HOW DO ENERGY EFFICIENCY MEASURES IN RESIDENTIAL HOUSING INTERSECT WITH HOUSING AFFORDABILITY FOR LOW-INCOME FAMILIES? A CASE OF A PRIVATE, PURPOSE-DRIVEN HOUSING DEVELOPER.

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By

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ABSTRACT

A sustainable approach to housing development enables integrating energy efficiency into low-income housing to improve affordability while simultaneously helping to reduce greenhouse gas (GHG) emissions. Public policy makers, urban planners, and private and not-for-profit housing developers are pursuing several approaches to expand the supply of energy efficient affordable housing for low-income communities and households. However, households and businesses invest less in energy efficiency than what may appear economically rational, and some other energy efficiency investments do not seem economically worthwhile despite evidence suggesting it makes economic, environmental, and social sense to do so. The research attempted to understand the factors that prevent investment in energy efficiency technologies and practices in residential housing by analyzing a private housing developer's strategy implemented to maintain a balance between energy efficiency and housing affordability for low-income families. The finding indicates that integrating energy and water efficiency technologies and practices can be an opportunity and a responsibility for private housing developers. Sustainability can be a viable economic model to develop affordable energy efficient housing provided that some of the underlying hurdles associated with the housing business model are adequately considered. The inherent limitations in pricing and profitability within affordable housing, unlike a high-end market, substantially determine subsequent decisions, requirements, and resources for investment and financing. Public policy and financial incentives that help to reduce uncertainties in cost-benefit of investment in energy efficiency; provide low-income housing friendly solutions; and accommodate emerging needs, complications, opportunities, and challenges of the sector are essential to leverage private housing developers' capabilities, networks, and strategic industry-location thereby deliver energy efficient affordable housing for low-income households.

BIOGRAPHICAL SKETCH

Tewodros Abera holds master's degree in Development Studies with a specialization in Rural Livelihood and Development from Addis Ababa University, Ethiopia, in 2011. Tewodros also did his bachelor's degree in Agricultural Extension at Alemaya University in 2005. For over 12 years, Tewodros has a research and development program management experience in agriculture, food systems and food security, livestock and dairy focused value chain, enterprise development, gender mainstreaming, and cross sector partnerships building.

Before joining Cornell to pursue his Master of Professional Studies (MPS) in Global Development, Tewodros worked with Land O'Lakes Venture 37, as Associate Program Manager and Gender and Training Coordinator for a Public Private Partnership for Artificial Insemination Delivery (PAID) program in Ethiopia. Prior to that he also worked as a Regional Project Manager for USAID funded Livestock Market Development Project, where he supported dairy and meat value chain development to improve smallholder farmers' income and nutrition. Tewodros started his career as a Researcher and Coordinator of Socioeconomic and Extension Department at the Ethiopian Institute of Agricultural Research focusing on pastoral and lowland area development.

Tewodros was a Fulbright Humphrey fellow at Cornell University in 2021 and his studies focused on private sector engagement and public private partnership in the design and coordination of rural extension and advisory services and gender and social inclusive livestock development programs. He was awarded the prestigious Joint Japan World Bank Graduate Scholarship in June 2021 to pursue MPS in Global Development at Cornell where he got the opportunity to extend and develop his passion for sustainability and social enterprise.

DEDICATION

In loving memory of my late sister, Fasika Hailemariam Abera

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
AMI	Area Median Income
CHP	Combined Heating and Power
DOE	Department of Energy
DOT	Department of Transportation
EGC	Enterprise Green Communities
EIA	Energy Information Administration
EPA	Environmental Protection Authority
ESG	Environmental, Social, Governance
FSC	Forest Stewardship Council
GHG	Greenhouse Gas
HUD	Housing and Urban Development
HVAC	Heating, Ventilation, and Air Conditioning
IRC	International Residential Code
KWH	Kilowatt Hours
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
LIHTC	Low-Income Housing Tax Credit
NYSERDA	New York State Energy Research and Development Authority
PACE	Property Assessed Clean Energy
PHEE	Partnership for Home Energy Efficiency
UN	United Nations
U.S.	United States
USGBC	United States Green Building Council
VOC	Volatile Organic Compounds
WSP	Weatherization Assistance Program

CHAPTER 1

INTRODUCTION

1.1 Background

Globally, commercial and residential buildings account for a significant share of energy consumption. In the United States (U.S.), while the building sector consumes 40% of the domestic energy (Hernandez, et al. 2011), residential housing accounts for over 22% of the total national energy consumption (EPA, 2021). Significant proportions of the energy in residential facilities are utilized for space heating and cooling, lighting systems, and operating various home appliances.

Energy consumption in residential housing is estimated to grow at a rate of 1.1% per year until 2035 (EPA, 2021). This forecasted energy growth has become a policy concern in three important ways. First, the growth is expected to be a huge burden on the infrastructure meant to generate, distribute, and manage energy in the country. Second, given residential housing's 21% contribution to total annual greenhouse gas emissions, direct energy consumption amplifies the sectors' climate and environmental footprint. Third, the increased energy consumption translates to high utility costs, making housing less affordable for many households (Ibid). Achieving efficient energy allocation and consumption in residential housing is, therefore, critical to promote sustainable development outcomes by lessening barriers to homeownership to families because of a direct implication of energy consumption on the maintenance cost of a house (Knowles, 2008).

Energy consumption has a significant impact on housing affordability. The U.S. Department Housing and Urban Development (HUD) defines housing affordability as when a family spend no more than 30% of the household's income on housing (EPA, 2021). Conventional houses with no energy and water efficiency and/or waste management design and structures translate into a high energy cost. Overall, families in the U.S. spend over $160 billion on energy each year (Ibid). According to a 2019 report by the Harvard's Joint Center for Housing Studies, approximately32% of households are spending over 30% of their income on housing, and more than 18 million households spend half of their income on housing, making them severely cost burdened (Fernald, 2021). In New York City, those metrics are even worse: 44% of all renters pay at least 30% of their income in rent, and more than half of those households are considered severely rent burdened, because they pay at least half of their income in rent (Ibid).

The concept of affordability based on the proportion of household income spent on housing seems complex, but it is highly relevant for low-income families. For those families, energy cost alone accounts for about 12% of their total income (Fernald, 2020). In recent years, the high cost of energy due to inflation and a persistent shortage of low-income housing supply have made housing even less affordable to many low-income families. A report by the National Low Income Housing Coalition (NLIHC) found that 85% of extremely low-income renters could not afford their rent and 70% of them were spending more than half of their incomes on housing (NLIHC, 2021). According to HUD, low-income and extremely low-income families are households whose income do not exceed 80% and 30%, respectively, of the median family income for the area.[1]

Considering residential housing sector's tremendous potential, improving energy consumption pattern has now become a public policy priority. In this regard, energy efficiency is considered as "the single most attractive and affordable component of the necessary shift in energy consumption" (Krosinsky & Warshauer, 2021). The U.S. Department of Energy (DOE) Building America program, for instance, aims to reduce the energy use of new residential houses by 70% (Knowles,

[1] See https://www.huduser.gov/portal/datasets/il/il19/IncomeLimitsMethodology-FY19.pdf.

2008). A more sustainable approach would integrate energy efficiency into low-income housing development to improve affordability while simultaneously helping to GHG emissions (Hernandez, et al. 2011). Green building materials, techniques, and appliances have been found to reduce energy consumption by an average of 33% and water use by about 30%.[2] New houses constructed based on Energy Star guidelines for energy efficiency are about 30% more energy efficient compared with standard houses (Ibid). Energy efficiency practices in housing include proper insulation and air-tight sealing, installing energy efficient heating and cooling systems, and promoting use of high-performing appliances and lighting fixtures (Ibid).

Given the implication of energy efficient housing to reduce energy consumption, improve affordability of housing to low-income households and contribute to mitigate climate change, public policy makers, urban planners, and private and not-for-profit housing developers are pursuing several approaches to expand the supply of energy efficient affordable housing for low-income communities in major cities. Private and not-for-profit housing developers employ various approaches and programs to deliver energy efficient affordable housing to low-income families.

1.2 Problem Statement

Sustainable housing implies developing housing facilities with enhanced energy and environmental efficiency. Affordable housing offers a reasonable economic benefit for low-income families by reducing the financial burden associated with increased rent, purchase price, and cost-of-living, including energy. Integrating energy efficiency in housing is generally believed to improve housing affordability to low-income families by lowering the overall cost of homeownership. Conversely, conventional, less energy efficient houses tend to employ

[2] See https://www.epa.gov/smartgrowth/smart-growth-and-affordable-housing.

technologies that are cheaper to install (or at least not replace), but are not as economically affordable over time even though energy efficiency improvements can cost less than centralized energy generation, transmission, and distribution (EPA, 2021). In other words, cost savings from energy efficiency can be passed on to end-user households through utility bills.[3]

However, energy efficiency technologies and measures still are not widely adopted. Several studies have documented barriers impeding the commercialization and deployment process of these technologies in residential housing. The Interlaboratory Working Group has identified misplaced incentives, inconsistent regulations, information and market failures, and financial barriers as major bottlenecks for low uptake of these technologies and practices (Brown, 2015).

Financial barriers, for instance, can prevent the introduction and widespread penetration of energy efficiency technologies. This is mainly because high-efficiency products and systems tend to have higher up-front costs, which can increase the ratio of capital to operating expense. This up-front cost is further exacerbated by the concurrent technical and market risks associated with advanced technologies (Brown, 2015). Hence, an important argument is that the added cost of integrating energy and environmentally-friendly technologies can be expensive for many families and in turn, makes housing initially less affordable for already cost-burdened families. In such circumstances, businesses and consumers tend to prefer a greater-than-average return on investment from efficiency projects because of the perception of greater uncertainty (Ibid).

[3] See https://www.eia.gov/energyexplained/use-of-energy/homes.php.

The connection between sustainability and affordability in the housing sector is often not only complex but also debatable. Given the increased move towards green housing, sustainable cities and resilient communities, conventional housing is no longer preferred because of the outsized impact on carbon emissions and the ongoing impact on climate change. Despite the perceived contradictions, however, promoting energy efficient affordable housing can make strategic sense. Several public policies, such as financing and tax incentives, are provided for real estate companies, housing developers, and their collaborating partners to encourage adoption and integration of energy efficiency technologies and measures in housing development. Yet, it remains common practice to view homes that are energy efficient as contradicting the ability to provide affordability for low-income families.

The purpose of this research was to examine approaches for developing energy efficient affordable housing to low-income families in New York State. To better understand the relationship between energy efficiency and housing affordability, and the implications it could have for policy and practice in the marketplace to address issues related to climate change, affordable housing, and clean technology deployment, the study analyzed the approach of how and why a private, vertically-integrated real estate company located in New York City, Fairstead, has intentionally integrated energy efficiency in the design, construction, and development of its low-income residential housing. The company's strategy to maintain a balance between energy efficiency and housing affordability for low-income families calls into question the conventional thinking and practices observed in the broader housing market in which the clean technologies associated with energy efficiency are seen as detracting from the profitability of building and operating low-income housing. The company's case provides an opportunity to reconsider existing public policy incentives meant to support the private sector's role in sustainable and affordable housing development.

