks for other types of projects within other sectors such as distributed renewable energy and transportation. The following strategies intend to take one of three strategies: loan, derisk, and aggregate, to solve for green finance market failures.

1. **Loan:** These tools involve direct co-investment into specific aspects of building decarbonization projects.
2. **Derisk**: These tools involve measures that improve attractiveness of projects to private lenders through risk mitigation.
3. **Aggregate:** To increase capital flows, these tools bundle small project finance for private lender uptake.

[27] Muir and Bose, “The Green Bank Opportunity.”

The four main physical interventions for building decarbonization come from: building envelope improvement, energy efficiency increases, on-site renewable generation, and electrification of heating and cooling systems. For energy efficiency, interventions include insulation, ventilation strategies, and sealing windows and doors. For electrification, interventions entail changing water boilers and gas appliances as well as introducing heat pumps and rooftop solar.

Finance Tool	Description
Loan Loss Reserve/Loan Guarantee	Loan loss reserves cover potential losses from borrower defaults, while loan guarantees enhance credit of projects to mitigate risks of the project.
Equipment Loans	Loans finance specific building decarbonization equipment like heat pumps and insulation.
Pre-Development Loans	Loans help fund pre-construction, with an average loan maturity of 7 years. Types might include pre-weatherization to prepare rooftops for solar, or providing soft-cost loans for staffing and scoping.
Green Bonds	Asset-linked fixed-income securities finance projects with environmental benefits. This tool raises a set amount of money from investors that can be used for both demand and supply-side aggregation.
PACE Loans	National program with local administration for energy efficiency loans repaid through assessments on property tax bills. This lien-based funding sits senior to all other non-tax liens on a building including the mortgage.
On-Bill Financing	Payments for energy efficiency or electrification projects on existing utility bills, while upfront capital are provided by a utility or private lender.
Energy Service Agreements (ESA and PPA)	Pay-for-performance, off-balance sheet financing solution that allows customers to implement energy efficiency projects

	without upfront capital expenditure.
Co-Investment	Equity investments through taking an equity stake in a project or company.
Warehousing/Securitization	Warehousing involves reducing transaction costs by bundling small projects together. Securitisation involves transforming non-traded or small scale assets into a standardized tradable asset.

Figure 3: Green Bank Financial Tool Overview (See Appendix C for more detail)

2: Research Methodology

2.1 Research Questions and Framework

Since public subsidies and existing green finance mechanisms alone have proven insufficient to retrofit buildings on scale to reach net zero emissions by 2050, this thesis seeks to understand how public investment in green banks might mobilize private investments and build the residential building decarbonization market and address climate justice goals. To complement existing work, this project focuses on the following questions:

1. *How can the green bank market-based approach to energy transition produce appropriate scales of financial impact and socially equitable outcomes?*
2. *Where are there strategy and program intervention points to leverage green banks to build capital stack programs for equitable residential building decarbonization?*

To address these questions, the research approach consisted of a literature review of theoretical underpinnings of market-based approaches and environmental regulation, interviews with founders and current and former employees of New York Green Bank and New York Energy Efficiency Corporation; and consultations with practitioners and experts on equitable building decarbonization and climate finance. Appendix A lists a table of stakeholder consultations.

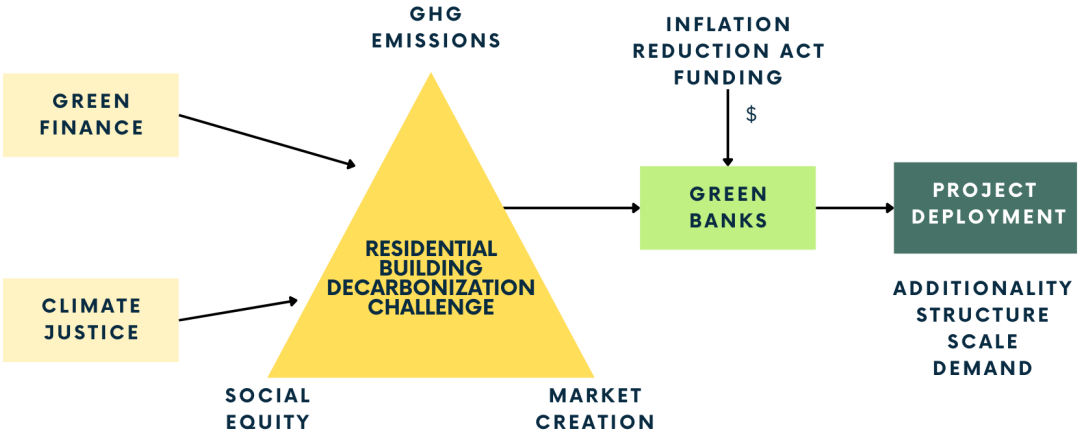

Figure 4: Problem Statement and Proposed Solution Visualization

This thesis will conduct a comparative analysis of the two main New York green banks in the context of windfall federal investment. New York State has supported climate policy and green economy initiatives for several years, and the two main green banks in the state are two of the most well established in the country. While the concept of a green bank is relatively new to the United States, New York Green Bank and NYCEEC each have long track records from 10+ years of experience. The two green banks differ greatly in terms of capitalization, organizational structure, and theory of change. Therefore, this analysis translates the successes and failure to understand potential considerations for individuals considering setting up new green banks.

2.2 Green Bank Literature Review

The green bank theory of change represents a market-based approach using public dollars to induce private capital to align incentives and create a clean energy market across sectors, including building decarbonization. To accurately analyze the green bank model as a clean energy transition solution, one must consider the theoretical assumptions behind the green bank theory of change. The following section explores through the theoretical lenses of green capitalism, public private partnerships, and industrial policy.

2.3.1 Green Capitalism

The frameworks around green capitalism provide insight into the blended market-based approach of the green bank model. Can a transition to green capitalism remain within Earth's ecological capacities while providing socially just outcomes? Different proposals such as the Green New Deal posit different roles for the state in regulating the market and financial sector.[28] Generally, green capitalism promotes the concept that economic growth can continue given the promise of green technologies as a "win-win" equation of providing employment and combating climate change.[29] This approach to solving the problem of climate change results in a diffusion of responsibility, with a sheer volume of actors involved which in turn supposedly distributes accountability.

Twin imperatives of emergent green capitalism call into question the green bank model as a change-making solution. First, green capitalism seeks to use market based mechanisms to address ecological crises while prescribing minimal, if any, disruption to existing economic relations and systems. At present, there exists no example of a market-based transformation that resembles the scale or complexity demanded by the global replacement of fossil-fuel based infrastructure.[30] Green capitalism seeks the pursuit of new domains of accumulation amidst otherwise unprecedented threat to economic returns, profit, and growth. Further, evidence strongly suggests that the burdens of ecological breakdown do not fall equally on all people. For example, studies have shown that historically redlined neighborhoods across the United States have a strong correlation with resident exposure to urban heat island effect.[31] Wholehearted embrace of this type of approach ignores and exacerbates the vast economic and social inequalities across the globe.

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[28] Hudson, "Capitalist Development, the Impossibility of 'Green' Capitalism, and the Absence of Alternatives to It."
[29] Tienhaara, "Varieties of Green Capitalism."
[30] Buller, *The Value of a Whale: Illusions of Green Capitalism*.
[31] Hoffman, Shandas, and Pendleton, "The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat."

Many market-based mechanisms for addressing climate change tend to descend into “greenwashing”, where corporations deceptively persuade the public that an organization's products, aims, and policies are environmentally friendly. This notion of making environmental policy compatible with financial speculation allows the financial sector’s reach to extend to the transition away from fossil fuels. Some believe the question of finance to be ultimately irrelevant to the pressing current questions facing humanity.

These dynamics inform this analysis of the green bank model for climate investments. In the end, finance is a means to accomplish something, not a means of itself. When analyzing the success of the green bank financial model to solve pressing climate challenges, theories of green capitalism warn of the pitfalls of unregulated markets in solving the ecological and sociological crises presented by climate change.

2.3.2 Public-Private Partnerships

Public-Private Partnerships (PPPs) have emerged in the last few decades to address some of the gaps in efficiency posed by government programs and in equitable outcomes and market failures posed by private investment. This form of organization for spurring green investment may be particularly beneficial in the current context of high uncertainty and incomplete contracts.[32] However, PPPs pose their own set of tensions and assumptions, requiring governments to know how to select the right projects and risks of long term contracts for infrastructure (typically 15-30 years) locking in certain technologies. Balancing the needs of profitability and sustainability requires comprehensive planning.[33] In addition, the dominant environmental policy paradigm of ecological modernisation accepts that technological advancements can decouple consumption from environmental harm and a commitment to perpetual economic growth.[34] These political and economic dynamics provide a good intervention point for a comprehensive urban planning effort around green finance and energy planning.

[32] Buso and Stenger, “Public-Private Partnerships as a Policy Response to Climate Change.”
[33] Koppenjan, “Public–Private Partnerships for Green Infrastructures. Tensions and Challenges.”
[34] Tienhaara, “Varieties of Green Capitalism.”

Critics tend to accuse public-private partnerships for backstopping private profits by socializing risk and privatizing profits from joint ventures. The simple fact of catalyzing investment in the hope that energy project returns become "attractive" by corporate actors raises a fundamental equity tension. While disadvantaged communities are less risky than investors may assume, these projects will necessarily take longer to realize returns. Under this model, public dollars are leveraged to reduce risk for private capitalists, who are then rewarded with profits for "doing the right thing" about climate change. In a telling quote by Adrienne Buller,

> "The question that hangs over the Inflation Reduction Act is to what extent we're willing to accept the compromise of handing control over investment in our collective decarbonized future to a handful of investment giants because we are desperate enough to get something — anything — that can cut through the quagmire of US climate politics." [35]

While mainstream climate activists may applaud the focus on low income and disadvantaged communities, much of the excitement around green banking is coming from large environmental groups allied with labor unions and green tech entrepreneurs. A large chunk of this federal investment will not flow to local governments and community based nonprofits directly. Instead, billions of federal dollars will cycle through nonprofit financial institutions, in the hopes of inducing private investments. When setting up public private partnerships, much care should be taken to make sure public dollars have a direct impact on public benefit.

Green banks represent an interesting form of a public private partnership, as they infuse public, private, and philanthropic dollars to attempt to achieve social outcomes and create attractive returns. The same critiques of PPP's can apply to green banks such as backstopping private actor's returns and avoiding creating real systemic change to prioritize disadvantaged community's participation in a just energy transition. Therefore,

[35] Buller, *The Value of a Whale: Illusions of Green Capitalism.*

how can green banks avoid increasing inequality through “green gentrification”, and who will hold them accountable?