Integrated to the points discussed, this research attempted to answer three independent and highly interrelated questions: (1) what energy efficient housing approaches and practices matter most for private housing developers, and why; (2) how do energy efficient housing strategies contribute to reduce the cost of homeownership for low-income families; and (3) what are the opportunities and challenges for private housing developers to implement energy efficiency measures through constructing and retrofitting of affordable houses for low-income families?

CHAPTER 2

RESEARCH METHODOLOGY

2.1 Research Methods and Design

In this research a qualitative study method, primarily exploratory case study design was employed. Exploratory case study design was selected because the method helps to undertake an in-depth analysis of "what", "how", and "why" questions in a certain business and organizational settings (Pathiranage, et al. 2020). In this research, the case study design was applied to investigate a private housing developer's approach in integrating energy efficient practices in retrofitting affordable houses for low-income families.

2.2 Data Collection and Analysis

A combination of methods was used to collect data pertinent to the research questions. Primarily, the study employed semi-structured interviews with the Director of Energy and Sustainability, the Coordinator of Community Impact and Government Affairs, and the Analyst for Environmental, Social, Governance (ESG) of Fairstead to collect quantitative and qualitative data about the company's sustainable and affordable housing development approaches; energy and environmental sustainability practices, priorities, and drivers; factors determining affordability of energy efficient housing development; the economic and social benefits of energy efficient housing; and the positive and negative elements of relevant public policy and tax incentive schemes in facilitating investment for housing developers to develop affordable energy efficient houses. All the interviews were conducted virtually through Zoom using interview protocols (see

Appendix I). Interviewees also responded to the follow-up questions emailed to them to further clarify conflicting issues and collect additional quantitative data.

In addition to interviews, archival sources were analyzed to gain insight into the intersection between energy efficient housing and its economic affordability for low-income communities. Similarly, company profile and housing development program documents, ESG reports, community impact report, program database, and performance reports were reviewed to generate supplementary information to answer the research objectives. Quantitative data on socio-economic and demographic profiles of housing beneficiaries, energy/electricity consumption and energy costs, cost-benefit analysis of installing energy efficient technologies, and number of energy efficient houses constructed or retrofitted were also collected and analyzed. The quantitative data were gathered from the review of company website, company documents (mainly ESG and community impact reports), as well as secondary sources.

The qualitative data generated through semi-structured interviews and desk reviews were coded, summarized, analyzed, and interpreted by transcribing the recorded interviews into a written text, arranging responses under each question, sorting responses into similar thematic areas, and looking for related information from archival sources to substantiate identified themes. In this research, the major themes identified and interpreted were: residential housing development approaches focusing on retrofitting existing multifamily housings; drivers for integrating energy efficiency measures in retrofitting multifamily housing; assessing whether affordability and energy efficiency are a complementary or competing undertakings; and key barriers for integrating energy efficiency while maintaining housing affordability. The data sorting, analysis, and interpretation were conducted manually due to the small number of interviewees participating in this research.

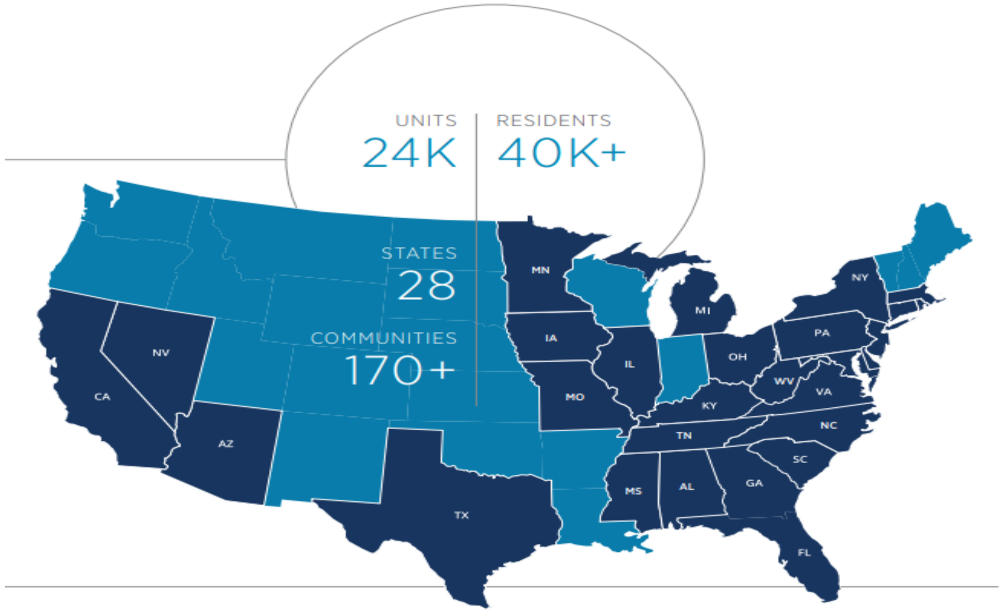
Similarly, the quantitative data indicating total number of housing retrofits conducted by the company, profiles of housing beneficiaries, energy, and cost saving, etc. were analyzed using simple descriptive statistics and are presented below.

2.3 Company Overview and Background

Fairstead is a vertically-integrated, national real estate developer specializing in the creation of sustainable, high-quality housing regardless of income. To achieve this overarching objective, the company has developed core expertise across multiple disciplines including capital markets, finance, acquisitions, development, design, construction, energy, sustainability, property and asset management, communications, leasing, marketing, and community impact. The housing development approach at Fairstead mainly focuses on renovating multifamily residential housing by integrating energy and environmental efficiency measures, technologies, and devices meant for energy and water saving, as well as carbon emission reduction.

The company's sizable project portfolio includes a significant amount of affordable housing. Fairstead's focus on affordable housing development is guided by three foundational principles: (1) quality affordable housing leads to economic stability; (2) quality affordable housing promotes neighborhood stability; and (3) quality affordable housing improves residents' health and quality of life. Thus far, the company has developed over 24,000 housing units that accommodate over 40,000 residents in 28 states (see Figure 1). As a long-term investor, owner, and operator, Fairstead believes it makes strategic business sense to invest millions of dollars in new technologies, participate in pilot programs, and act as an incubator to pilot innovative products and services or scaling new and proven technologies across the company's portfolio.

Figure 1: Operational geographies[4] of Fairstead



Source: 2021 Fairstead ESG Report

[4] Fairstead operates in states colored in dark blue

CHAPTER 3

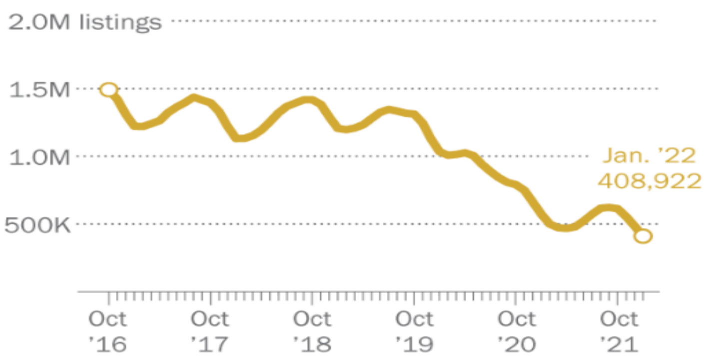
LITERATURE REVIEW

3.1 Smart Growth and Infrastructure

Many communities and households in the U.S. are looking for ways to live in smart and green housing that are energy and water efficient, manage waste effectively, and generate renewable energy (Jonathan Ross Companies, 2009). The underlying motive for creating green and resilient cities is primarily aligned with the goal to mitigate environmental pollution and climate change. Interest in building sustainable cities and infrastructure also stems from the increased awareness and pressure to curb carbon emission-induced climate impacts, improve efficiency in energy generation and consumption, and build social and economic resilient communities.

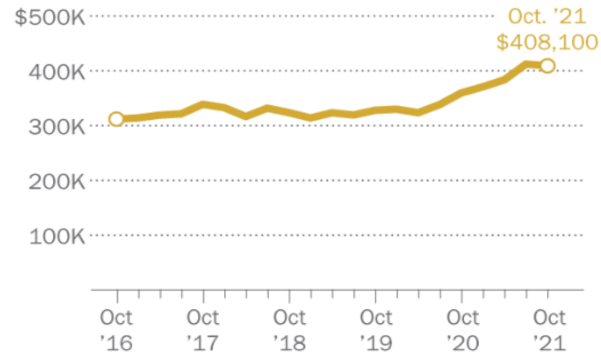
The building sector, especially residential housing, is the principal focus of plans and efforts to advance smart growth and sustainable infrastructure in major cities (EPA, 2021). Concurrently, the U.S. housing market faces a significant supply shortage of homes, pricing out most low- and middle-income households (Kaul, et al.2021). Over the last five years, for instance, active housing listings have declined substantially while the median house sale price has risen sharply. In January 2022, there were about 408,922 active housing listings on the market, a 60% drop from about 1 million listings in February 2020 (see Figure 2). Similarly, the national median sale price for a single-family house jumped 25% from $327,100 in 2019 to $408,100 in 2021 (see Figure 3).

Figure 2: Number of U.S. active housing listings by year



Source: Federal Reserve Bank

Figure 3: Median U.S. home sale price by year



Source: Federal Reserve Bank

The scale of the residential housing supply shortfall is considerable in the U.S. This means overall there is less housing available for rent and sale at this time than at any time in the past 30 years, and the situation is expected to get even worse (Parrott & Zandi, 2021). As a result, building and available residential housing for families in major metropolitan areas has become a significant public policy priority. However, in recent years the discourse on housing development has transcended beyond just delivering low-cost housing to the market. Today, in addition to affordability, there is interest in energy and environmental efficiency, as well as broader agendas associated with building resilient neighborhoods, green cities, and mitigating climate change (EPA, 2021).

3.1.1. Sustainable Housing

Overall, there is no consensus on the definition of sustainable housing. The most commonly used definition for sustainable housing is provided by the Geneva UN Charter for Sustainable Housing which defines sustainable housing as an approach to "ensure access to decent, adequate, affordable, and healthy housing for all" (UNECE, 2015). Most discussions on sustainable housing primarily focus on environmental and economic dimensions of sustainability (EPA, 2021). The social aspect of sustainability is often given less attention in sustainable housing discourse. There is an intellectual debate on whether to focus on protecting the environment or addressing residents' needs, safety, and comfort.[5] Many agree that a holistic approach and definition of sustainable housing that integrates the environmental, economic, and social dimensions of sustainability is considered essential to better understand and achieve sustainable housing.

Out of the three sustainability dimensions, environment is often given more emphasis in the sustainable housing concept and applications in the form of energy and water efficiency, waste management, and resilient structures for extreme weather conditions. Many terms are used to describe buildings that incorporate energy and other environmental efficiency features. These include "green buildings", "high performance buildings" and "sustainable buildings." In most cases, the terms "energy efficiency" and "green" are used interchangeably, and there is a growing public perception that green buildings are energy efficient. However, this correlation does not always hold true as some "green" buildings are not "energy efficient" (EPA, 2021).