2.3.3 Industrial Policy and the Role of the State

Since the beginning of trickle-down economics and its resulting rise of inequality across the world, the orthodox view has prevailed of keeping the government out of innovation and market-based solutions for economic growth. Instead, traditional tools for funding environmental investment programs have relied on environmental externalities like Pigouvian taxes or subsidies, while government financing programs normally address credit constraints.[36] The programs aim to provide economic incentives and subsidies to remove barriers for development of innovative tech and boost private incentives to invest in green technologies. However, studies have shown that outcomes of these programs remain inconsistent with targets, which have led to debates about equity capacity and climate adaptation goals failing to be as effective if not sufficiently linked to private strategies.[37]

However, industrial policy has recently reentered the political conversation, with economists such as Mariana Mazzucato asserting the role of public finance or “patient capital” in determining the rate and direction of innovation.[38] This emphasis on the government’s role in combating rising short termism of corporations speaks to the political and market signaling role of the Inflation Reduction Act as the first and largest climate bill in the history of the US. Green banks represent a blend of public and private capital, and their track record remains varied on the role of government-led financial innovation.

If green banks are to use public dollars to create markets, they must have strong strategic visioning and organization to effectively determine the direction of innovation while also promoting the public good. Purely market-based mechanisms cannot be expected to provide solutions for societal and environmental challenges. The Inflation

[36] Gillingham and Palmer, “Bridging the Energy Efficiency Gap.”
[37] Urwin and Jordan, “Does Public Policy Support or Undermine Climate Change Adaptation?”
[38] Mazzucato, “Innovation, the State and Patient Capital.”

Reduction Act, as a sweeping industrial and climate law, reflects a transformational vision reflecting John Maynard Keynes' hope for government to, "not to do things which individuals are doing already, and to do them a little better or a little worse; but to do those things which at present are not done at all." [39] Because of the newness of green banks as a concept, much consideration and accountability must be built into deploying these federal dollars to spur clean energy project deployment.

3: Current Policy Frameworks

3.1 Federal Policy

3.1.1 Inflation Reduction Act

The Inflation Reduction Act (IRA) is the biggest climate law passed in United States history. This massive budget reconciliation bill provides subsidies for industrial policies around energy and net zero technologies. The capital needs are large. According to Princeton Net Zero America, the United States must invest $703 billion through 2025, accelerate to $1.7 trillion 2026-2030, and $3.2 trillion 2031-35.[40] For net zero buildings, investments must reach $806 billion total through 2035 ($259 billion in low income and disadvantaged communities), which mostly consists of residential heat pump space heating and solar rooftop PV. The IRA represents a first step towards these lofty needs, and green banks intend to use public money to help induce larger private capital.

Unfortunately, many of the regions of the country facing the most serious challenges in terms of energy pollution and fossil fuel energy production do not have state, regional, or local institutions focused on supporting sustainable finance in those communities. The IRA seeks to provide federal support to this end through the national climate bank structure.[41] Of note, the IRA is covered by Biden's Justice40 initiative, meaning

[39] Keynes, *The End of Laissez-Faire*.
[40] Grant, Tonkonogy, and Liston, "Implementing the Greenhouse Gas Reduction Fund: Investment Needs, Barriers, and Opportunities."
[41] O'Neill et al., "Environmental Financial Advisory Board Presentation."

that 40% of investments must occur "in" disadvantaged communities as designated by the government. One of the key benefits brought by the IRA signals to the private market the government's investment in creating clean energy solutions and mandating that these subsidies come along with prioritizing disadvantaged communities.

The question of ownership remains relevant with this strategy to drive building decarbonization across the country. Because these new national financing institutions will be structured as nonprofits with public and philanthropic capital, the organizations will face fewer federal restrictions such as the prohibition from privileging disadvantaged communities by race. However, these entities also tend to rely more on the preferences of influential donors and investors. Provisions of the IRA have since faced Republican repeal attempts, although none have been successful thus far. Just as climate change has become a politicized issue in the United States, proposed solutions such as green banks have also become a political problem.

3.1.2 Greenhouse Gas Reduction Fund

The Greenhouse Gas Reduction Fund (GGRF) provision of the IRA, administered through the Environmental Protection Agency (EPA), seeks to reduce greenhouse gas emissions, send benefits to underserved communities, and transform financial markets. The $27 billion total consists of two pots of money: Zero Emissions Technology ($7 billion) and Disadvantaged Communities Money ($20 billion). Eligible entities applied for direct or indirect funds, and the nonprofit intermediary recipients must operate for public purpose and be non depository. Timeline constraints of the program required the EPA to design and execute the program within a 18 month window, and that all the money must be disbursed by Sept 30, 2024.[42] The EPA has identified three areas for priority investments: distributed generation, transportation electrification, and building decarbonization. According to McKinsey, the initial capitalization of $20 billion in the GGRF will result in $250 billion total

[42] Environmental Protection Agency, "Implementation Framework for the Greenhouse Gas Reduction Fund."

mobilization or a 7:1 capital mobilization ratio.[43] In addition, this capital movement will lead to a predicted 400,000 DAC jobs and total 1.1 million direct jobs. In terms of GHG emissions, GGRF could contribute up to ⅙ of emissions reductions needed over the next 10 years to reach 2050 Net Zero.

GRRF seeks to address the lack of requisite "start up" capital at reasonable costs and flexibility to meet climate goals. This capital can look like a variety of financing mechanisms, including technical assistance, planning and pre-development grants, as well as loans and traditional financial tools. In particular, many priority areas for reducing GHGs including buildings, industry, and transportation may not readily lend themselves to existing funding structures in priority communities. GGRF focuses on funneling money through nonprofit intermediaries to focus on places and people, as opposed to project based funding. The receiving entities must commit to accountability and reporting, with all resulting financial transactions reported publicly as well as mandatory impact reporting of GHG emissions reductions.

Another noteworthy aspect of the GGRF is that by structuring fund dispersal to a network of accelerator nonprofit banks, traditionally difficult federal processes to energy projects such as the National Environmental Policy Act (NEPA) do not apply. NEPA requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions.[44] Because the EPA administrator would be providing funding directly to the nonprofit entities—not to the qualifying emissions-reduction projects—no federal government agency administers loans, grants, or other financial assistance for these projects. Without "federal action," NEPA's environmental analysis requirement may be inapplicable, accelerating the timeline by which capital could be transferred to certain clean energy projects. In addition, the EPA designed GGRF funds to be politically durable, given that all funds must be deployed by the next presidential transition, and entities outside the government will distribute funds.

[43] Buehler, Eis, and Levy, "Delivering Transformative Impact from US Green Bank Financing."
[44] US EPA, "What Is the National Environmental Policy Act?"

Some of the core tensions facing GGRF program design and implementation reflect the larger tensions seen in the green bank landscape. For example, equity and access vs. leverage for market creation, short vs. long term project impacts, and "shovel-ready" projects vs. community capacity building. For example, a project could enhance funding additionality and recycling of capital that may not provide immediate benefits to disadvantaged communities but are likely to provide funding sustainability for GHG reduction programs for the long-term. Some actors in the space expect the funding will drive homogeneity in a currently diverse green bank landscape. In addition, experts predict that GGRF will have a massive deployment problem for buildings as opposed to DER and transportation. Whereas the economics of utility scale solar work with some caveats of subsidized financing (low income community solar, affordable housing multifamily solar), building decarbonization is another matter.

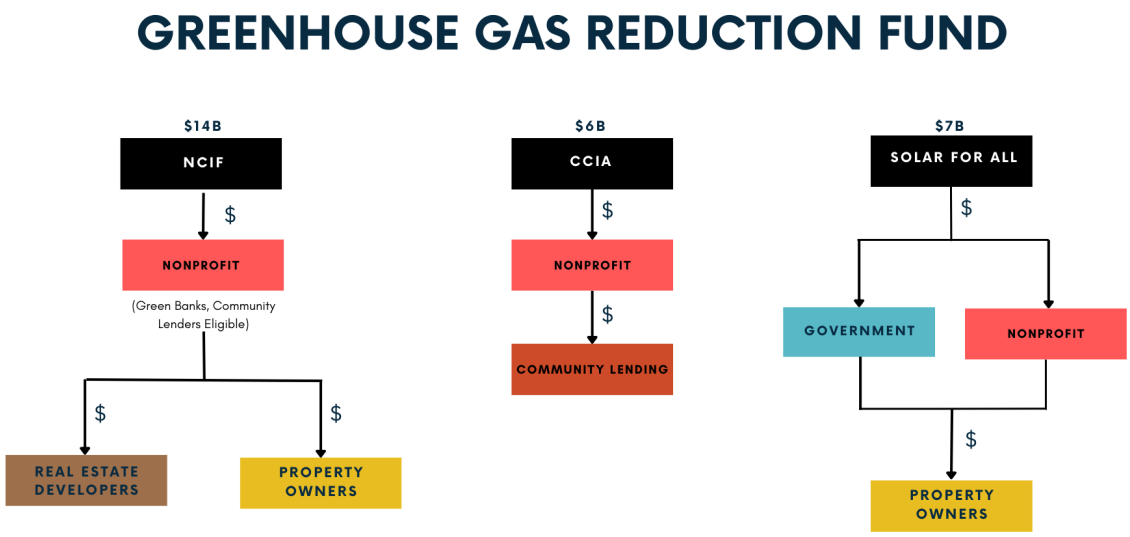


Figure 5: Greenhouse Gas Reduction Fund Capital and Organization Flows[45]

Within the GGRF, the three programs are described below.

[45] "EPA Announces GGRF Awards."

1. **National Clean Investment Fund (NCIF) ($14 billion):** will provide grants to two or three national climate banks, thereby enabling them to partner with the private sector to provide financing to tens of thousands of clean technology projects nationwide. These entities will not be providing grants and instead will be providing financial products for a variety of scaled projects.

Due to the size of the capital pool, no one organization submitted an application for this fund. Instead, a variety of coalitions submitted applications for the NCIF from a variety of sectors. There were five applicants to this funding: Climate United, the Justice Climate Fund, the Coalition for Green Capital, Power Forward Communities, and Ecority. The applications ranged from providing no or low-cost loans to community lenders to prioritizing inducing private capital for projects. Some applicants put forward detailed environmental performance standards to ensure their lending would target zero-carbon building and transportation projects. At the subaward level, states without green banks are currently scrambling to create green banks in order to capture the expected influx of funds from the GGRF.

On April 4, 2024 the EPA announced the three selected applicants for the NCIF fund as follows:

- **Climate United ($6.97 billion award):** Climate United consists of Calvert Impact social investing and two CDFIs (Community Preservation Coalition and Self-Help Ventures Fund). Climate United Fund's program will focus on investing in harder-to-reach market segments like consumers, small businesses, small farms, community facilities, and schools.
- **Coalition for Green Capital ($5 billion award):** Coalition for Green Capital's program will have particular emphasis on public-private investing and will leverage the existing and growing national network of green banks as a key distribution channel for investment.

- **Power Forward Communities ($2 billion award):** A coalition of five members—Enterprise Community Partners, LISC (Local Initiatives Support Corporation), Rewiring America, Habitat for Humanity, and United Way– focus on customized and affordable solutions for single-family and multi-family housing owners and developers.