3.2. Energy Sources and Energy Consumption

Electricity and natural gas are the two widely used energy sources in residential homes in the U.S. While electricity accounted for 43% of the total energy consumption in 2021, natural gas comprised 42%. Petroleum and renewable energy sources such as solar and geothermal accounted for 15% of the total energy consumption. A 2015 report by the U.S. Energy Information Administration (EIA) indicated that the average U.S. household consumes about 11,000 kWh (kilowatt hours) of electricity per year.[6]

[5] See https://www.plannersnetwork.org/2007/07/developing-sustainable-housing-moving-beyond-green/.
[6] See https://www.eia.gov/energyexplained/use-of-energy/homes.php.

U.S. households use energy for several purposes. Space heating and air conditioning accounted for 52% of families' annual energy consumption in 2015. Energy use for air conditioning has been growing rapidly over the years and nearly 90% of homes used air conditioning in 2022[7], up from 57% in 1980. Water heating, lighting, and refrigeration constitute the second largest category for energy consumption. These three energy end-uses combined accounted for 27% of the total annual energy consumption. Powering devices such as televisions, cooking appliances, washing machines, and growing list of consumer electronics devices accounted for the remining 21% of annual energy consumption.[8]

Several factors, including climatic conditions and geographic locations, determine the amount of energy consumed in residential homes. Studies have found that there is a strong correlation between increasing trends in air conditioning use and climate change. A 2022 report by UC Berkeley explored this correlation using cooling degree days (CDDs) based on data from the 2020 Residential Energy Consumption Survey (RECS). CDDs are a widely used measure of cooling demand that reflects both the number of hot days and the intensity of heat on those days and are calculated based on the annual average cooling degree days in Fahrenheit relative to a base temperature of 65^0F. The analysis suggested that average annual cooling degrees in the U.S. have increased 30% since the 1950s.[9] As a result, U.S. households are experiencing more hot days and higher intensity of heat on those days, making air conditioning more important and increased energy consumption over time.

[7] See https://energyathaas.wordpress.com/2022/08/15/how-many-u-s-households-dont-have-air-conditioning/.
[8] See https://www.eia.gov/energyexplained/use-of-energy/homes.php.
[9] See https://energyathaas.wordpress.com/2022/08/15/how-many-u-s-households-dont-have-air-conditioning/

Housing size and housing structures also influence residential housing energy consumption. Big houses and families often use a high proportion of energy compared with smaller houses and families. Energy use for space heating and air conditioning in apartments was found to be smaller than in detached single-family homes. This is because apartments are generally smaller than single-family homes and require less energy to warm and cool. Moreover, the average household living in a single-family detached home consumed nearly three times more energy than a household living in an apartment building that has five or more units.[10]

3.3. Energy Cost Burdens on Households

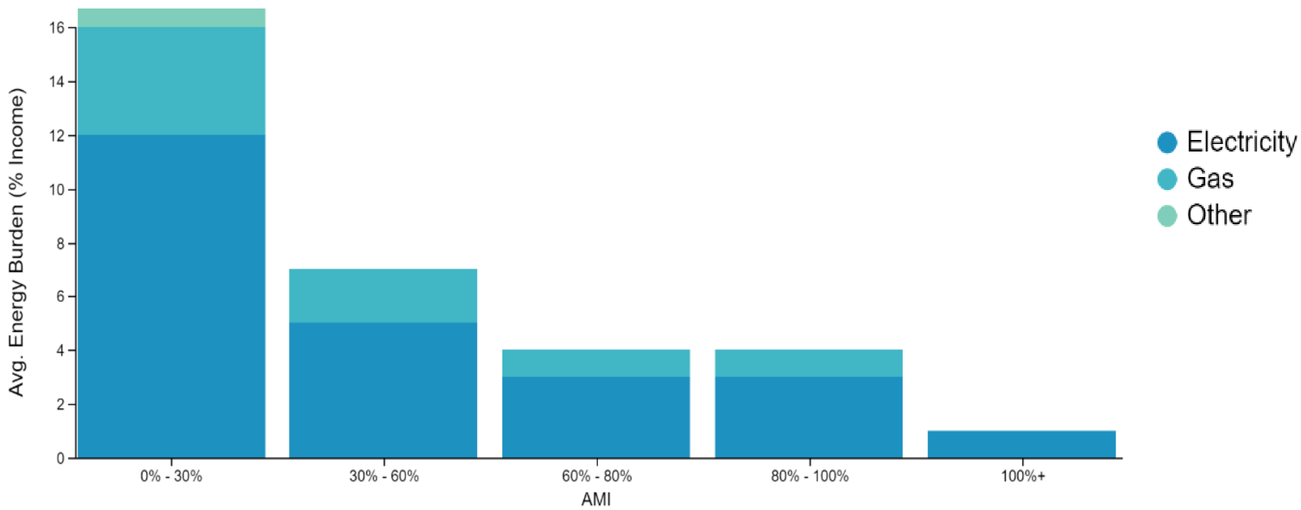
Energy consumption patterns are critical as energy-related expenses are an important component of many families' housing costs. Energy costs alone account for 19% of the total annual income for low-income families. This means these families spend a significant amount of their income on energy compared to the national average energy cost of 4% of household income (EPA, 2021). According to HUD, a household is classified as "low income" if the family's annual income is less than 60% the Area Median Income (AMI) and "very low income" if the family is earning below 30% of the AMI (Goldstein, et al. 2020).

Another analysis by the DOE's Low Income Energy Affordability Data Tool (LEAD) provides a deeper insight on energy expenditure across households.[11] That report uses average energy burdens as a proportion of a household's income spend on energy cost (electricity, gas, and other energy sources) determined using the 2018 U.S. Census Bureau's American Community Survey. While households earning below 30% of the AMI spend about 16% of their annual income on energy,

[10] See https://www.eia.gov/energyexplained/use-of-energy/homes.php.
[11] See https://www.energy.gov/eere/slsc/maps/lead-tool.

households making 80%-100% and above 100% of the AMI income spend only 4% and 2% of their income, respectively[12] (see Figure 4). Reducing energy costs could be an effective measure to reduce the burden and keep residential housing affordable for such households.

Figure 4: Average energy burden (% income) for the United States (2018)



Source: Low-income energy affordability data (LEAD)

3.4. Energy Efficiency and Housing Affordability

Pursuing a mechanism that promotes energy efficiency is a key option to reduce energy consumption. This is because energy efficiency is considered as the single most attractive and affordable component necessary to induce a shift in energy consumption. Energy efficiency generally pertains to the technical performance of energy conversion and consuming devices and building materials. Ensuring energy efficiency remains a priority is essential given the high degree of energy and electricity wastage in many major U.S. cities due to the old age of many residential and commercial buildings (NYSERDA, 2019).

[12] Ibid.

Energy efficiency can be achieved by installing energy-efficient devices and equipment such as lighting, home appliances, and space and air conditioning systems. This can help to lower energy-related expenses for many families. Consuming electricity efficiently, for instance, benefits residents because of its positive impact in reducing the cost of electricity generation, transmission, and distribution. When demand for electricity increases, utilities often transfer the added cost of energy generation and management to end-users' energy bills.[13] However, the cost and benefit of integrating energy efficiency measures in residential housing have always been subject to debate and discussion.

3.4.1. Energy Efficiency Investment vs. Perceived Economic Benefits

Overall, integrating energy efficiency measures and technologies in residential facilities is believed to make homes affordable by reducing the overall maintenance cost of the house, especially energy. Energy efficiency can be integrated either when constructing new housing or undertaking partial or major retrofitting of existing housing facilities. Analyzing the Weatherization Assistance Program (WSP) implemented on 30,000 households in the State of Michigan, Fowlie, et al. (2018) estimated that energy efficiency investments promoted by WSP helped program beneficiaries to reduce their monthly energy consumption by 10-20% on average. The reduced energy consumption helped low-income families minimize their energy bills. Similarly, according to an estimate by the DOE, energy efficiency measures help the average household to save about 25% on utility bills which amounts to over $2,200 annually.[14]

A deeper look into the empirical evidence on the economic gains of energy efficiency measures in housing affirms that cost savings because energy efficiency practices are achievable and realistic.

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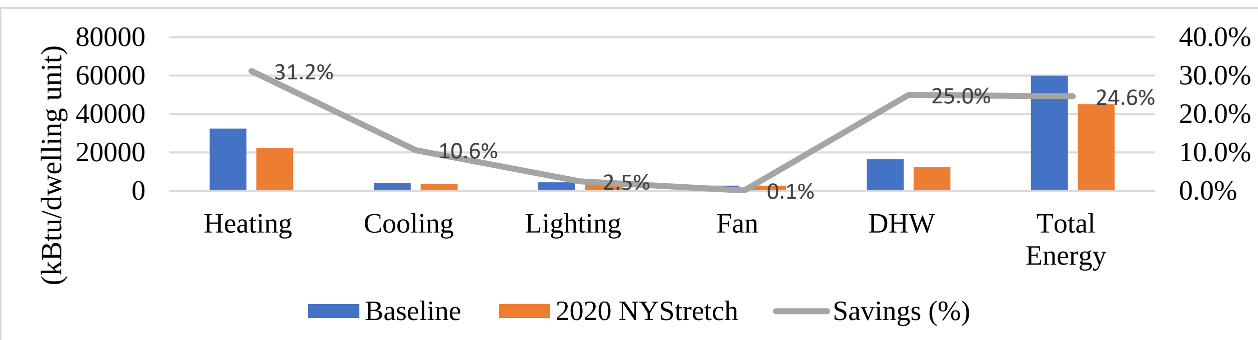
[13] See https://www.eia.gov/energyexplained/use-of-energy/homes.php.
[14] See https://www.energysage.com/energy-efficiency/why-conserve-energy/cost-of-ee/.

A study by New York State Energy Research and Development Authority (NYSERDA, 2019) estimated the economic benefit of integrating energy efficiency measures in residential housings in the state. The study compared the energy savings and cost-effectiveness potential of houses constructed as per the 2020 NYStretch Energy Code with the 2016 Energy Conservation Code (ECC), which was referred to as the baseline. Using the average costs for electricity, natural gas, and fuel oil, the study calculated the residential energy consumption for, as well as savings from, heating, cooling, ventilation, fans, lighting, and domestic hot water (DHW) in houses constructed in 2020 NYStretch and the baseline codes. Although houses constructed under the 2020NYStrech codes achieved 24.6% total energy savings compared to the baseline, significant variation was observed across the different energy end uses (see Figure 5). This indicates heating and domestic hot water represent the largest share for average energy saving, while lighting and fan were the lowest.