According to the EPA, 50% of funds are dedicated to net zero buildings, 15% for zero-emission transportation, 20% for DER and storage, and 15% for other qualified projects.[46]

2. **Clean Communities Investment Accelerator (CCIA) ($6 billion):** provides grants to support up to seven nonprofit groups that will deliver funding and technical assistance to build the clean financing capacity of local lenders specific to lower-income and disadvantaged communities.

This fund was created to distribute to hundreds of community lenders, indirectly financing smaller markets with upper bound financial caps. Unlike the other two GGRF competitions, these funds come with a requirement that the selected nonprofits will pass 95% of the capital they receive to community lenders such as credit unions and community development financial institutions across the country.[47] Green banks may play a role as an intermediary for CCIA but do not play a main role in this provision.

The five selected applicants for CCIA fund are: Opportunity Finance Network ($2.29 billion award), Inclusiv ($1.87 billion award), Justice Climate Fund ($940 million award), Appalachian Community Capital ($500 million award), and Native CDFI Network ($400 million award).

[46] US EPA, "NCIF and CCIA Fast Facts."

[47] Michigan Saves, "How the Clean Communities Investment Accelerator Will Boost Your Green Lending Game."

3. **Solar for All** ($7 billion): awards up to 60 competitive grants to states, territories, Tribal governments, municipalities, and nonprofits to expand the number of low-income and disadvantaged communities primed for residential solar investment.

Under Solar for All, EPA competitively awarded grants to the 60 selected residential solar programs across the country that deliver meaningful benefits to disadvantaged communities.[48] The announcement on Earth Day allocates funds to all 50 states and territories including five multi-state awards. EPA lists energy efficiency improvements, electrical system upgrades, and structural building repairs as allowable enabling upgrades, signaling intent to pair energy efficiency upgrades with solar deployment. 75% of funds must provide financial assistance to residential rooftop and community solar projects, and the remaining 25% can be used for project deployment efforts. The program also targets a range of scales, from 10,000 households to greater than 30,000 households. This program is somewhat less relevant to the green bank conversation, as the funds will primarily be going to municipal and tribal authorities, however, existing green banks have applied as sub awardees to various applications.

3.2 State and Local Policy

For the purposes of the comparative case study between New York Green Bank and New York Energy Efficiency Corporation, the state and local policy landscape focuses on New York state and city. The two main relevant pieces of legislation are the Climate Leadership and Community Protection Act (2019) and the Climate Mobilization Act (2019).

3.2.1 Climate Leadership and Community Protection Act (Climate Act)

In 2019, after four years of organizing, lobbying, and advocacy from a variety of environmental and social justice groups, New York State passed the Climate Leadership and Community Protection Act (Climate Act). The Climate Act requires New York to reduce economy-wide greenhouse gas emissions 40% by 2030 and no less than 85% by 2050 from

[48] Kent and Elizondo, "EPA Announces the Greenhouse Gas Reduction Fund Solar for All Program."

1990 levels. The Climate Act also set up the Climate Action Council (CAC) to draft an implementation plan to ensure its goals are met as well as the Climate Justice Working Group.[49]

The mandate focuses specifically on cleaning the grid through clean energy and transforming buildings and transportation to carbon neutrality by 2040. Some notable milestones include 6,000 MW of distributed solar and energy efficiency, 100% clean greenhouse gas emissions free electrical grid by 2040, and net 100% reduction in emissions by 2050. Thus far, ballpark figures for New York state's transition to clean energy appears to be around $44 billion, higher than expected.[50] This law constitutes the main climate emissions goals the two New York green banks work towards.

3.2.2 Climate Mobilization Act (CMA): Local Law 97

The New York City council passed the Climate Mobilization Act (CMA) in 2019 to put NYC on the path to reducing building carbon emissions by 40% by 2030 and by 80% by 2050. The largest climate legislation of any city in the world, the CMA consists of several laws aimed at reducing the greenhouse gas emissions across the city, with special attention paid to improving the energy efficiency of both residential and commercial buildings.[51]

The centerpiece of the CMA is Local Law 97 (LL97). This provision requires buildings larger than 25,000 square feet to meet strict greenhouse gas emissions limits starting in 2024.[52] This new law will reduce cumulative emissions from large buildings at least 40% citywide by 2030 through building retrofits. LL97 applies to 50,000 buildings across New York City across 22,000 properties, around 60% of total buildings. Compliance begins in 2024, and noncompliant building owners face a financial penalty of $268 per ton of CO2 equivalent over limits, stepped over time in five year increments. The city assigns limits according to building occupancy type. Limits are set to become significantly more stringent during the second compliance period (2030-2034). Local pushback on achieving

[49] State University of New York, "Climate Leadership and Community Protection Act (CLCPA)."
[50] Arbetter, "Observations on the Cost — so Far— of Implementing New York's Climate Law."
[51] Brooklyn SolarWorks, "What Is the NYC Climate Mobilization Act?"
[52] "Climate Mobilization Act Brief."

these goals has led to a significant watering down of the legislations, where building owners can can deduct 10% of emissions through greenhouse gas offsets during the first period, as well as purchase unlimited renewable energy credits (REC) as long as the RECs represent emissions for energy in the New York City area and generated in the same year.

Other pieces of this legislation include establishing a new Property Assessed Clean Energy (PACE) program to enable retrofits through long-term financing, and requires the installation of solar PV and green roofs on new buildings and major renovations. Energy benchmarking provides another potential solution to incentivize property owners to make energy efficiency and electrification improvements to their buildings.

All told, experts predict that CMA will eliminate 6 million tons of greenhouse gas emissions by 2030, create 26,700 green jobs by 2030, and prevent 150 hospital visits annually by 2030. However, the bill is not without its controversy. Many real estate actors have complained about inability to comply, with some going so far as to sue the city in an ongoing case to prevent the enforcement of Local Law 97, claiming that the penalties are too burdensome and target the wrong buildings. Still, LL97 presents an important piece of local climate legislation that will have a huge impact on building decarbonization for the city of New York.

4: Case Studies

4.1 New York Green Finance and Buildings

This comparative analysis focuses on the two main New York green bank initiatives in the context of windfall federal climate investment and ambitious state and city climate goals. New York City and state support economies with demonstrated interest in transitioning to the green economy and can provide leadership in the just transition. New York City makes up the vast majority of building emissions for the state at large, such that if the city achieves its climate decarbonization goals, the state is more likely to comply. More than 90% of New York buildings today will still stand in 2050 and account for

approximately 2/3 of NYC's overall greenhouse gas emissions.[53] Therefore, building retrofits must comprise the majority of decarbonization strategies to reach the city's ambitious climate goals.

Specific to residential building electrification, New York has a large task ahead, with 6 million households needing to transition to electrified heat sources. According to Census data, the vast majority of households in New York use either natural gas or fuel oil to heat their homes (83%). Nearly half of New York households qualify as LMI, making resolution of building decarbonization issues central to achieving New York's climate goals. Finally, about 40% of buildings in the city are multifamily residential, which also have the most need for energy efficient and weatherization upgrades in addition to electrification needs. This thesis focuses on the residential building sector for the green bank efficacy analysis.

The two green banks for this case study differ in their organizational structure, since New York Green Bank (NYGB) was set up by state legislature as a quasi-governmental organization, while New York Energy Efficiency Corporation (NYCEEC) was set up with public and philanthropic funds but now functions as a nonprofit entity. This main difference in organizational structure provides the basis for a comparison between the two organization's histories, approaches, successes, and critiques.

	New York Green Bank	**NYCEEC**
Organization Type	Quasi-Governmental	Nonprofit
Capital Pool	$1 billion	$44 million
Funding Breakdown	Annual Net Income	Blended Portfolio - federal (57%), bank (22%), philanthropic (13%), city (9%) [54]
Market Type	Wholesale	Retail

[53] Burns-Maine and Klein, "Financing Multifamily Rehabilitation in New York City."
[54] Pillay, Probst, and Luk, "Establishing a City Green Bank."

Rate Approach	Commercial	Subsidized
Service Area	NY	NY, NJ, MA, PA, RI, CT, MD, NJ, DE
Sector Priority	Wholesale Renewable Energy	Building Decarbonization
Success	- Creation of NY Community Solar Market	- Co-investment with Affordable Housing - Capital Stack Gap-filling
Critiques	- Social Equity Outcomes - Lack Real Estate Finance Expertise	- Project Pipelines - Investment Policy Decisions - Scale of Impact

Figure 6: Comparison of NYGB and NYCEEC Summary

4.2 NY Green Bank

New York Green Bank (NYGB) is the largest green bank in the nation, with 10 years of experience and $1 billion in capitalization through ratepayer dollars with funding from New York State (NYS). NYGB has committed over $1.7 billion as of June 30, 2022, resulting in up to $4.5 billion total capital mobilized in sustainable infrastructure in NYS. Unlike NYCEEC, NYGB has historically focused on modeling project finance for utility scale community solar renewables on the wholesale market.[55]

4.2.1 NYGB History

New York Green Bank was founded in 2013 as a division of New York State Energy Research and Development Authority (NYSERDA). NYS determined that the existing state energy office, NYSERDA, could create its own divisions internally to provide financing. Using a regulatory path was the optimal way to capitalize on potential funds, so lawmakers pursued capitalization through ratepayer funds. NYGB initially attempted some retail lending to buildings but found much more success as a wholesale lender for utility scale solar. NYGB was not initially set up with any policy mandate to prioritize projects related to

[55] Muir and Bose, "The Green Bank Opportunity."

disadvantaged communities. Instead, the organization's sole purpose was to create market conditions for clean energy.

Specifically, NYGB comprises a key component of the Clean Energy Fund (CEF), a 10-year, $5.3 billion commitment by NYS to advance clean energy market growth and innovation while reducing ratepayer collections and driving economic development. The initial capitalization for NYGB's establishment was issued by the New York Public Service Commission (PSC) and approved in December 2013 through an Initial Capitalization Order providing NYGB with $165.6 million to begin its operation.[56] NYGB continues to be self-sufficient through the generation of annual net income. As the bank itself puts it, "NYGB is committed to being market-focused and market-responsive." [57] This history of how the organization was created and with which mandates characterize the approach and relevant outcomes of the bank.

4.2.2 NYGB Approach

NYGB's core goal focuses solely on GHG reductions as outlined by law in the Climate Act using wholesale project finance practices to respond to market needs.[58] The NY Green Bank 2023 impact report focuses on four pillars of impact: energy storage, clean transportation, building decarbonization, and community distributed generation. Key elements of NYGB's approach to green banking are focusing on wholesale markets, collaborating with existing market participants, providing commercial interest rates, and recycling capital. NYGB focuses on being responsible stewards of the public dollar, which means being careful on financial risks and documentation oversight on loans. The organization does not view subsidized capital as market transforming, so it tries to be as commercial as possible as proof of concept for clean energy deals. By trying to emulate market rates, NYGB hopes to execute financial product transactions that can then be replicated by the private sector.

[56] Green Bank Network, "New York Green Bank."
[57] New York Green Bank, "New York Green Bank Metrics Reporting and Evaluation Plan."
[58] "C40 Good Practice Guides."