Figure 5: Average energy savings for the 2020 NYStretch code against the baseline

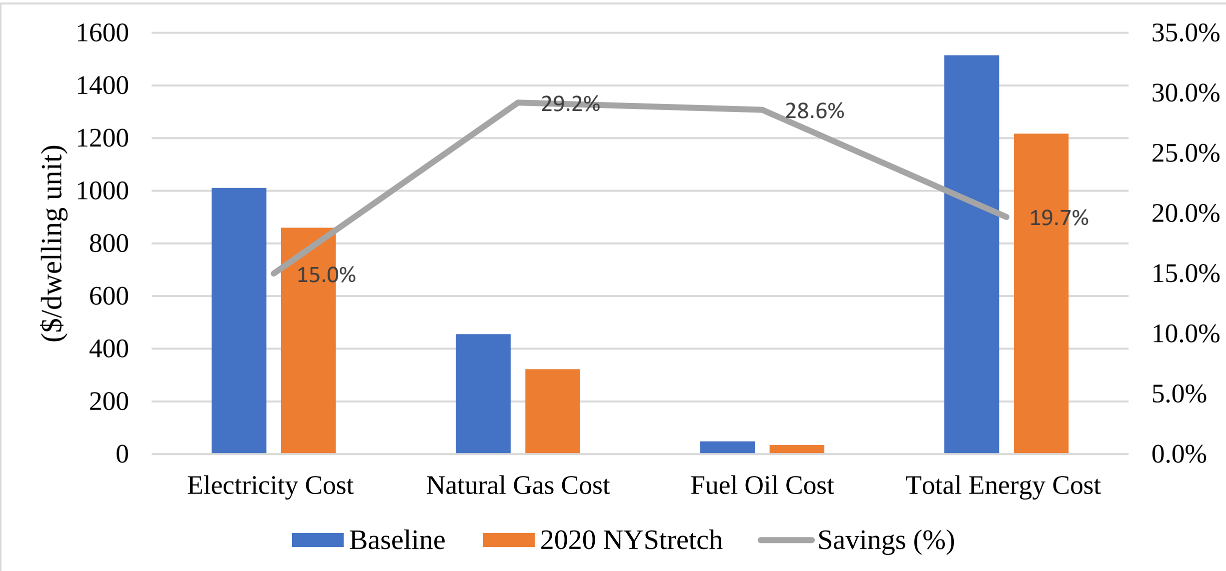


Source: NYSERDA (2019)

Similarly, housing constructed as per the 2020NYStretch Code resulted on average 19.7% total energy cost saving (electricity, natural gas, and fuel oil) compared to the baseline code (See Figure 6). The largest energy cost saving was achieved from natural gas and fuel oil, 29.2% and 28.6%, respectively, although electricity represented the least cost saving of all energy sources.

Interestingly, while electricity accounted for the largest proportion of the total energy cost, it represented the lowest in energy cost saving. The highest energy cost savings came from natural gas and fuel oil which accounted for the least in their share of the total energy cost.

Figure 6: Average annual energy cost savings of the state



Source: NYSERDA (2019)

These findings are consistent with other similar studies. A report from U.S. Environmental Protection Agency (EPA), for instance, suggested that new residential houses built as per Energy Star's standards are 20% to 30% more energy efficient compared to conventional houses (Hernandez, et al. 2011). The report also indicated Energy Star-labeled new homes are at least 15% more efficient than homes built to the 2004 International Residential Code (IRC) (EPA, 2021). These improvements carry potential cost savings for low-income homeowners and the millions of cost-burdened renters (Fernald, 2021).

A further analysis shows that integrating energy efficiency practices and services prescribed in NYStretch code were found to be cost-effective for the homeowner and yield positive savings over the life of the residential housings (see Table 1) as evidenced by the positive average value of the overall State level Life Cycle Cost (LCC) savings.

Table 1: Average summary cost effectiveness results for the prescriptive and mandatory provisions of the 2020 NYStretch Code in New York State

Annual Energy Cost Savings ($/dwelling unit)	$278
Incremental Costs ($/dwelling unit)	$1,795
Simple Payback (Years)	6.4
10-Year Net Present Value (NPV) of Cost Savings including replacement Costs and Residual Values ($/dwelling unit)	$2,854
30-Year LCC Savings ($/dwelling unit)	$1,741

Source: NYSERDA (2019)

Despite the evidence to the contrary, though, many continue to argue that investments in energy efficiency practices and products are more expensive than investments in conventional practices and products, and thereby suppress return on investment. This is because high-efficiency practices and products tend to have higher up-front costs, which can increase the ratio of capital to operating expense (Brown, 2015). Fowlie, et al. (2018), for instance, reported that the benefits of energy efficiency investments are substantially lower than upfront investment costs, which were twice the actual energy savings. Technical and market risks associated with advanced technologies further intensify the issue associated with upfront costs. In turn, in practice firms prefer to make capital investments towards reducing costs of production (Brown, 2015) leading to developing low-cost energy efficient residential housings.

Many have also argued that while energy efficiency can be the more expensive option in the short term when compared with conventional alternatives, savings over the life of the efficient product can fully offset the initial cost premiums and yield an implicit return on investment for homeowners.[15] Incremental cost estimates for energy efficiency investments can be partly offset by cost savings from the reduction in average energy use. A few large prototype buildings incorporating such technology have been constructed with incremental costs of only 5–7%, which is generally recovered from reduced energy bills in less than 5 years (Brown, 2015).

The third line of argument is centered around applying energy efficiency measures in renovation or upgrading of existing housings. In this case, energy efficiency is a cost-effective investment, but the actual amount of savings differs based on the type and scale of upgrade conducted. Overall, gross energy savings are positively correlated with the cost and difficulty of the upgrade, which means that more extensive home renovations result in greater savings over time. Furthermore, a combination of compatible multiple upgrades in a "whole-house" approach earns disproportionately greater savings relative to their total initial cost.

3.4.2. Beyond Affordability: Environmental and Climate Related Benefits of Energy Efficiency

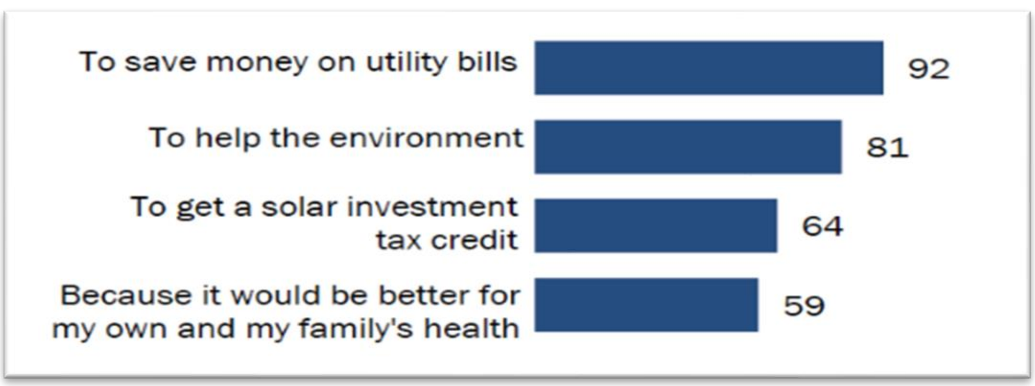
Apart from improving affordability, advancing energy efficiency in housing helps to GHG emissions and other environmental impacts by minimizing reliance on fossil-fuel based energy. This plays a vital role in mitigating carbon-induced climate change and the corresponding impacts, especially in major cities and metropolitan areas. Overall, the building sector accounts for 36% of the annual GHG emissions related to direct energy consumption (Knowles, 2008). Energy use in residential housings alone contributes 21% of the total emissions (Goldstein, et al. 2020). In New York City, 67% of the city's total GHG emission comes from the city's buildings. By 2050, the

[15] https://www.energysage.com/energy-efficiency/why-conserve-energy/cost-of-ee/

city administration has an ambitious plan to reduce GHG emissions by 80% from commercial and residential buildings (Krosinsky & Warshauer, 2021).

The housing sector has tremendous potential to reduce carbon emission by advancing energy and environmentally efficient buildings and resident facilities. According to the EPA, an Energy Star-labeled new home can achieve GHG emissions reductions up to 2 metric tons each year (EPA, 2021). Evidence also suggests that public awareness regarding the environmental benefit of integrating energy efficiency practices, as well as adopting clean energy technologies, is improving. A recent survey conducted by the Pew Research Center in 2022 found that 81% of U.S. homeowners who installed or have considered installing solar panels at home are motivated by the reasons of environmental stewardship (see Figure 7). This suggests that it would be reasonable for residential housing developers, policy makers, and investors to focus on homes that are not only affordable, but also energy efficient for many cost-burdened households.

Figure 7: Proportion of U.S. homeowners by reasons for installing solar panels at their homes



Source: PEW Research Center Survey (2022)

Despite ongoing debates and uncertainties, concrete evidence shows that there are multiple advantages for investing in energy efficiency. These include energy cost reductions, decreases in

GHG emissions and other local pollutants, and the subsequent health benefits. However, households and businesses invest less in energy efficiency than what may appear economically rational, and some other energy efficiency investments do not seem economically worthwhile (Houde and Aldy, 2017). In other words, energy-efficient technologies are not always adopted by architects, builders, owners, building maintenance workers, persons occupying the buildings, etc. despite evidence suggesting it makes economic, environmental, and social sense to do so (Yeatts, et.al. 2017). According to the latest report by the Coalition for Energy Savings in 2018, investments in energy efficiency should grow and play a key role in the years to come (Houde and Aldy, 2017). In this context, understanding the factors that prevent investment in energy efficiency technologies and practices in residential housing is crucial to fostering and realizing the perceived benefit of reduced energy consumption.

3.5. Reasons for Underinvestment in Energy Efficiency Measures

The energy efficiency gap arises when a technology that may be profitable for consumers in terms of efficiency is available in the market, but consumers do not take advantage of it for several reasons. This situation can be explained through different failures and factors. In their extensive review of over 200 articles published between 2000-2020, Solà, et al. (2021) identified three major factors and failures for the underinvestment in energy efficiency technologies and measures: 1) market failures (including informational failures and other market failures); 2) behavioral failures; and 3) other factors (see Table 2).

Table 2: Main failures explaining the energy efficiency gap

Failures	Factors promoting the gap	Description of the situation
(1) Market failures		
a. Informational failures	▪ Asymmetric market information	Markets do not reflect the real value of an investment or purchase. This is common with products such as home appliances or properties. Consumers informed about energy efficiency benefits may be willing to buy more energy-efficient goods and owners of rental properties may invest in energy-efficient goods if they know that tenants are willing to pay more for energy-efficient buildings.
	▪ Hidden and transaction costs	Costs borne by consumers are not always taken into consideration by modeler and such costs are associated with economic transactions that could lead to a nonoptimal outcome. These costs are generally not accounted for in models but are real and are common in the residential sector due to their combination with behavioral failures.
	▪ Myopia	Occurs when willingness to pay for a good is not affected by changes in expected future operating costs. Consumers do not consider reductions in future costs as benefits.
b. Other market failures	▪ Lower-than-efficient energy prices	Investments in energy efficient products are affected by extremely low-energy prices because they do not reflect the external costs of energy and incentives to invest in efficiency are thus very low, as the return period for the investment becomes very long.
	▪ Slowness of technological adoption	Slowness of technology adoption could explain the efficiency gap because consumers do not consider some technologies even if they are available on the market.

	▪ Capital market imperfections	Potential adopters may lack access to capital needed to undertake the investment. Low access to capital for lower income customers leads them to reduce their valuation of future benefits.
	▪ Principal agent / split incentives problem	Arise when one party decides about efficiency investment, but another party bears the cost or enjoys the benefits of that decision. In other word, energy efficiency investments and benefits are driven by different incentives between parties and do not coincide.
(2) Behavioral failures	▪ Inattention	Inattention to future energy costs has clear implications and could potentially explain underinvestment in energy efficiency. The level of inattention among individuals may change and depends on the decision environment
	▪ Decision-making heuristics and biases	These suggest that individuals are constrained by cognitive limitations and/or bounded rationality. In addition, consumers are frequently unable to process all the information required to trade-off all the alternatives in real decision-making processes, resulting consumers to place more value on initial costs.
(3) Other factors	▪ Social norms	Represents the collective norms that establish what should or should not be done in a specific society. These norms can positively influence the use of heating and cooling in public buildings
	▪ Personal belief and experience	Households with eco-friendly behavior tend to invest more in energy-efficient products. Previous personal experience with electric vehicles may affect preferences and attitudes towards such vehicles.

Source: Adapted from Solà, et al. (2021)

Given market failures, behavioral failures, and other factors, as well as their complex interactions, addressing these failures is a public policy concern and priority. It is essential to understand the nature and specific features, as well as the effectiveness and shortcomings of major programs and policy instruments promoted to advance energy efficiency by lessoning the efficiency gap in residential housing in the United States.

3.6. Programs and Policies to Promote Energy Efficient Housing Development

Federal and state governments have numerous initiatives and programs to support access to sustainable affordable housing to low-income communities. HUD works with public and private bodies to manage several home assistances programs (EPA, 2021). Local governments, on the other hand, work with various partners to promote energy efficiency in housing to make housing affordable to many low-income families. While some local governments own and develop affordable housing units by themselves, others partner with private and non-profit developers, homeowners, and real estate companies to leverage those organizations' resources, networks, capabilities, and technical expertise to promote energy efficiency by retrofitting existing housing and constructing new residential housings (EPA, 2021).

EPA, HUD, and U.S. Department of Transportation (DOT) established the Partnership for Sustainable Communities in 2009 to help improve access to affordable housing, expand transportation options, and lower transportation costs while protecting the environment (Hernandez, et al. 2011). Partnership for Home Energy Efficiency (PHEE), a collaborative initiative created and managed by the EPA, the DOE and HUD, has been a national flagship program to promote energy efficiency in housing. PHEE primarily focuses on existing homes to achieve at least a 10% saving in residential energy consumption. The partnership provides technical support, research, financial incentives, and technological options to drive homeowners, housing developers, and other stakeholders to invest in energy efficiency practices.

Another vital federally administered energy efficiency program is Energy Star, a joint program of the EPA and DOE. Its main purpose is to promote the adoption of energy-efficient products and services among diverse stakeholders working within the housing and building industry. While EPA leads the Energy Star program management, DOE leads the National Building Rating program, which is a sub-component of the Energy Star program.

These programs, initiatives, and partnerships have leveraged several policy instruments as a vehicle to advance their objective of energy efficiency and affordability in residential housing by addressing the failures and features discussed in the above section and thus reduce the energy efficiency gap. According to Markandya et al. (2015), these policy instruments are broadly classified into three categories: 1) price instruments (including taxes, subsidies, credits, and rebates); 2) command and control (including codes and standards); and 3) information-based instruments (including energy audits, energy labels, smart meters, etc.).

Price instruments include taxes, subsidies, tax deductions, credits, permits and tradable obligations (Solà, et al., 2021) and include competitive grants, interest subsidies, rental assistance, and mortgage guarantees (EPA, 2021). All these policies intend to address market failures by providing fiscal incentives and encouraging or discouraging consumer decisions. In many commercial buildings, architects, engineers, and builders select equipment, duct systems, windows, and lighting for future building occupants. Similarly, landlords often purchase and maintain appliances and equipment for tenants who pay the energy bill, providing little incentive for the landlord to invest in efficient equipment (Brown, 2015). Taxes and subsidies are among the most common fiscal incentives used to reduce energy consumption through revenue generation and sometimes also changing energy use behavior (Solà, et al., 2021).

Fiscal policies and financing programs can also help overcome the liquidity constraints of capital markets. While energy-efficient equipment is a capital cost, energy bills are an operating cost, leading to budgetary and accounting problems for upgrades and retrofits. Thus, one set of recent innovations tie repayment of energy efficiency investments into taxes or utility bills, allowing firms and consumers to adjust their cost structures and consider the upgrades as an operational savings rather than a capital expenditure (Brown, 2015). Organizations sometimes limit the use of energy efficiency technologies because of the standard accounting procedures they use, which do not account for the financial benefits. Many states in the U.S. offer financial incentives to overcome the high upfront cost of individual energy efficiency appliances and equipment, both for businesses and homeowners. For example, California offers a rebate for measures that save at least 15% of a home's energy use, with larger rebates given for larger savings (Ibid).

Regarding command-and-control instruments, codes are a policy instrument that specify how energy efficient products must be constructed or must perform, while standards establish how a product should be constructed to save energy effectively (Markandya et al. (2015). Codes and standards are among the main policies for promoting the adoption of energy efficiency and are commonly implemented in residential buildings. Such policies are commonly chosen by governments although they are considered inflexible policies (Solà, et al. (2021).

In this regard, green building rating systems are proliferating at the international and national scales. Nationally, government run programs include the Energy Star program and Building America program. The most prominent non-governmental organization managed rating systems include Audubon International, the Green Building Initiative's Green Globes, and the U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED). Such home rating companies provide independent third-party assessment and verification of energy efficiency and assist housing developers during the design and construction phases by performing plan reviews, recommending energy efficiency measures, conducting onsite energy efficiency testing, and ensuring that homes meet Energy Star's standards (U.S. EPA, 2008). These raters also help residents, homeowners, and landlords to assess, understand, and take necessary measure to improve home energy efficiency (EPA, 2021).

Informational instruments are designed mainly to address informational and behavioral failures. Markandya et al. (2015) classify these instruments into energy certificates and labels, information feedback tools and energy audits. Energy efficiency labels are used to address the energy efficiency gap by giving more information on energy consumption to potential customers at the point of sale. Energy labels are usually designed to help and encourage consumers to make efficient decisions, so they are designed to tackle hurdles related to information asymmetry. Labels have become the cheapest and easiest way of providing consumers with energy efficiency related information (Ibid). Again, energy certificates and labels seem to be a very widespread energy efficiency policy instrument in the building and residential sectors.

In summary, energy efficiency labels, smart meters, information feedback tools and energy audits can be said to be designed to tackle most failures (market, behavioral, and others), while price instruments are designed to deal mainly with market failures. In addition, codes and standards are designed to ensure a minimum level of adoption of energy-efficient technologies (Solà et al., 2021). Despite several efforts to implement these policy instruments, their success and effectiveness in driving the anticipated shift in adoption of energy efficiency technologies and practices has always been a concern.

3.7. Effectiveness of the Programs and Policies Instruments

Command and control instruments are commonly used to address market failures. It is known that codes and standards can be hard to implement because all those agents who are unable to achieve the minimum energy efficiency levels established by the governments would have no other option than to quit the market due to their high implementation costs (Markandya et al. 2015).

Overall, command and control instruments help to reduce energy consumption and increase the price premium for buildings built under such policies. But these policies are considered as legislative or normative measures so the renovation of a building might lead to high costs (Markandya et al. 2015). Houde and Aldy (2017) developed a system for assessing a rebate program for household appliances in the US. Their results indicated that consumers tend to buy appliances which are of higher quality but not necessarily more energy efficient. They concluded that the long-term impact of this rebate may not lead to a decrease in energy demand. They also estimated an increase due to rebate policies in the sales share of 'US Energy Star' household appliances of 3.3 to 6.6%.

Regarding the effectiveness of energy codes, a significant proportion of buildings reduced their energy consumption with the introduction of residential building codes in the US (Markandya et al. 2015). In a similar context, the author finds decreases in electricity and gas consumption following a change in the energy building code. Papineau (2013) confirmed the effectiveness of energy codes for improving the efficiency of buildings by analyzing whether commercial real estate owners are willing to pay a premium for properties with stringent energy codes in the US.

The results of that study indicated that buildings constructed under stringent building codes have a price premium of between 2.7 and 10%, and tenants are willing to pay 5.7% higher rents.

The effectiveness of some of the policies varies across different social and economic variables. Jacobsen (2019) attempted to understand how energy efficiency incentives such as rebates, taxes, and incentives are distributed across income groups in the US. He showed that incentives and taxes always seem to be the policies which are concentrated most in higher-income households, while rebates impact lower-income households. Despite these results, both energy audits and rebate programs were found to reduce energy use by 5% for heat pumps in the US. The effects of energy audits appeared to be stronger in summer, while the rebate program saw stronger effects in winter.

In a recent study based on the mandatory audit policy implemented in New York City, Kontokosta et al. (2020) found that mandatory energy audits reduced energy use by 2.5% for multifamily residential buildings and 4.9% for office buildings. However, the results of their study also showed that audits did not provide sufficient incentive to invest in energy efficiency. It seems that the reduction in energy use produced by this audit policy was not sufficient to attain the carbon-reduction goals of New York City. Others also noted that these price instruments do not always successfully “nudge” consumers towards more energy-efficient products (Houde and Aldy, 2017).

CHAPTER 4

RESULT AND DISCUSSION

4.1. Residential Housing Development at Fairstead

Fairstead is publicly committed to creating high-quality sustainable housing. The company develops high quality residential housing mostly for the affordable domain rather than for the high-end market. While their largest share of the housing development focuses on renovation of existing residential houses, building new housing also comprises a small portion of the company's portfolio. The Energy and Sustainability Director is on record as noting that a "key part of Fairstead's strategy is preserving and enhancing existing affordable housing stock so they can remain a great place to live in the long-term for low-income families."[16] The company also plans to expand its engagement in building new affordable energy efficient housing facilities in the future. Regarding housing types, the company exclusively develops, renovates, and preserves multifamily residential housing. Overall, building or renovating single family housing is not a strategy considered at Fairstead.

Fairstead's core philosophy is delivering affordable housing in high-opportunity areas and providing residents with various support services required to enhance their lives.[17] Most of the company's affordable housing targets low- and medium-income families who are managed and transferred to beneficiaries through the Housing Choice Voucher Program also known as Section

[16] See https://www.prnewswire.com/news-releases/fairstead-adds-nearly-2-000-units-to-portfolio-in-new-yorks-largest-affordable-housing-deal-of-2021--301443334.html.
[17] See https://www.prnewswire.com/news-releases/fairstead-new-york-city-department-of-housing-preservation--development-and-project-find-launch-lottery-for-new-fully-affordable-senior-housing-development-on-the-upper-west-side-of-manhattan-301561048.html.

8. This program is the federal government's major program for assisting very low-income families, the elderly, and the disabled so those demographics can afford decent, safe, and sanitary housing in the private market.[18] Eligibility for the program is generally determined by HUD income definitions and requirements. Fairstead relies on those to administer residential housing under that program. A family can qualify if the household's annual income does not exceed 50% of the median income for the county or metropolitan area where the housing facility is located. Through arrangements made by Fairstead and the local representative agency for HUD, families whose income does not exceed 30% of the area median income can receive up to 75% rental assistance. Because median income level varies by location and family size, HUD publishes updated income levels annually.