NYGB addresses social equity impacts through specialized loan products (mainly predevelopment loans), community engagement, and partnerships with CDFIs and other local lenders. NYGB pledged that between 2020 and 2025, at least 35% of NY Green Bank's capital is committed to projects that benefit disadvantaged communities as defined by the Climate Justice Working Group. However, in 2023 only 22% of capital funnels toward DACs.[59] As for programming, NYGB's approach to more socially equitable projects has been to outsource the work to partnering with CDFI lending pathways to complete transactions, including a recent loan to NYCEEC.

NYGB's approach to the building decarbonization market consists of the $250 million Community Decarbonization Fund (CDF), which provides bilateral lending at market rates on a secured basis.[60] The CDF is a wholesale lending pathway available to CDFIs and mission-driven lenders to enable them to provide more capital to eligible projects benefiting residents of disadvantaged communities. The fund gives applicants significant flexibility in the form of a 12-year loan between $2 and $25 million to work with local partners to identify funding opportunities. These flexible funds can be used for rental and homeowner affordable housing as well as economic development ends, as long as they take place in New York state and in partnership with a local financial lender. The CDFI participants would in turn provide underwriting for these projects using their organization's infrastructure, staff, and business model practices.[61]

4.2.3 NYGB Successes

NYGB has been very successful in establishing wholesale utility renewable energy sources across the state, and in turn raised a lot of money doing so. The green bank achieved financial self-sufficiency through completing some of the earliest community solar transactions in New York state, which in turn helped lead to the success of New York State becoming the leading community solar market in the nation, with over 1.7 GW of

[59] "NY Green Bank Impact Report 2023."
[60] New York Green Bank, "Community Decarbonization Fund."
[61] New York Green Bank, "Climate Equity."

capacity installed.[62] Now the green bank provides gap-filling products in utility scale solar such as interconnection finance, community solar business model management, and construction finance. NYGB has also provided other innovative financial solutions, such as issuing green bonds. In 2017, NYGB issued a $134 million green bond to finance a range of clean energy projects that included energy efficiency retrofits in public housing buildings.

NYGB has also seen success as a back stop when credit markets have tightened and other private lenders have backed out of ongoing project transactions. In addition, certain kinds of innovative technologies or new markets require co-lending approaches, with NYGB providing low interest capital in addition to private actors. NYGB has found that due to the wide array of energy projects and changing market conditions, additionality has not been an issue. They have not been in competition with private lenders despite offering competitive interest rates. Potential borrowers mainly come to NYGB due to small deal size, followed by early stage development of organizations and technologies.

4.2.4 NYGB Critiques

Because NYGB is part of and under control of NYSERDA as a public entity, many more people question NYGB's policies from a public policy standpoint. Social equity advocates argue that NYGB has created insufficient conditions for equitable projects and continue to obfuscate their work, especially around multifamily decarbonization financing.[63] To address equity concerns, the NY green bank provides tiered interest rates for community solar project loans based on the amount of LMI households that have subscribed to a community solar project.[64] However, these measures have not been sufficient to serve disadvantaged communities other than being in the correct zip code. The CDF was also created to address this gap in money directed toward LMI communities.

Because the fund was created with ratepayer dollars and given that the market for wholesale renewables has taken off, some argue that NYGB no longer provides a public

[62] "NY Green Bank Impact Report 2023."
[63] NY Renews, "NY Renews."
[64] New York Green Bank, "Climate Equity."

policy purpose. This approach has garnered the critique of asking whether NYGB needs to continue to spend public dollars to provide private actors with project subsidies. Critics believe that perhaps 10 years ago when NYGB was founded this might have qualified as a market failure, but now this approach does not describe the current situation for renewable energy production. Instead, public entities should be directing public dollars to the hardest climate actions not currently happening as well as the barriers in other sectors outside of wholesale renewable energy.

In addition, the organization structure of NYGB means that the staff don't have the expertise of the building decarbonization market, in particular anything at the affordable market rate. For example, NYGB solicited a request for proposals for specific financing of DAC energy efficiency projects, and the sole response and allocation was from none other than NYCEEC.[65] NYGB are big project finance dealmakers. They understand the project finance required to create big infrastructure like utility solar or a wind farm. They don't understand the diffuse and varied finance required to install a million little heat pumps. Organizational pivoting to building decarbonization proves a difficult task for a large mature green bank such as NYGB.

4.2.5 NYGB and GGRF

A cross-NYSERDA working group including NYGB was formed to develop application materials for the GGRF. NYGB partnered with Coalition for Green Capital as a subawardee for the NCIF competition. According to NYGB, with GGRF funds they plan to continue their focus on large scale renewables and grow the portfolio with revenue generating assets such as distributed energy local systems and community solar (5-10 MW) instead of large scale utility solar.

[65] New York Green Bank, "New York Green Bank Metrics Reporting and Evaluation Plan."

4.3 New York Energy Efficiency Corporation

New York Energy Efficiency Corporation (NYCEEC) is the country's first local green bank, established in 2010.[66] From an initial capital base of $34.4 million, NYCEEC has now mobilized over $430 million of capital for energy efficiency and clean energy projects across various real estate sectors, marking a multiple of more than 12x the initial federal capital.[67] In addition, NYCEEC is New York City's designated C-PACE administrator. In addition, the green bank mandate means that NYCEEC will not invest in projects with projected higher GHG emissions.[68]

The organization now operates independently from its governmental roots, with two members of the NYC government serving as directors on the board. This structure provides NYCEEC with the high level guidance and support it needs and allows for greater flexibility than NYGB's structure due to the absence of government processes and limitations. Despite its name, the organization now serves building decarbonization finance products outside of the city, including other states across the New England and Mid Atlantic regions. NYCEEC can commit to a minimum of $250,000 up to $2 million per project. However, NYCEEC works with a number of financing partners to finance transactions larger than $2 million. NYCEEC primarily completes financing transactions in relation to large scale building decarbonization projects on a project-by-project basis.

4.3.1 NYCEEC History

NYCEEC was first conceived as a green financing institution as part of a series of local laws included in the Greener Greater Buildings Plan. This unregulated, specialty finance nonprofit was initially capitalized by the city after the 2008 financial crisis, using federal funds through the American Reinvestment and Recovery Act (ARRA) and Energy Efficiency and Conservation Block Grants. NYCEEC began with strong affiliations with the city, where mayor Bloomberg approved the board and CEO and the city controlled

[66] "C40 Good Practice Guides."
[67] Coalition for Green Capital, "Green Banks & Catalytic Blended Finance."
[68] Muir and Bose, "The Green Bank Opportunity."

disbursement of federal grant money. As a result of mayor Bloomberg's departure, the organization was then spun off from the city to protect from potential future political movements against the organization. NYCEEC was modeled from other successful public private partnerships in healthcare and Toronto's clean economy fund with the vision of operating a self-sustaining financing organization. Given that project funding tends to be "use it or lose it", the early stages of the organization needed to find a coalition of the willing to finance projects.

One aspect to note is that NYCEEC did not always prioritize electrification and Net Zero for financing projects. When the first green banks were conceptualized, the focus was solely on energy efficiency in buildings. Therefore, the theory was that energy retrofits will save energy and therefore could pay for the finance improvements using future savings. If actors could get smarter about the technical pieces of building decarbonization alongside flexible capital, then we could solve this problem. The early projects involved primarily cost-efficient oil to gas conversions in line with contemporary policy priorities. Because policy visions included cogeneration using natural gas boilers to heat the building and domestic hot water, NYCEEC completed several of these projects, even though in today's view these projects would not be considered greenhouse gas reductions. NYCEEC had to comb the city to try and find partners and projects, with a specific lack of demand for these solutions at the time. They focused on contractors and energy service companies, whereas NYCEEC today has much more demand. The organization still has a very small balance sheet compared to the scale the city needs to decarbonize the buildings sector.

4.3.2 NYCEEC Approach

From the beginning, NYCEEC was set up with a needs based approach to finance the deals no one else would take on. Beyond the federal requirements, the organization raised more money through philanthropic sources that have their own ties and requirements. In this way, NYCEEC's structure looks more like a community lending institution. One of the main goals of the organization is the preservation of limited capital.

One drawback to this lean structure with a small capital pool is that the organization must focus on capital need instead of market need.

NYCEEC takes a diversified portfolio approach to project finance, primarily a combination of market rate and low income community projects in both multifamily and commercial properties. NYCEEC does not provide financial products to single family homeowners due to the small deal size. NYCEEC prioritizes partnership building, with close relationships with NYGB as a lender who originates loans. NYCEEC also operates as a loan loss reserve function to provide appropriate interest rates and loan guarantees for proposed projects. Finally, NYCEEC provides financial support for two technology market areas currently underserved by traditional lenders: 1) energy efficiency technology and 2) combined heat and power (CHP). These loans tend to have short payback periods, and combined with the longevity of infrastructure, ensures these loans remain cost effective.

4.3.3 NYCEEC Successes

NYCEEC's impact approach involves prioritizing socially impactful projects while balancing the requirements of financial self-sufficiency. NYCEEC has succeeded in finding philanthropic funding and operating as a self funding organization without budgetary support from the city.[69] As of 2023, NYCEEC had mobilized $496 million and upgraded 569 buildings, with a reduction in 1.09 million megatons Co2 (over lifetime of projects).[70] These projects included 6973 affordable units and created 1829 jobs.[71] To date, NYCEEC projects have achieved almost all projected energy savings modeled during the technical underwriting process, for an average energy savings realization rate of 91%. NYCEEC also generates quarterly reports that include realization rates for energy, costs, and greenhouse gas emissions that NYCEEC uses to review portfolio-level trends and performance.

As for prioritizing climate justice, NYCEEC focuses on affordable housing projects based on census data and targeting opportunities based on community based

[69] "C40 Good Practice Guides."
[70] "Our Impact."
[71] New York Energy Efficiency Corporation, "Investment Policy."

organizations and partnership networks. As a mission-driven nonprofit, NYCEEC commits to primarily impactful projects and secondarily sustains the organization. One example of a noteworthy project was the Marcus Garvey apartments, an affordable housing property that now has the first battery storage microgrid installation at a low-income property in greater New York. NYCEEC has one of the most successful strategies for social impact because it focuses on disadvantaged communities and projects with meaningful impact.

4.3.4 NYCEEC Critiques

NYCEEC faces three main critiques. The first is that it took many years to reach a steady demand of building decarbonization projects. To replicate this model in other places, potential future green banks don't have the time to build out processes and ramp up for 10 years. Another critique involves the NYCEEC investment committee's decision making, which occasionally provides predevelopment lending for buildings that aren't going to be electric. This example describes financial needs driving the institution and preventing the organization from reaching its mission. Because of competing balance objectives, maintaining appropriate balance of loan terms and mission orientation remain difficult. The final main problem with NYCEEC's current model is scale of impact. To some experts, financing orgs like NYCEEC are nibbling around the edges of the problem. This may change in the context of federal investment, but comparing the potential capital impact of NYCEEC and NYGB, NYCEEC struggles to achieve the same scale. In the view of the organization's leadership, if NYCEEC were 10 or 100 times larger, climate would still be an enormous issue for New York that could not be solved by just one organization.