4.2. Drivers of Sustainability and Environmental Efficiency in Residential Housing

Integrating energy and water efficiency in multifamily residential housing is considered as an opportunity and responsibility for Fairstead. Resource-efficient and environmentally sound design, construction, and operation principles can offer financial opportunity for housing developers and represent a viable economic model that encourages the expansion of affordable housing options for low-income families regardless of income. In real estate, net operating income that is calculated as a property's gross operating income minus its operating expenses is a vital determinant of the profitability or market value of an investment property.

At its most basic level, resource-efficient renovation and construction not only conserve resource but also reduce operating expense and increase net operating income making the residential building more valuable. However, the connection between reducing resources and enhancing the

[18] See https://www.hud.gov/topics/housing_choice_voucher_program_section_8#hcv01.

financial value of a residential facility is complex and requires a thorough investment analysis and extensive decision-making process. Installing the most efficient durable device and technology that makes budgetary sense is the major objective the company seeks to achieve. Fairstead analyzes extensive data drawn from a variety of sources in order to develop a program for each asset to optimize its capital investment, utility usage and spend, and resident comfort.

From an environmental perspective, efficiency improvement-related interventions aim to uphold the company's commitment to be a responsible steward of the planet focusing on resource conservation and decarbonization to mitigate harm to the environment. From the perspective of a resident, sustainability is seen by the company as a tool to enhance quality of life for families, limit service disruptions, and improve families' and neighborhood resilience. This is particularly important as a significant portion of the residents are vulnerable to utility service disruptions.

External factors also drive sustainability in housing development. These include everything from a government policy to a public- or private-sector program. The company is very aggressive and skilled in leveraging sustainability-focused programs and incentives. Some of the government and industry-leading state initiatives, for which Fairstead is a signatory, that intend to advance integration of energy and environmental efficiency in housing are discussed in the later sections.

4.3. Fairstead's Environmental Efficiency and Sustainability Concerns

Fairstead's residential housing development primarily focuses on energy and water efficiency, as well as social aspects of sustainability including enhancing residents' resilience. Some of the energy and water efficiency and decarbonization strategies the company integrates in the design and construction of renovating old multi-family residential houses include boiler controls, leak detection, solar development, and heating, ventilation, and air conditioning (HVAC) improvements, as well as low-volatile organic compounds (VOC) paints, carpets, and flooring.

4.4. Affordability and Energy Efficiency at Fairstead: Do They Compete or Complement?

Overall, Fairstead considers energy efficiency and affordability as a complementarity, not competing, objective. In high-end market for housing, developers and owners can typically raise rent when demand outstrips supply. The affordable housing market, however, operates differently. As in most affordable housing projects, Fairstead cannot raise the rent or price of its multi-family residential houses to increase profitability of the properties because these facilities are earmarked in certain federal or state programs and are developed under a dedicated financial scheme which include lending or incentives. The primary mechanism by which the company can make its residential facilities more profitable is by decreasing the costs associated with the operation of those properties.

Integrating energy efficiency in housing through renovation is often a capital-intensive investment. Upgrading the space heating system, developing effective insulation, or even installing energy and water conservation devices involves high upfront costs. Although these investments potentially reduce long-term operating expenses, securing finance from lenders and investors can be challenging as these projects are earmarked to operate within the affordable housing domain. This can lead to a gap between the investment required and the funding available to housing developers. An appropriate financing vehicle can be required to bridge this financing deficit. To address this, governments inject financial resources dedicated to finance projects intended to develop affordable and energy efficient housing. In the recent Inflation Reduction Act[19], for instance, almost half a trillion dollars was allocated to energy efficiency and electrification in residential housing.

4.5. Integrating Energy Efficiency in Housing at Fairstead

The Energy and Sustainability team at Fairstead undertakes pre-acquisition due diligence including on-site evaluation to ensure that the economic and financial aspects of building new or renovating existing residential housing is adequately appraised and well reflected in any subsequent bidding process. This helps to determine the level of energy and water efficiency sought, the use of healthful materials, and best practices for construction while residents remain in place.

Subsequently, multi-family residential housing facilities are renovated in accordance with the company's standard for sustainability-conscious construction and healthy living. These include green-label carpeting, low-VOC paints, and other sustainable construction materials; installing technologies that monitor energy, steam, and water leaks; as well as HVAC equipment and water consumption.

Fairstead is also a significant developer of solar power systems. The design and construction team apply the same level of rigorous technical and economic analysis and construction methodology in developing solar systems. The company first installed a solar project in California in 2018. Since then, the company has increased the pace of solar development across the country not only installing solar systems in new acquisitions, but also retrofitting older buildings when the investment is economically viable.

[19] See https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/15/by-the-numbers-the-inflation-reduction-act/.

Fairstead recently worked with National Grid and Rhode Island Housing to plan and install a 426-kWh photovoltaic system across the rooftops of Echo Valley, a 10-building complex in West Warwick, RI. The company submitted the project to the Rhode Island Renewable Energy Growth's Community Remote Distributed Generation Program which allowed the company to share the cost savings with the residents of Echo Valley—approximately 100 families and the broader community.

Fairstead invests heavily in data-management and analytical technologies that allows it to assess a given residential facilities' utility performance against its overall portfolio and a national database of multi-family buildings. This greatly improves the speed and efficacy in diagnosing and repairing and remediating operational deficiencies which waste money, energy, and water. Further, the company also installs boiler-monitoring-and-control technology to detect equipment problems, reduce fuel consumption and greenhouse gas emissions, and deliver more reliable services. The company has deployed these monitoring systems at most of its properties.

For too long, affordable housing has been underserved in technology, despite its immense impact to promote sustainability in housing. Cognizant of this reality, Fairstead invests in cutting-edge technologies to better integrate energy efficiency innovations in the design and purchasing of affordable housing. In this regard, the company participates in pilot programs, technology incubators, and strategic partnerships, to test new equipment, software, systems, and approaches that focus on improving efficiency in the construction and operation of residential facilities.

Fairstead's venture arm engages in synergistic partnerships and strategic technology investments that help buildings and communities become more sustainable and resilient. For example, the strategic partnership with PropTech companies and business incubators allow Fairstead to engage in testing for innovative solutions that aim to set a new standard for the affordable housing industry. Their partners transform existing heating infrastructure into an energy platform via its SmartWatt Boiler technology: a micro-CHP system that generates hot water for heating and domestic use plus electricity at nearly zero-cost. Designed to run on either natural gas or liquid propane, the SmartWatt Boiler is one of the most efficient heating solutions for buildings and homes in the market, with a 97% (HHV) heating efficiency. Equally important, this electricity produces half the carbon dioxide emitted by electricity from the grid, while lowering the carbon footprint and increasing resiliency by providing a backup power feature.

Fairstead also has signed a strategic partnership with energy-technology company Enviro Power to develop and deploy SmartWatt Boiler cogeneration technology. Fairstead Ventures has invested in Enviro Power and made a commitment to install these systems at selected properties across the country to support an efficient solution that is better for the environment and residents. Moreover, the company partnered with Kwant Artificial Intelligence (AI) to deploy an AI safety and productivity platform in residential multi-family housing renovation projects in New York City.

4.6. Energy and Water Efficiency Outcomes in Multifamily Housing

Evidence from Fairstead indicates that efficiency implemented in renovation of residential housing has brought measurable outcomes on energy and water saving, cost savings, and reduction in carbon emissions. In this section, selected housing development projects are discussed to highlight some of those tangible benefits.

Federation Gardens is a $53.2M multifamily residential housing renovation project that targeted 161 apartments in South Florida. Between 2019-2020, renovations to Federation Gardens included installation of Energy Star-rated stoves and refrigerators, electronic-ignition ranges, and energy efficient new microwaves; kitchen exhaust upgrades, low-flow plumbing and bathroom fixtures, Light Emitting Diode (LED) lighting upgrades, and installation of live water monitoring.

As a result of these upgrades, energy consumption at Federation Gardens decreased by 640,000 kWh and water consumption decreased by almost 1.8 million gallons. The building received 65 on the Energy Star Water Scorecard in 2018 and scored 91 in 2021, a 40% increase in energy and water efficiency. In 2021, Federation Gardens was named "residential building with the most water saved"[20] by a Miami-based challenge initiated by the city's mayor to advance efforts to GHG emissions and energy and water consumption efficiency in South Florida.

Another example of housing investment by Fairstead is Federation Towers, a $36.7 million project to renovate the studio and one-bedroom apartments and common spaces under the Section 8 affordable housing program in Florida. The major renovations included installation of energy-efficient appliances such as new refrigerators, weather-resistant glass windows and slider upgrades, electronic thermostats, and HVAC upgrades, in-unit and common-area LED lighting, and low-flow fixtures. Energy consumption decreased by 400,000 kWh, while water consumption decreased by almost 1.2 million gallons. This facility received 23 points on the Energy Star Performance Scorecard in 2018, and earned 69 in 2021, an increase of 200%. Federation Towers property was also designated as "a residential building with the most energy saved."[21]

Fairstead's commitment to water conservation is exemplified at the Savoy Park Apartments in Harlem, New York City. Powered by a $365 million investment, Fairstead undertook a comprehensive renovation of the 1,800-unit complex, including a full complement of energy and

[20] See Fairstead 2021 ESG Report
[21] Ibid.

sustainability upgrades. Already, the company has saved approximately 40 million gallons of water from installation of low-flow fixtures and other conservation measures, as well as 5.5 million gallons from leak detection and correction.

The solar development at Echo Valley in Rhode Island has now become a community solar project that provides access to clean, renewable energy at discounted rates to many families. Overall, Fairstead's solar energy development and heating system renovations have reduced carbon dioxide emissions by more than 440,000 pounds. Further, through a partnership with Con Edison, one of the largest investor-owned energy companies in the United States, Fairstead's home appliance recycling programs have helped to save over 1.7 million kWh of energy from New York City's power grid.

4.7. Enabling Environment for Affordable Energy Efficient Housing Development

Fairstead believes that the design of residential housing, the materials to be used for construction, and housing systems and infrastructure to be installed are the major entry points to integrate energy efficiency and sustainability measures into its affordable housing portfolio. To realize these companywide commitments, Fairstead complies and adheres to several federal, state, or local initiated voluntary, as well as compulsory, standards and certification programs meant for affordable residential housing.

4.7.1. Certifications and Standards

Fairstead is a signatory of several industry-leading state initiatives that aim to hold affordable housing developers to an especially high sustainability standard (see Table 3). These commitments signify that cost-effective, zero-carbon retrofits can be seen as desirable by the affordable housing community.

RetrofitNY – an initiative sponsored by the New York State Energy Research and Development Authority intended to make carbon-neutral retrofits a reality at scale in the state. By signing this pledge, Fairstead is working with NYSERDA to create many affordable housing units that are carbon neutral by 2025.