4.3.5 NYCEEC and GGRF

NYCEEC was involved with all three competitions of GGRF. They were a lead applicant for Solar for All $400 million as part of a national program multifamily affordable solar with a number of partners. NYCEEC also collaborated with three of the applying coalitions for NCIF funds as a subawardee. Finally, they were actively involved and provided letters of support for the CCIA competition.

5: Discussion

While green banks provide a potential solution to solving climate crisis financing questions, much care should be taken when analyzing whether the tool would be a good fit for addressing equitable residential building decarbonization. The theoretical underpinnings of green capitalism and industrial policy inform the critical analysis of whether green banks achieve the goals professed of greenhouse gas reductions, market creation, and positive social impacts. The comparative case study between NYGB and NYCEEC provides insights centered around two different models of a green bank. The following four patterns outline the major challenges that characterize the green bank proposal: **additionality, scale, organizational structure, and demand**. This discussion could have direct implications for policymakers intending to create a green bank for their city or state.

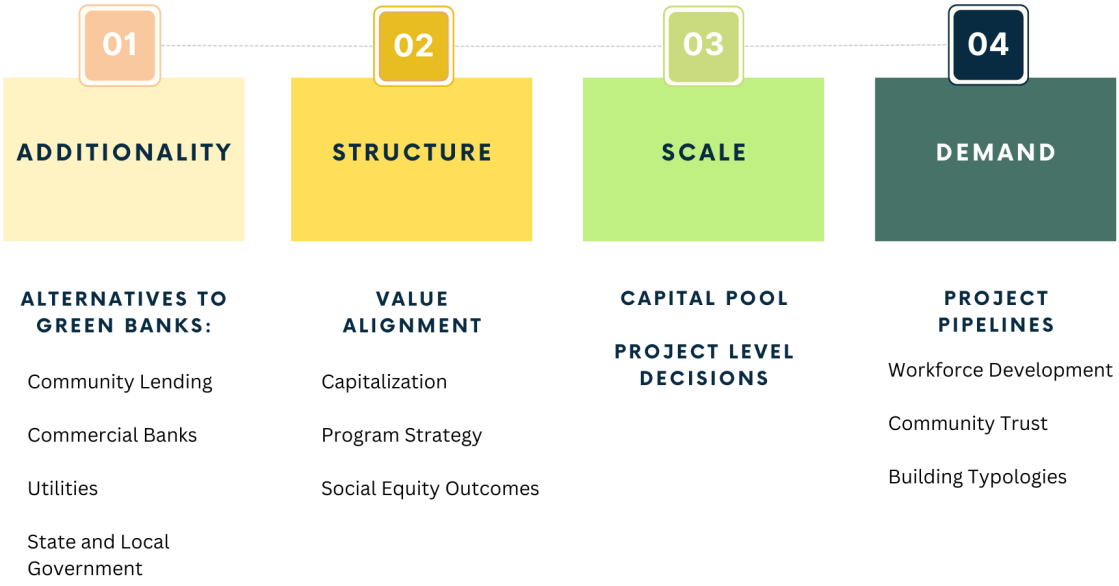


Figure 7: Summary of Green Bank Analysis Considerations

5.1 **Additionality** and Alternatives to Green Banks

The concept of additionality analyzes whether the value added of an intervention taken with public dollars will provide public benefit that would not have happened in the private sphere. This concept is of utmost importance regarding green banks, because 1) care should be taken not to duplicate efforts of government programs; and 2) green banks operate within an existing financial ecosystem. With the passage of GGRF, green banks have committed to leverage a 7:1 capital ratio with private lending, an enormous goal for the next seven years. The GGRF winners must make good on their claims, without a clear precedent. As discussed in chapter 3, even the premise of using public money to derisk private investment could be a problem as a form of extractive green capitalism. We must ask the question: are green bank investments really moving the capital markets, or are they just purporting to do so?

The problem with analyzing additionality is the difficulty of calculating a hypothetical counterfactual. First, a green bank must determine that its actions are differentiated from a commercial bank's. And then if so, the organization would need to evaluate when to end financing. Much of the discussion from chapter 2 considered what green banks contribute, especially their credit risk appetite compared to traditional banks. The truth is that many corporate and institutional investors already seek to invest in projects that will meet climate and equity goals. State and local green banks have been highly successful in lending for clean energy projects, and some like NYCEEC are experienced in providing green lending to disadvantaged communities in partnership with local developers and city departments. However, not all green banks successfully reach disadvantaged communities. Further, not all states or regions have an existing green bank. Many different actors may intervene, including community lenders, traditional banks, utilities, and state and local governments. The following section describes each of these stakeholders in turn and analyzes their potential as an alternative to green banks to finance building decarbonization across the country.

5.1.1 Community Lenders

Community lenders such as Community Development Financial Institutions (CDFIs) provide a similar function to green banks in the community development industry for housing and economic development. The community lending industry grew in the wake of urban renewal and the 1970's Community Reinvestment Act to provide housing and economic development to Low and Moderate Income (LMI) communities. This movement created the CDFI, a nonprofit entity that provides debt, equity, and low interest loans for housing and economic development with a specific geographic focus. CDFIs can be nonprofit structures providing services similar to a credit union, bank, loan fund, or venture capital fund. CDFIs are better positioned to prioritize DAC projects and help these gaps to provide funding to low-income communities and hard-to-reach areas.

The consideration for whether CDFIs could play the role of a green bank comes down to their success folding potential federal money into existing community lending finance efforts. These actors are mission-based but extremely heterogeneous across the country, with many operating a non self-sustaining business model to raise philanthropic money because they do not provide enough liquidity through loan repayments. Both green banks and CDFIs fill certain roles and have certain blind spots. CDFIs play a great role in accessing the small building stock and have community connections, but they do not have the technical knowledge of climate lending. On the other hand, green banks don't know how to do underwriting and lending for affordable housing development. The CCIA provision of GGRF intends to bridge this gap by incentivizing CDFIs and other community lenders to enter the green finance space. To be a successful alternative to green banks, CDFIs need to build capacity internally through education and technical assistance.

One additional consideration is that local sentiments on the importance of climate may vary, which will impact the capacity for CDFIs to take on projects. Even with pro-climate sentiment, decarbonization investments and clean energy access need to be deeply integrated in other goals of the community. Without a more robust community engagement and support, building decarbonization projects have the potential to stall or even fail. As trusted partners, CDFIs and local community based organizations could

facilitate conversations and empowerment for local residents to take part in the energy transition with their residences. Green banks simply do not have this type of relationship with the highly localized decision-making processes of people's homes.

5.1.2 Commercial Banks

Commercial banks have recently started to enter the climate space, and the goal of green banks is to eventually pass off all building decarbonization lending to private actors. From socially responsible B-corporation banks to institutional investors issuing green bonds, private actors have already started to participate in climate investing in substantive ways. Socially responsible "triple bottom line" banks such as Amalgamated bank have a fossil-fuel free portfolio and dedicated climate wing with 32% of loans specific to climate solutions such as loans for utility scale solar projects. Amalgamated has even provided loans to Inclusive Prosperity Capital, a spin-off of Connecticut Green Bank, as part of their climate justice and community development strategy.[72]

Institutional investors developing a robust green bond market could play a role in driving green lending for building decarbonization. Historically, labeled bonds have been used to fund railroad, aircraft, highway, war industries and other infrastructure.[73] This type of finance gives autonomy over spending and attracts a new pool of large institutional investors such as mutual funds, hedge funds, and endowments. Green bonds tend to be large ($5 million or greater) and require extra costs and a high level of certainty in energy reductions. The 2010s saw the development of green bond funds, broadening the ability of retail investors to participate in these initiatives. According to the Climate Bonds Initiative, the global issuance of green bonds reached $2.983 trillion in 2024.[74] Some green banks such as NYGB have successfully issued green bonds to support projects and portfolios with an operating track record.[75] While green bonds may play a role in directing private capital

[72] Joftis, "Amalgamated Bank Announces $15 Million Loan for Decarbonization and Climate Resilience Initiatives."
[73] Institute for Market Transformation, "External Financing Guide."
[74] "Climate Bonds Initiative."
[75] National Resource Defense Council, "Green & Resilience Banks."

toward climate initiatives, due to the large size and general nature of the financial tool, they may not replace the niche finance required to solve the building decarbonization market failure.

Many large green banks such as NYGB have been developed to mimic the ethos and parameters of commercial banks. Unfortunately, the traditional commercial lending terms, rates, and risk analysis don't work in all scenarios when considering the added climate justice goals of many green banks. Factoring in climate justice goals works better for wholesale as opposed to retail lending. Moreover, compared to commercial banks, soft costs are high for green banks while their return requirements remain market rate, which can lead to operational problems. Therefore, green banks filling the same role as a commercial bank would not translate as a successful strategy for accelerating investment in building decarbonization. Consideration should instead focus on at what point green banks would hand off building decarbonization finance to socially responsible or institutional private actors.

5.1.3 Utilities

Public service commission action and appropriate utility regulation to speed up clean energy adoption could have huge implications for building decarbonization incentives and project deployment as an alternative. Utilities may play a similar indirect role to green banks in terms of driving demand toward clean energy deployment and consumer building energy consumption. For example, in some US jurisdictions, upfront costs of retrofitting homes to be more energy efficient can be partially paid for by ratepayer funds. In particular, public service commission structures and regulatory frameworks determine regulated utility interventions to move the energy transition.

The public service commission is often a powerful actor that influences decision making at the electrical grid level. The public service commission sets rate increases on utilities to build infrastructure projects. In New York, the state could indirectly incentivize utility companies as well as directly influence quasi-public green banks such as NYGB. NYSERDA, the public utilities, and NY Green Bank all report to the public service

commission. This public mandate and regulation means that funds like these ratepayer dollars and bill surcharges need to result in green bank actions that make sure they impact the most people possible. Public utilities commissions can also set standards to require money for building energy efficiency and low income programs. Unfortunately, these programs tend to be often under-enrolled and often do not spend the full amount available.

Finally, utility regulatory frameworks could prove a huge driver of both positive and negative change in terms of energy sourcing directly to consumers. As related to buildings, how the utilities handle gas-to-electric conversion business models going forward will have a huge effect on the building decarbonization retrofit market. In New York, Con Edison and PG+E have electric and gas combined business models and can therefore theoretically pivot to an all-electric business model, but in other states natural gas companies simply must leave the business. In addition, utility structures vary greatly state by state, and this structure has vast impacts on how utilities play a role as an actor in driving the clean energy transition. For example, electrification project deployment could lead to hidden costs through utility demand charges or variable utility costs, leading to uncertainty of energy savings after a deep energy retrofit is completed. These considerations have vast impacts on green bank deployment capability, and there are also key climate justice and energy burden questions raised at the state level.

5.1.4 State and Local Government

Other alternatives to approach the equitable building decarbonization challenge involve regulatory approaches at different scales of state and local government. For example, building codes and energy benchmarking are important tools that could do some of the job of green banks. Building codes set performance standards for new buildings and major renovations. The IRA further encourages updated building energy standards, including $1 billion in grants to help states adopt new residential and commercial building energy codes. However, careful consideration should be placed on the relationships between building regulation and housing affordability. Manipulation of building codes

could negatively impact housing production and push costs of energy efficient homes onto consumers instead of housing developers. It is essential to ensure that residential building decarbonization happens in ways that support LMI communities who face pressing issues of housing instability and housing cost burdens.

Government intervention through building standards and labeling could also help create building decarbonization markets. Carbon penalties like Local Law 97 could work in conjunction with financing tools to induce demand for building decarbonization projects. At present, these regulations have not resulted in direct pipeline projects with buildings-focused green banks like NYCEEC, potentially due to the special exceptions for affordable and rent-regulated buildings for earlier penalty caps. Building labeling such as the energy benchmarking of Local Law 84 requires building owners to disclose information about the building's energy use through a scorecard and bring transparency to the real estate market. Governments can also require phase-out of fossil fuel-based energy use in buildings. For example, New York City banned the installation of natural gas infrastructure in new buildings in 2021. However, these emission reductions may pass along negative consequences to DACs.

5.2 **Organizational Structure** and Value Alignment

Organizational design at the time of the green bank's formulation defines the culture, scale, and capabilities of each green bank. These initial organizational choices offer lessons in unintended consequences. As discussed in the chapter four case study comparison, even green banks within the same state tend to have vastly different approaches, structures, and mandates. Across the country, green banks have organized programmatic strategy differently, from creating state revolving loan funds to focusing on consumer-directed big pools of financing. These differences in structure directly impact the type of work and social equity outcomes for green bank projects. Green bank organizational design declares value alignment regarding the fundamental tensions between prioritizing financial self sufficiency and climate justice projects.

Green banks are completely unregulated in any uniform way. Depending on how organizers set up the green bank, either as a nonprofit entity or as a quasi-governmental organization through legislation, various limits and regulations apply to the green bank's investing priorities. Other options might involve state legislators taking an existing governmental body and expanding its capacity, similar to what happened with NYSERDA and NYGB. They could also house the entity in the governor's or treasurer's office.[76] All of these creation strategies lead to vastly different regulatory oversight over the green bank's mandate and impact.

The initial funding sources of a green bank each come with conditions, from policymaking mandates to philanthropic limitations. The market creation approach adopted by older and more mature green banks such as NYGB have produced an organization culture where leadership attempts to emulate commercial lending.[77] Because NYGB was set up structurally like an investment firm, this organizational design makes it far more difficult to honor their commitment to carve out 35% capital for disadvantaged communities without outsourcing to partners such as NYCEEC and the CDFI industry. NYGB doesn't have 35% of staff dedicated to disadvantaged communities, and indeed even 35% would likely be insufficient given the difficulty of those types of transactions. Although NYGB is in a good financial operating standpoint, the organization has lost sight of how they should act to fulfill their public policy mission as a quasi-governmental entity. While without ill intent, there is a gap in accountability and expertise amongst senior management to maintain equity at the forefront of business operations.

Other green banks have chosen to prioritize social equity as part of operations, although this choice comes with strengths and weaknesses. For green banks with structures similar to NYCEEC, the question is instead how to build capacity while also filling financial obligations. These organizations must consider whether they can act as a solution to address green gentrification by building contractor capacity in communities and building the wealth of individuals now. While these organizations have more social

[76] "Green Banks Issue Brief."
[77] National Resource Defense Council, "Green & Resilience Banks."

equity built-in, there are important foundational questions of who bears the risk and who benefits from returns of building decarbonization green bank projects. As mentioned before, choosing to primarily operate in LMI communities also accompanies a smaller capital pool and therefore limits the organization's breadth of potential impact.

Only in the last five years have lawmakers and organizations prioritized the convergence of environmental and social goals. This mission may change over time, and the measurements of equity may change as well. Green banks are tasked with seeking the optimal leverage to induce private capital and create markets for clean energy technologies. Equity measurements at present normally look like deploying projects in DAC geographies or economic development through job creation. For established green banks, social equity approaches primarily rely on evaluating projects based on location. 55% of the green bank capital pipeline expects to deploy within the EPA's environmental justice communities with expectations that this will rise in the future, but beyond this metric there is not much to speak of in terms of climate justice commitment.[78] Other co-benefits of building decarbonization projects have not yet been codified, such as potential public health benefits and community wealth empowerment. These measurements tend to vary based on tech maturity, community needs, and availability of complementary grant based programs.

5.3 Problems of **Scale** for Impact

Another consideration for green bank development is scale of impact, namely the tension between local impact and breadth. Green banks have the opportunity to play a gap-filling role connecting policy and localized investment decision making across a variety of financial sector actors. Building decarbonization economics works on a project by project basis, so green banks must strategize how to best use public dollars to make the broadest impact. The definition of impact at local and regional levels as well as the ability to work with different pools of capital will define a green bank's success. Although each

[78] Coalition for Green Capital, "Green Banks in the United States Annual Report 2022."

topic varies in scope, all address the scale obstacles to effective project deployment for green banks as a relatively new financial tool.

First is the impact of the size of the capital pool on a green bank's scale of impact. For example, NYGB operates a $1 billion capital pool while NYCEEC operates less than 5% of the amount of capital at $44 million. From a high level financial landscape perspective, local lenders create financing roadmaps that are necessarily more localized while commercial banks tend to operate at the national scale. Each green bank's scale of deployment depends on where the organization operates and local conditions. For example, some cities may have a lot of support for climate projects but no buy-in at the state level. In the end, even GGRF money is merely a drop in the bucket of climate investment needed, and green banks will need to figure out how to get additional dollars and set up a recycling mechanism to achieve long lasting local impact.

Second, in this next stage of project deployment, green banks and other finance organizations will need to make decisions about greenhouse gas reduction goals. Some believe requirements should be to have goals of net zero or goals of net zero over time. These considerations affect decisions at the project level, such as whether to invest in a geothermal project for a small campus of public housing, or more heat pumps for space conditioning in a larger but more diffuse array of residences. The most appropriate technological strategy depends on the highly local climatic conditions, building purpose, and existing infrastructure, so building decarbonization requires tailor-made solutions for local circumstances. These thorny decision making processes on the ground must inform how green banks operate and strategize to achieve maximum market impact and provide socially equitable outcomes.

5.4 **Inducing Demand** for Project Deployment

Now that Congress passed the IRA and a windfall of federal investment is set to pour into clean energy projects, the focus shifts to project deployment. When considering implementation in the building decarbonization space, one needs to consider project readiness needs. "Shovel ready" organizations need access to knowledge and technical

advice from trusted sources and a modest amount of cash equity to put into projects. However, a huge part of the current problem is lack of awareness and therefore demand, paired with the urgent need to build a pipeline of projects. The related and difficult supply and demand problems of unaffordability of certain projects, lack of workforce to deploy, and unawareness/lack of demand all contribute to the difficulties green lenders face.

Current building project pipelines lack a natural customer base or community trust. Other than lowering prices for building decarbonization interventions, green banks rely on outside factors to induce demand such as high energy prices or regulatory interventions like LL97. As mentioned above, CDFIs, energy companies, commercial lending institutions, and credit unions tend to have high engagement with potential building projects that need decarbonization and distributed energy projects, and critically all have natural banking customers. In addition, given federal prevailing wage requirements for construction loans, even money like GGRF may not be enough to induce demand for market rate developers to take up building decarbonization projects. Finally, service delivery will be a severe problem for implementation, given the current lack of contractors with technical skills for the specific tools needed for deep energy retrofits, coupled with homeowner's confidence in these methods.[79]

These supply and demand challenges bisect further when considering market rate vs. affordable housing. Building typologies and building ownership structures make a big difference in terms of efficient project deployment. For example, multifamily affordable housing with one owner and 100 units will require a very different set of interventions than an affordable home with a single low-income homeowner. Outreach and customer acquisition must be top of mind for aspiring green banks in addition to the unique challenges of the affordable housing sector.

[79] Steven Winters Associates, "City Playbooks for the Equitable Electrification for Multifamily Buildings."

6: Recommendations

Keeping in mind the nuances of additionality, structure, scale, and demand, the following recommendations provide an array of potential leverage points for states and cities to consider using the green bank model to approach equitable building decarbonization. Instead of the traditional financial proposals of predevelopment and equipment loans, these recommendations instead focus on partnership and strategy interventions using the niche technical assistance and unique position green banks enjoy as quasi-governmental and nonprofit actors within a larger green lending landscape. Some of the core tensions of GGRF's program design from chapter three surface, such as equity and access vs. leverage for market creation and priority of "shovel-ready" projects vs. community capacity building.

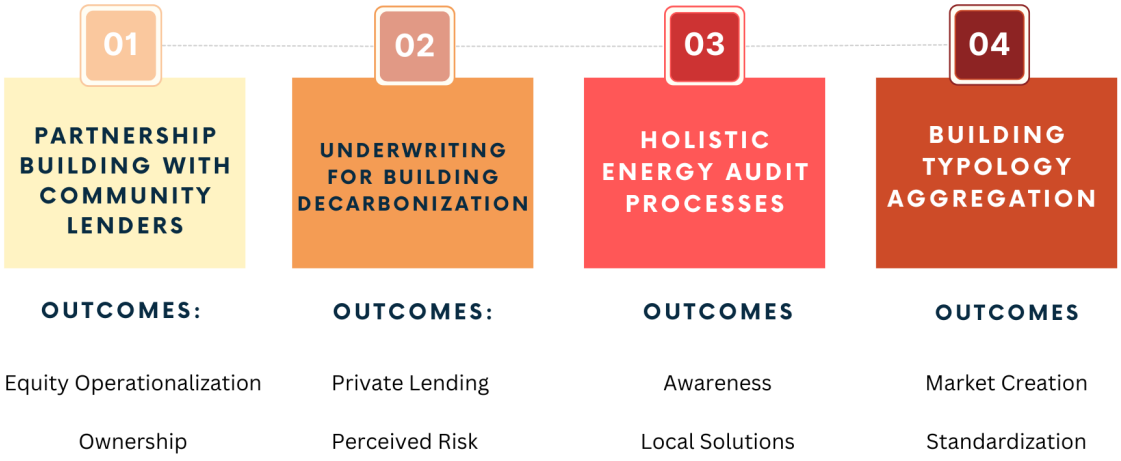


Figure 8: Summary of Green Bank Recommendations and Outcomes

6.1 Partnership Building with Community Lenders

For green banks to be effective, they must persuade the wider landscape of community lenders to align on strategy and outputs. In this context, community lending spans a wide variety of financiers and housing developers including community development corporations, affordable housing developers, and community lenders. Green

banks have strong private capital induction but without a strong record on environmental justice issues, and community development actors have longer history and community ties. As discussed above, the community development industry largely does not participate in green finance. This gap potentially provides an excellent opportunity in equity-focused building decarbonization deployment, as affordable housing plays a huge role in developing equity-focused climate solutions.