Realize-CA – an initiative sponsored by RMI, an independent nonprofit that uses market-driven solutions to secure a clean, prosperous, zero-carbon future for all. The program is intended to establish a statewide net-zero carbon retrofit program that will significantly improve the affordable multi-family building stock in California. The program standardizes and streamlines economically viable retrofit packages using decarbonization technologies. In addition to its overarching goal, Realize-CA aims to improve building resilience, ensure healthy and comfortable living environments, cut down energy expenditures and carbon emissions, preserve affordable housing, and increase grid stability.

Enterprise Green Communities (EGC) – Fairstead also strives to adhere to EGC's criteria for affordable housing. This framework provides proven, cost-effective standards for creating healthy and energy-efficient homes. In New York City, for instance, all new construction and substantial rehabilitation that receive funding from the Department of Housing Preservation and Development are required to comply with the Enterprise Green framework or pursue LEED certification.

Energy Star – Fairstead seeks to attain Energy Star certification for its residential communities. This is based on the belief that financially efficient, Energy Star-certified buildings help protect the environment by generating fewer greenhouse gas emissions than average. To obtain the certification, a building must meet strict energy performance standards set by the EPA. Certification is annual and verified by a qualified third party. Evidence suggests that Energy Star-certified buildings have lower utility bills, using, on average, 35% less energy than similar buildings nationwide.

WaterSense – Fairstead seeks to meet WaterSense standards in product procurement, construction, and operations. WaterSense is a voluntary partnership program sponsored by the United States Environmental Protection Agency. WaterSense-labeled products and services have been certified to use at least 20% less water, save energy, and perform than regular models. WaterSense is also intended to encourage innovation in manufacturing and support sustainable jobs for American workers.

SmartWatt Boiler – Fairstead has invested in SmartWatt Boilers and is committed to installing them in many of its residential communities. SmartWatt is a micro-CHP (Combined Heating and Power) system that generates hot water for heating and domestic use and on-site electricity at nearly zero-cost. When connected to a smart thermostat, SmartWatt boilers provide more flexibility and efficiency in heating and add to building resiliency.

EarthCraft Certification – Fairstead seeks EarthCraft Certification for qualified communities. EarthCraft, the country's first multi-family-specific green building program, addresses new construction, renovation, and adaptive reuse projects. EarthCraft-certified properties meet standards for improved air quality, as well as conservation of energy, water, and natural resources.

Research has shown that EarthCraft communities are healthier, operationally cost effective, and on average, 30% more energy efficient[22].

Forest Stewardship Council (FSC) – Fairstead's cabinetry vendors have FSC certification that enables the company to source construction materials from FSC-certified forests, as well as recycled and controlled sources. This certification also follows FSC-defined best practices throughout production and supply chain. The guidelines are designed to maintain biodiversity, ensure zero deforestation, safeguard the rights of indigenous peoples, and support fair wages and safe work environments. FSC is an international organization that provides a system for voluntary accreditation and independent third-party certification that allows certified forests to market their products and services as the result of environmentally appropriate, socially beneficial, and economically viable forest management.

[22] See Fairstead 2021 ESG Report

Table 3: Summary of federal, state, local, and industry standards and certification to which Fairstead complies

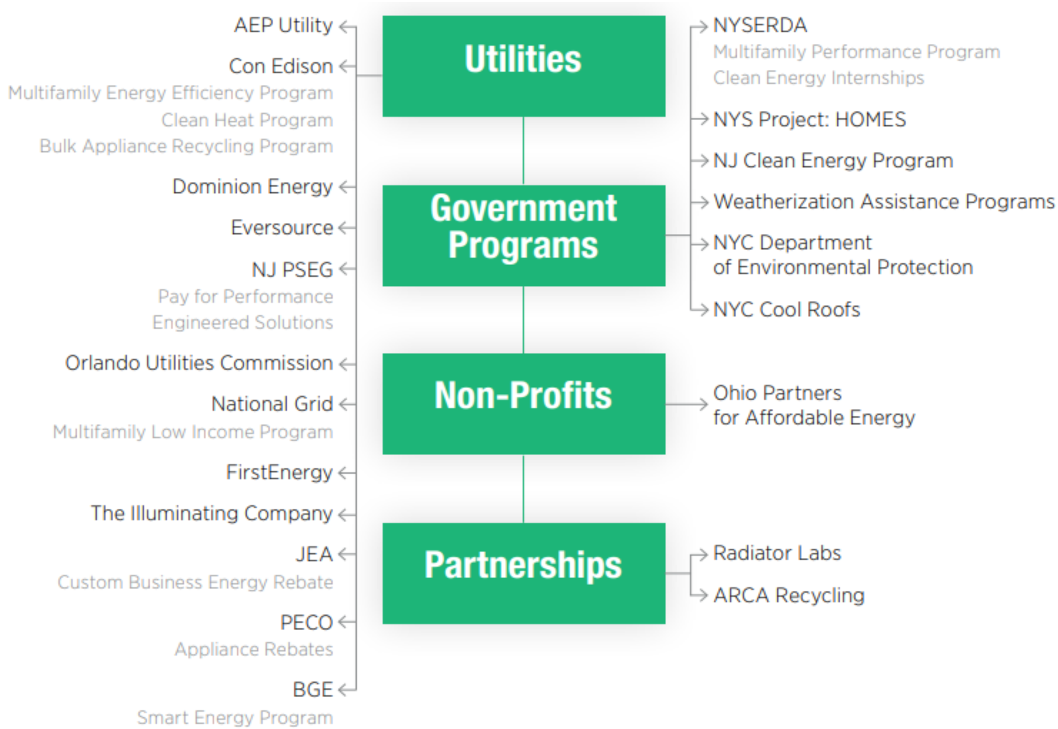
Name of the regulation	Domain	Jurisdiction
Building Energy Benchmarking Program	Energy efficiency	California
Enterprise Income Verification System	Affordability	Federal
Existing Buildings Energy & Water Efficiency Program	Energy and water efficiency	Los Angeles
Housing Authority Project and Tenant-Based Voucher	Affordability	State and local
HUD Project Based Rental Assistance	Affordability	Federal
HUD Section 3 Requirements	Affordability	Federal
HUD HOME Regulations	Affordability	Federal
Local Law 33	Energy efficiency rating	New York City
Local Law 84	energy and water consumption reporting	New York City
Local Law 87	Energy efficiency reporting	New York City
Local Law 97	Emissions reduction	New York City
Low-Income Housing Tax Credit (LIHTC)	Affordability	Federal, State, & Local

Source: Fairstead ESG and Community Impact Reports (2021)

4.7.2. Public and Private Incentives

Funding the energy transition will require both public tools and private capital. Fairstead incorporates several federal, state, and utility incentives into its project financing to deliver incremental revenue or savings to communities (Figure 8). Public and private sponsors and partner-led incentive programs are seen as critical for Fairstead's effort to promote energy and water efficiency, decarbonization, and robust building infrastructure. These programs include free building improvements focusing on air sealing, insulation, water fixtures, and appliances, and significant rebates for everything from lighting to boilers. The incentives make it more attractive to undertake energy and water improvement projects that reduce consumption, waste, and operating expenses, as well as improve resident comfort.

Figure 8: Public and private incentives for sustainable affordable housing



Source: Fairstead 2021 ESG report

As noted above, the Inflation Reduction Act provides billions of dollars for states to issue rebates to homeowners and developers for whole-home retrofits and efficient heat pumps, heat-pump water heaters, and other electrical equipment. Most of those funds are intended for low- and moderate-income households and this makes Fairstead eligible to access those resources. The bill also provides billions more in loans and grants for upgrades to subsidized apartments. These funds have the potential to catalyze action at scale, especially when paired with other public incentives and private capital.

4.8. Key Barriers to Scale Investment in Energy Efficiency

Although evidence, as well as cases, from the company demonstrates there can be a tangible return on energy efficiency improvement investments in the housing sector for developers as well as residents, these benefits are not always straightforward. So many factors inhibit private housing developers (including Fairstead) from realizing cost savings and other benefits from such investments. This study identified three barriers to scale investment in energy efficiency in the residential housing sector: 1) uncertainty compounding the cost-benefit in energy efficiency retrofits; 2) financing and financing related barriers; and 3) barriers related to policy and public incentives for affordable. These barriers are discussed below.

Uncertainty in the Cost-Benefit of Energy Efficiency Retrofits

Some energy efficiency measures can be either non-economical or too intrusive to the residents in terms of the ability to afford the disruption they cause. This is further compounded by several factors such as misalignment about how buildings performances are metered, who pays for the expense of the investment (especially which portion of the construction or retrofit), and who derives benefit associated the energy efficiency. Further, the current economic environment, which is characterized by rising costs, tighter credit conditions, supply shortages, and inflation makes investments in energy efficiency and benefits from these investments more complex.

A recent report by the Federal Reserve Bank of New York indicated that under current commodity prices, electricity is more expensive per unit of heat than natural gas. In some regions, such as downstate New York, the price can be even two to three times higher. Therefore, for many buildings currently heated with natural gas, electrification can lead to higher utility prices, even while reducing overall energy consumption (Mills and Scott, 2022). For affordable housing developers like Fairstead, this burden can become financially unsustainable, regardless of who is paying for the heating and cooling. However, many agree that these issues are cyclical trends that will diminish over time, and that decreasing inflation, easing supply constraints, and macroeconomic policies such as the Inflation Reduction Act will create opportunities for investment in the future (Ibid).

Access to Capital and Financing-Related Challenges

The challenges to financing energy efficiency investment, particularly for housing developers and landlords of affordable housing, are numerous. This is partly linked to that fact that building retrofits require substantial up-front investments and also to the fact that commitments to keep low- and moderate-income rents affordable can limit cash for developers to cover costs or leverage debt for renovations.[23] Moreover, these required sizable up-front capital expenditures can be disruptive to residents. Subsidized and unsubsidized affordable housing serving low- and moderate-income families in New York is particularly financially limited due to restricted cash flows. The commitment to keep rents affordable, a requirement for projects receiving subsidy, restricts the rental income available to cover the full cost or leverage the debt necessary for renovations that include energy efficiency upgrades (Mills and Scott, 2022). After interviewing several housing developers and financiers in New York City, Mills and Scott (2022) reported that out of the many energy efficiency upgrades, electrification measures do not always lead to operational expense savings that can offset the initial project capital cost.

Another financing-related challenge is related to attracting new capital investment. Supplemental sources of capital often require consent from the existing mortgage holder, and mortgage holders

[23] See https://www.crainsnewyork.com/climate-change/ny-fed-lays-out-financing-ideas-green-building-transition.

are not always keen to provide this consent. A typical example of this problem is Property Assessed Clean Energy (PACE) financing. PACE enables property owners to finance up-front costs of energy upgrades and pay the costs back over time through their property tax bill. Despite the abundance of PACE lenders, and the clear alignment of the approved uses of this financing with the clean energy transition, PACE has hardly been used in the multi-family market due to restrictions from senior debt providers limiting capital from reaching to efficiency projects.

Access to capital is further exacerbated by the ability of housing developers to pay for potential loans. This is because a property must generate enough income to support any additional debt the developer utilized for energy efficiency improvements. However, many affordable developments are not able to take on new debt because their net operating income is too low relative to their existing debt service. Especially in the case of regulated affordable housing programs, developers are unable to raise rents to cover the additional debt service. Many residential housing facilities are fully leveraged based on their existing cash flow, and are therefore unable to supplement an existing loan, even in scenarios where energy efficiency measures would increase property value and create higher cash flow in the long term (Mills and Scott, 2022).