Operationalizing equity principles in this partnership building work will provide opportunities to center and empower LMI communities in residential building decarbonization uptake. Residential buildings are not just assets to be capitalized. Missing from many green finance conversations is the human element of decarbonizing people's homes and the potential benefits such as indoor air quality and improved occupant comfort that accompany these projects. By creating an understanding of how communities interact with the built environment, green banks and community lenders can jointly solve for inducing demand and customer acquisition. Direct investments in disenfranchised communities allow for deeper collaboration in the design of bold climate and building policies, and sustained investments will build relationships and prioritize equitable projects.

Thinking about the existing ecosystem providing financing to the affordable housing sphere and specific considerations for affordable housing projects will be critical to producing equitable outcomes. First, affordable housing financiers and developers need longer term money to get involved. Affordable housing developers normally work with housing agencies that provide 1% interest rates for 30-40 years. NYCEEC has had success with retail equipment lending, except that terms are market rate terms at 7%, while affordable housing developers require much longer term sheets to participate. Another challenge specific to affordable housing is the operational challenges. Equipment loans tend to introduce difficulty for affordable housing because income is always restricted, so while operating costs keep going up, these entities tend to lack cash flow to take on more debt. Normally, these organizations first dip into reserves before needing incentives or

grants from organizations like NYSERDA and ConEd. Finally, they need a large loan per unit to make the retrofit worthwhile, typically much larger than the standard $50,000 loan.

The most successful green bank and community lending financing projects in New York thus far have been the most flexible. These flexible green bank projects participate with CDFIs alongside existing loans with same terms and rates on the back end. The Green Housing Preservation Program involves NYCEEC partnering with affordable housing developers and New York Housing Preservation & Development department to co-finance energy efficiency and water conservation for small- and mid- size affordable housing. This co-creation approach brings together disparate actors across the housing and green finance landscape to provide low and no cost loans to decarbonize affordable housing. Green banks need to have a collaborative mindset and not a competitive one to focus on parts of the building decarbonization market where the most issues lie. This kind of partnership building work instead of focusing on finance as a means to an end would be a more effective tool to achieve efficient and equitable outcomes.

Opportunities: As green banks try to enter existing residential finance markets, they must create tools with relevance to that market with a team that understands the relevant considerations. With the passage and development of GGRF, the community lending industry is much more likely to partake in funds available. The most successful partnerships involve participating coterminous with low interest long term CDFI money. Drawing on these successful examples in the New York affordable housing market provide direction and evidence for the potential of green bank and community lending partnership building.

Challenges: This approach comes along with its own set of challenges, as green banks moving into the community lending industry ask lenders to add new goals to organizations already spread thin. Depending on how sophisticated the community lender operates, they have access to certain types of federal and state funds. This approach could be a good model for large CDFIs such as LISC and Enterprise, but it might be difficult to bring smaller

CDFIs or affordable housing developers to the table. Robust education and professional training will be required, with a lack of obvious actors to provide such training. In addition, many of the upgrades need to be additionally grant funded because these mission driven organizations are unwilling to pass off energy burdens onto tenants in order to get projects done.

6.2 Underwriting for Building Decarbonization

The first mortgage lender market provides another potentially highly impactful leverage point to bring private lenders into the conversation around building decarbonization. A first mortgage is the primary or initial loan obtained for a residence. When someone obtains the first mortgage loan to buy a home, the mortgage lender places a primary lien on the property, which gives the lender the first claim to the home if the homeowner defaults on the loan. Focusing on providing low interest first loans linked to sustainability leverages the tools of the mature housing and finance market and uses the influx of federal grant money to offer what works in housing to finance climate goals. Without adjustments to underwriting standards, many residential buildings are fully leveraged based on their existing cash flow and are therefore unable to supplement an existing loan, even if the decarbonization economics function correctly. Green banks would need to reorient and better understand the first mortgage lending market in order to partner and provide appropriate financing resources for building decarbonization projects.

One solution could be for green banks to develop direct-to-consumer financing options, including mortgage-like products to assist building- and homeowners with financing up-front costs of retrofits. Underwriting efficiency is a process of including the projected savings from energy efficiency in computing net operating income that can be used to cover debt service. Since improved building performance can stabilize tenancy as well as reduce a property's exposure to utility rate increases and volatility, more efficient properties may be associated with lower risk of loan delinquency. "Sustainability-linked pricing" for projects meeting minimum energy performance standards could provide

financial incentive for first mortgage lenders to promote these interventions. If paired with longer amortization for loans used in decarbonization, projects could lower debt service and improve their coverage ratio. A recent paper found evidence that more energy efficient properties were correlated with lower loan delinquencies in the commercial mortgage-backed securities market.[80] This method would be replicable across cities with accompanying efficiencies of scale or one off investments. While not a common practice currently, underwriting for decarbonization allows projects to move forward in cases that would otherwise fail using traditional underwriting that does not account for future savings.

Specific to the affordable housing sector, experts have recommended that the mortgage market will play an important role for point of sale interventions. Given that the economics of building decarbonization have not caught up, green banks need to provide a pathway and incentive to motivate a first mortgage lender to respond to third party reports such as appraisers and engineers. Flexible, long-term, unsecured loan products aid in overcoming the barriers to projects in the affordable housing market segment. These loans do not have the right to foreclose on any of the borrower's property in the case of a loan default. By contrast, secured equipment loans require the borrower to provide some collateral for the loan. If the borrower defaults on the loan, the creditor can foreclose on the collateral. Private capital providers may not be able or willing to provide financing with long enough tenures to bring debt service down to less than realized energy savings, especially for small to midsize projects. This gap is where green banks could provide interim capital for these equity driven affordable housing projects.

Green banks leveraging their ability to provide more flexible capital to entice direct-to-consumer financial products would be an effective way to prove to first mortgage lenders the benefits of financing building decarbonization projects. Introducing private capital to what it takes to meaningfully address GHGR will become more important as the perceived risk of not doing so is exposed in their portfolios. It can also be used with the

[80] Bergöö and Sims, "How Green Banks Are Driving Energy Efficiency Improvements in Affordable Housing."

mortgage banking industry through Freddie Mac and Fannie Mae, who often set industry standards for how housing gets financed and can therefore capture hundreds of thousands of housing units as the transition drives decarbonization and building codes and government regulations catch up. In this way, green banks can leverage private capital in an impactful way to create decarbonization markets and shift perceived risk.

Opportunities: Property owners financing properties, whether newly constructed, retrofitted, refinanced or acquired, are motivated first and foremost by interest rate. Rationally, they will want a low rate and high leverage. This approach offers great flexibility and introduces owners who would not otherwise be thinking about GHG reductions to the process by enticing them with a lower interest rate. Green banks could use their position to target the first mortgage lending market as an impactful market creation technique.

Challenges: Because of the solution's newness and untested nature, there may be slow uptake from risk-averse mortgage lenders. Convincing early adoption for property owners of the benefits will also be a major challenge for this approach. In particular, distrust of energy companies and discomfort in a somewhat invasive process such as an energy audit may mean lack of uptake in LMI communities. From the lender perspective, similar lien-based programs such as the residential PACE financial program have received pushback from senior lenders due to discomfort with its priority for payback periods in the capital stack (see Appendix D).[81] In addition, this approach is far from comprehensive, as certain ownership models cannot take on more debt such as public housing. Financing techniques alone through the green bank model will be insufficient to tackle all building typologies and ownership models.

[81] Mills and Scott, "Strategies for Financing an Inclusive Energy Transition."

6.3 Holistic Energy Audit Processes

Another high leverage intervention point involves green banks taking advantage of energy audit processes to incorporate building decarbonization strategies into day to day operations for building managers, property developers, and private lenders. A home energy audit is an inspection and written report that identifies the most significant and cost-effective energy efficiency improvements, including an estimate of the energy and cost savings calculations. Energy audits as an intervention point provide an appropriate opportunity to introduce community-supported program design and focus on local issues to address challenges as they arise. Many stakeholders have confusion over how to assemble financing from different sources in the marketplace including utility incentives, tax credits, and community funds.[82] Energy audits allow a specialized entity like a green bank to provide advice while not necessitating the property owner to learn all of the "behind the curtain" complicated considerations required to execute the retrofit. If assessing the property's energy and efficiency intervention points became a requirement as part of the energy audit process, green banks would have an opportunity to promote awareness and provide technical assistance with a better strategic plan for the property. Being able to look at the entire property life cycle would allow both the green bank and the building owner to identify opportunities in reducing energy consumption across portfolios as well as appropriate time frames and cost comparisons for technologies.

Focusing on energy audits may be particularly useful for building owners with large portfolios, such as affordable housing developers that own multiple buildings or a university campus. By introducing this process, an organization could align building-level decisions with portfolio-level emissions reduction targets. DOE Better Buildings suggests a more comprehensive energy audit that not only assesses energy efficiency but also GHG emissions to address operational emissions and potential for additional solutions like on-site renewables and EV charging. Operationalizing this process could provide clear

[82] Steven Winters Associates.

guidance and pathways for building owners to prioritize deep energy retrofits as part of the building life cycle.

Opportunities: Approaching building owners using energy audits as an intervention point would also work towards the green bank goals of community outreach and customer acquisition. Green banks could use the energy audits as an opportunity to provide financial assistance to achieve "pre-requisites" to building retrofits, as well as analysis, planning, contracting assistance for building owners, thereby creating a reliable project pipeline. Currently, green banks such as NYGB and NYCEEC tend to focus on financing through a project by project basis and therefore do not provide holistic support. Holistic energy audits provide an untapped opportunity to intervene and build project pipelines as well as achieve greater impact.

Challenges: While energy audits are widely available to property owners, few choose to undergo the process often due to lack of awareness. In addition, some of the downsides include the complexity and expense of the work of energy audits, as no one contractor would execute the project. Highly efficient properties are often not properly credited for that efficiency, and assessments lack proper risk analysis for inefficient properties. In addition, on the ground situations are quite different than the ideal standardized loan product. The conditions of housing stock and historic disinvestment in DACs in many cities due to systemic racism, lack of investment, and high rates of poverty within the city lead to a whole array of challenges to audit implementation.

6.4 Building Typology Aggregation for Market Creation

Green banks guided by a national climate bank could play a role in the aggregation of local portfolios of buildings to diversify risks. Thus far, there has been an ad-hoc approach to understanding building types and interventions required with their diverse levels of risks. Traditionally, owners have taken a project-by-project approach across their portfolios, focusing on discrete actions with clear stand-alone project finance principles.

On the demand side, a standardization of building typology approach would help address project size barriers, high upfront costs, interest rate risks from a highly heterogeneous potential project pool. These solutions would help fund climate infrastructure projects with more predictable returns to private investors. On the supply side, structured finance with investment tranches would help create legibility for private investors to enter the building decarbonization emerging market.

Developing best practices and mobilization by residential building type would go far if green banks leverage these practices to then securitize decarbonization projects for a secondary capital market. Recent studies have shown that packages developed for a single building typology will likely be applicable to other segments across the country.[83] Then the green bank could offer incentives/concessionary finance and innovative financing mechanisms like on-bill financing or PACE loans to then implement projects. Fannie Mae Green Mortgage-backed securities are an example of tranching in green investments. Their Green Bond Business supports the single-family and multifamily housing markets by purchasing mortgages backed by properties that meet Fannie Mae criteria for energy and water efficiency and/or renewable energy generation. In 2017, Fannie Mae had a green lending portfolio of 1,100 loans worth US$31 billion to reduce borrowers' utility bills by US $53 million and has issued US $27.6 billion in green mortgage-backed securities. These examples of aggregation techniques provide models for similar approaches to distributing benefits of building decarbonization while creating market conditions.

One key consideration when implementing building typology aggregation will be to ensure LMI communities are prioritized and modeled. For example, buildings in LMI communities have high rooftop solar technical potential and could play a role in achieving parity in solar access across income groups.[84] NYSERDA also completed an LMI market characterization study by occupant and building type to understand better market dynamics and promote energy affordability. This approach requires analysis considering

[83] Reyna et al., "U.S. Building Stock Characterization Study: A National Typology for Decarbonizing U.S. Buildings."
[84] Flanegin, "Can Low-and-Moderate Income Households Play a Role in Realizing U.S. Rooftop Solar Technical Potential?"

the human scale of residential buildings instead of just the dollar potential of market aggregation.

Opportunities: To move quickly and build residential building decarbonization markets, the United States cannot afford to solely take a project-by-project basis. Standardization and scaling of solutions will be necessary to achieve the finance and project completion needed to meet net zero buildings goals. As the building decarbonization market goes from early adoption to standardization, this step will be a key way green banks could prioritize ensuring LMI communities are legible to private lenders and increase probability that building decarbonization projects in DACs are not left behind.

Challenges: Green banks must operationalize considerations for LMI communities to ensure climate justice is prioritized with this approach. By standardizing certain building typologies for residential building decarbonization projects, financial actors risk losing flexibility to deal with the local conditions of financing project-by-project bases. More proof of concept and pilot projects as well as research are needed to effectively implement this market creation strategy. In addition, simply aggregating different building typologies does not address the granular challenges by building type. For example, addressing the split incentive problem of rental housing or cooperative housing remains to be solved. More understanding of ownership models must be understood to address the unique challenges of different types of residential building decarbonization projects.

7: Conclusion

The next few years will determine the shape and scope of how green banks may become players in the green finance building decarbonization landscape. At the national level, although the Inflation Reduction Act represents the first major commitment of federal money towards climate solutions, the US needs astronomically higher investment in the coming years to meet GHGR targets and the target of Net Zero by 2050. This federal investment represents the first step of a wider wave of green finance and residential

building decarbonization market building, one that green banks are well poised to take advantage of. Local conditions play a huge role in terms of addressing whether a green bank would be appropriate to address decarbonization challenges. Well-organized green banks have an opportunity to play a role filling gaps between higher level policymaking and localized investment decisions and projects. But green banks alone can't solve the problem of complete unaffordability of certain projects, they can't create a workforce, and they can't manufacture demand.

Governance over the clean energy transition remains a big question. As outlined in the literature review, some believe in market based solutions under the direction of green capitalism, with diffuse responsibility and hypothetically efficient outcomes. Others maintain that the government should play the main role in creating markets and prompting climate innovation, in line with industrial policy. As a relatively new concept and solution, green banks have much flexibility in how they might interact with these governance systems and distribute benefits and costs of completing building decarbonization projects. As seen by the large differences in outcomes between NYGB and NYCEEC, a carefully set up and well managed green bank has much broader implications for creating markets and ensuring that both greenhouse gas emissions reductions and community wealth building goals are met. Both public and private actors creating green banks to solve building decarbonization challenges must carefully consider additionality, structure, scale, and demand.

This research represents a first step towards understanding the power and pitfalls presented by the green bank financial model. Much more research and evaluation must be undertaken as the GGRF money rolls out to keep green banks accountable as they seek to leverage huge amounts of capital into clean energy projects. Opportunities for further research include: analysis of the role of green workforce development on green banks, the role of tenant organizing in residential decarbonization, and unique challenges of different building ownership models for project pipeline creation.

While creating a legible residential building decarbonization market is a main goal for green banks to take on, the real challenges coming out of the IRA are the planning

problems: project development, workforce development, and community engagement at the local level. The recommendations provide a variety of program and strategy options for a nascent green bank to consider approaching strategy and programs in localizing building decarbonization efforts. Climate change presents a huge opportunity and challenge of addressing racist systems and building community wealth through the clean energy transition. The complex work of decarbonization must be considered carefully. Green banks are insufficient to solve these changes on their own, but they may play a role in a larger landscape of people and organizations collectively solving these complex implementation problems.

Glossary

CBO - Community Based Organization

CDFI - Community Development Financial Institution

DAC - Disadvantaged Community

DOE - Department of Energy

EE - Energy Efficiency

EPA - Environmental Protection Agency

ESA - Energy Service Agreement

GGRF - Greenhouse Gas Reduction Fund

GHGR - Greenhouse Gas Reductions

IRA - Inflation Reduction Act

PPP - Public Private Partnership

PPA - Power Purchase Agreement

Solar PV - Rooftop Solar Photovoltaic

Appendix

Appendix A: Interview Consultations

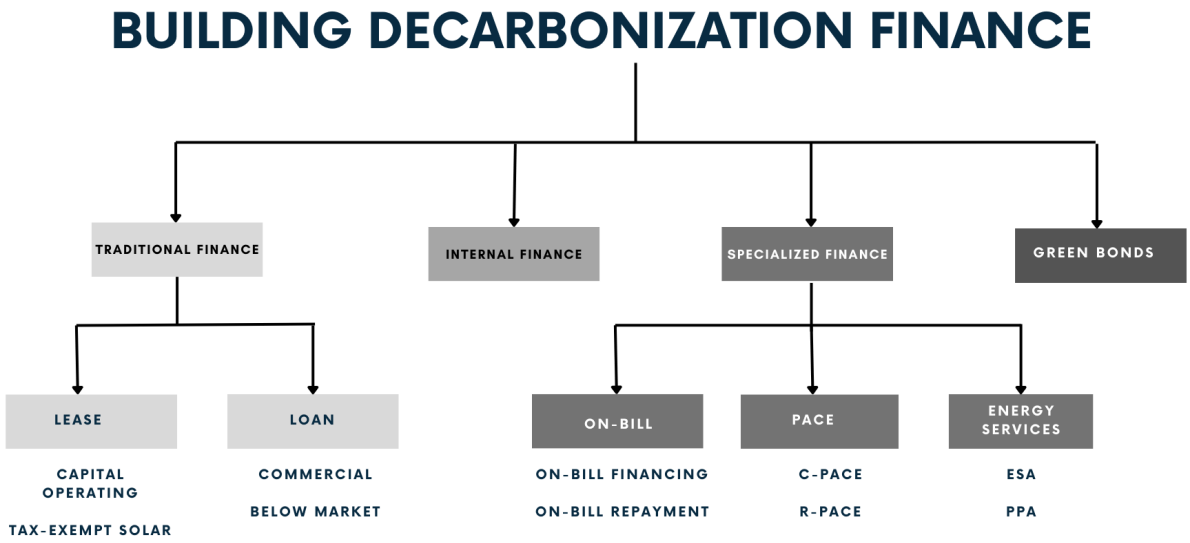
Research Phase	Key Stakeholder Types	Stakeholder #
Informational Interviews	Municipal Sustainability Manager State Renewable Energy Business Development Staff Affordable Housing Developer Climate Finance Nonprofit Manager	5
Targeted Interviews	Green Bank Executive Director Green Bank Founder Green Bank Consultant Green Finance Policymaker	11

Appendix B: Interview Questions

1. What is your role at [Organization], and how long have you been in that role?
2. Which programs of the Inflation Reduction Act has [Organization] applied for?
3. How does your organization define green banks? What are the main green bank programs?
4. What types of green bank projects exist or are being planned?
5. What were the primary reasons for [X] to start a green bank?
6. How do green banks include equity prioritization in projects?
7. What are the biggest obstacles to inducing private investment in these types of energy projects?
8. What are the weaknesses of green banks as a financial mechanism? What are competitors/alternatives? What are other financial models that compete or collaborate with green banks?
9. How does your organization interact with those planning for climate change in different sectors?

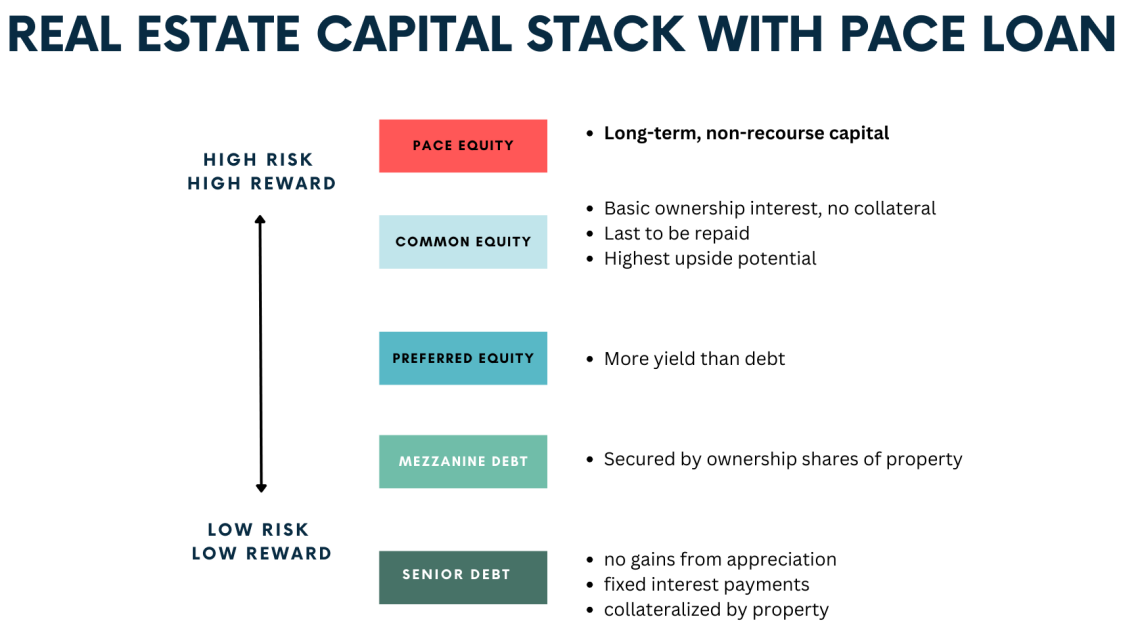
10. How is your organization thinking beyond the IRA? How can cities secure the elusive long term funding needed for energy projects?
11. Is there anything else important that we have not covered?
12. Who else should I speak with?

Appendix C: Overview of Building Decarbonization Finance Tools



Source: Department of Energy Better Buildings

Appendix D: PACE Loan Real Estate Capital Stack



Source: PACE Loan Group

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