Policy and Public Incentive-Related Barriers for Investments for Energy Efficiency

As discussed in the above sections, several federal, state, and local governments promote programs and policy incentives that encourage housing developers to integrate a sound energy efficiency measure while maintaining housing affordability. However, despite actions of Fairstead and other private housing developers, several factors limit the positive outcome that could be generated by leveraging these such policy incentives structures.

Financing energy-efficient multi-family affordable housing development requires stitching together a host of disparate programs and capital sources. Developers often must go to one place to secure financing for an affordable housing project and another place to obtain capital or incentives to cover the energy efficiency or low-carbon measures. In turn, this negatively affects the scalability of such solutions and presents risk; for if one of the programs falls through, the entire project can become financially infeasible. Stressing these concerns, the Director of Energy and Sustainability at Fairstead said "to finance retrofits projects for affordable housing the company is required to work with a series of disparate programs, which can be a long and demanding process that costs both time and money."

Another critical limitation is that the various capital sources and incentive structures have a diverse set of requirements and terms that can be time sensitive. As a result, not all of them are available during the different stages of the building such as construction, limiting their ability to be used in conjunction with construction lending debt. The LIHTC program, for instance, has a restricted time window for application and enrollment. Related to this, most incentive programs lack programmatic flexibility. The administrative procedure associated with LIHTC is highly cumbersome as it involves many stakeholders in the approval process of any additional debt. The Director of Energy and Sustainability believes "the LIHTC program has a set of additional obligations to build and retrofit residential housing that must be met by housing developers. So, this makes approval and compliance for that process complex and time consuming."

The slow pace, or even absence, of gradually adapting policy and incentive structures to accommodate emerging industry challenges and opportunities is also a vital barrier. Energy efficiency measures can lead to higher property assessments and, in turn, higher property taxes. The higher taxes dilute the savings generated by the energy efficiency investments, increasing the payback period, and weakening the overall economics of the energy efficiency investment. At the same time, while the assessment of the property for tax purposes is often higher following these improvements, the appraisal, used for lending and calculating fair market value, is frequently unchanged. This results in a double negative outcome: the taxes on the property rise, but the appraised market value of the property does not. Similarly, most available green financial incentives help cover the installation cost; however, there are very few incentives designed to lower the ongoing operational expenses associated with operating and maintaining these systems (Mills and Scott, 2022).

CHAPTER 5

CONCLUSION

Fairstead’s housing development approach primarily focuses on renovating existing multi-family residential housing by integrating energy, water, and other environmental efficiency measures and technologies. Given the escalating housing supply shortage, targeting multi-family housing can be seen as an appropriate strategy to meet the needs of families and communities who are highly affected by a housing problem. Accordingly, a sizeable proportion of Fairstead’s housing portfolio comprises affordable housing facilities targeted to low-and-medium-income households.

Many factors drive the rationale for integrating energy, water, and other environmental efficiency measures and technologies in the development and renovation of residential housing at Fairstead. The major sustainability drivers can be categorized as internal and external. Internally, sustainability is considered as an opportunity and a responsibility. Guided by rigorous investment analysis and sound business decisions, sustainability can support efficient resource utilization and allocation that translate into better financial outcomes and return on investment. Although that is complex and requires so many contextual factors to happen, sustainability can be a viable economic model for private developers to advance energy efficient affordable residential housing to low-income households.

Sustainability is also seen as a responsibility at Fairstead because resource conservation through integrating energy and water efficiency, as well as decarbonization through technologies and practices that reduce carbon emission, can help to minimize damage to the environment and mitigate climate related impacts. That perfectly aligns with Fairstead’s mission as a vital environmental steward. The environmental dimension of sustainability is intrinsically intertwined with social dimensions such as enhancing residents' quality of life and comfort because energy and water efficiency measures can improve residents' health, reduce utility service disruptions, and overall increase families and communities' resilience.

External factors including public policy and private and public resources and incentives are also critical drivers for Fairstead's engagement in energy efficient affordable housing development. Given the proliferation of voluntary and compulsory federal, state, and industry-led policy frameworks and housing programs, the company leverages its internal expertise and strategic-industry location to harness the available resources. Fairstead is a signatory of several federal, state, and local initiatives, requirements, and standards that call upon better integration of energy and environmental efficiency measures in housing development. Fairstead's aggressive approach towards leveraging these drivers is explained by a combination of motivations including meeting compliance requirements, incubating sustainability as a viable economic model for housing, and capitalizing on highly required, scarce external resources.

Cases and evidence showed that energy and water efficiency technologies and practices integrated in the design and construction of renovating multi-family residential housing led to measurable outcomes on energy and water conservation, associated cost savings, and carbon emission reductions linked to energy consumption. The company strategically leverage technologies and expertise to perform a rigorous data-management and analysis to deepen those economic and environmental gains by exploring viable options, informing future decisions and investments, and advancing efficient resource allocation and consumption. Parallel to those efforts, Fairstead engages in synergistic partnerships with innovators and technology incubators to co-create, test, develop, and commercialize new equipment, systems, and approaches that focus on improving efficiency in the construction and operation of residential facilities.

Fairstead's experience and belief suggest that integrating energy and water efficiency technologies and practices can go together with maintaining affordability. Achieving that complementarity objective is possible, however, it requires an alignment between the housing development process and critical external factors and requirements. This is because unlike the high-end market, the pricing and profitability of housing properties within the affordable housing market operate differently. That in turn significantly influences subsequent analysis, management, and arrangements required in residential housing investment and financing. Overall, the options available to maximize revenues and profits from housing properties under affordable housing scheme are somewhat restricted because of the very nature of such programs. Coupled with the high upfront costs involved in integrating energy and water efficiency, those restrictions can eventually limit current and future operating income resulting in a deficit in the amount of funding required and the amount of investment available for a housing developer. As the private financial market may lack sufficient solutions, public policy and public-private financial incentives and structures can serve as appropriate mechanisms to bridge those deficits. Yet, it is important to note that these incentives and financing vehicles can have the potential to catalyze action at scale, especially when paired with private capital.

Despite the high upfront cost involved in retrofitting and developing residential housing in accordance with energy and water efficiency standards and requirements, affordability and sustainability in housing can be harmonized provided that supportive public policy incentive and private capital are put in place. Several policy incentives, financial resources, and funding arrangements are promoted by federal, state, and local authorities to support low-income affordable housing. However, three vital barriers are impeding private housing developers from effectively leveraging those incentives and funding arrangements to deliver energy efficient affordable residential housing. These barriers include: 1) uncertainties compounding the cost-benefit in energy efficiency retrofits; 2) financing and financing related barriers; and 3) barriers related to policy and public incentives for affordable housing.

Although investigating to what extent those barriers impact private housing developers' profitability, access to capital, and investment decisions associated with energy efficient affordable housing is a subject for future research, understanding how those barriers intersect with private housing developers (including Fairstead); federal, state, and local agencies; investors, lenders, and financiers is vital. First, despite substantial strides in our understanding and approach towards uncertainty in the cost-benefit of energy efficiency retrofits; rising costs, tighter credit conditions, supply shortages, and increasing inflation yet remain detrimentally important in many ways in influencing investments in energy efficiency and benefits from these investments. Second, access to capital is a major constraint for many private housing developers operating in the affordable housing domain. Limited access to capital is a function of two interdependent factors: 1) housing developers face shortage of fund due to restrictions on the pricing of properties under affordable housing program which in turn curtail their ability to access and finance loans from financial markets; and 2) lack of low-income housing friendly financial capital and/or less flexibility in existing capital sources inhibit access to capital. Third, the existing policy and public incentives schemes are highly fragmented and cumbersome, as well as are not aligned with the design and construction phases of housing. Thus, requiring developer's extensive time and cost to comply to and benefit from those opportunities. Those public policies and incentives also do not adequately adapt to accommodate fully the emerging needs, opportunities, and challenges that dictate investment and financing decisions within the affordable housing market.

APPENDIX

Semi-Structured Interview Questions

Part I: Overview of the company and housing development approach in NYS

- Explain the residential housing development approach and focus at Fairstead. What is the proportion of building new houses vs renovating/retrofitting existing?
- Describe the type and proportion of residential houses developed (single family, townhouse, and apartments) at Fairstead. What proportion of houses transferred to homeowners via sale and rent?
- Why does Fairstead primarily target medium and low-income beneficiaries? What criteria do you use to categories beneficiaries to medium and low-income? What proportion of the beneficiaries did Fairstead serve in the past years in each category across housing type and ownership status?

Part II: Approach and drivers to sustainability/energy efficiency in residential housing

- What are the energy and environmental efficiency concerns that matter most for Fairstead? What are the driving factors for integrating these issues in Fairstead's housing development approach?
- How is energy efficiency in housing understood at Fairstead? What specific variables do you use to measure energy efficiency in housing?
- Discuss the specific energy efficiency measures Fairstead implements while building new and renovating existing residential housing?

Part III: Linking energy efficiency and housing affordability

- How is housing affordability defined at Fairstead? What are the parameters used to determine affordability? How does purchasing price and rental cost of the houses compare with residents' income in relation to NYS and national median income and average housing price?
- How does Fairstead balance integrating energy efficiency measures with housing affordability? Are energy efficiency and affordability competing or complementarity objective? If so, why?

- Fairstead's mission reads "to provide people a great place to live regardless of income." How does your company address this competing interest to deliver energy efficient sustainable houses that are affordable to these families?
- How does the cost of integrating energy efficiency technologies and practices (upfront cost) in the house affect the total sale/rent price and maintenance cost? (e.g., cost of constructing energy efficient and conventional housing of a same size single family/multifamily/townhouse).
- How does performance of sustainably constructed new and renovated houses in energy consumption and total energy costs compare with conventional facilities? On what parameters do you focus to make performance comparison? (economic, environmental; social; combination; holistic).
- Many developers use projected/models' data over actual data to show energy efficiency and the associated economic benefits/gains. This is often criticized for not revealing real performance of efficiency investment. How does your company handle this?
- What housing assistance (rental assistance or homeownership assistance, subsidy, low-interest loans, and down-payment assistance, and homeownership counseling) does Fairstead provide for beneficiary families?
- What are the major barriers that impede strategies implemented to balance the cost of energy efficiency and affordability of housing?

Part IV: Certifications, policy, and tax incentives for sustainable affordable housing

- What standard protocol (such as LEED or Energy Star) does your company use to assess and certify the energy efficiency of newly built or rehabilitated houses?
- What policy and regulatory incentives do the company obtain from the public to integrate energy efficiency measures in building and renovating residential housing? How do these incentives help to enhance house affordability?
- Policy and regulatory frameworks that favor and disfavor energy efficient housing development. State and federal building codes and regulations that support energy efficient affordable housing development.

- What are the advantages and shortcomings of LIHTC in Fairstead's approach to develop energy efficient affordable housing?
- Do you think a grant and subsidy can be sustainable to address the affordability problem given the problems current scale and trend? What do you suggest to sustainability improve this situation?

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