BUILDING ENERGY EFFICIENCY RETROFITS: Policies and Market Transformation

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Policies and Market Transformation

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LIST OF ACRONYMS

CEAC	Clean Energy Advisory Council
CEF	Clean Energy Fund
C&I	Commercial and Industrial
DOE	Department of Energy
DPS	New York State Public Service Commission
ECM	Energy Conservation Measures
EISA	Energy Independence and Security Act
EPAct	Energy Policy Act
EPC	Energy Performance Contracting
ESA	Energy Savings Agreement
ESCO	Energy Service Company
ESPC	Energy Savings Performance Contract
FEMP	Federal Energy Management Program
FY	Fiscal year
GHG	Greenhouse Gas
GOA	Government Office Administration
GSA	General Services Administration
HVAC	Heating, ventilation, and air conditioning
IDIQ	Indefinite-Delivery, Indefinite-Quantity
MOHURD	Chinese Ministry of Housing and Urban-Rural Development
M&V	Monitoring and Verification
NECPA	National Energy Conservation Policy Act
NYS	New York State
NYSERDA	New York State Energy Research Development Agency
OMB	White House Office of Management and Budget
O&M	Operations and Maintenance
UESC	Utility Energy Service Contract
U.S. REV	United States Reforming the Energy Vision

EXECUTIVE SUMMARY

BUILDING ENERGY EFFICIENCY RETROFIT: POLICIES AND MARKET TRANSFORMATION

Approximately 40% of annual global CO_2 emissions can be attributed to building construction and operation in recent years[1]. The global buildings sector continues to grow, with floor area estimated to reach 235 billion m^2 in 2016[2]. The buildings sector represents a ripe opportunity for decarbonization interventions, and also a huge challenge to decarbonize considering the long-life cycle of infrastructure builds. The building stock in place today will last for decades, which could inhibit decarbonization efforts necessary to meet the global climate goals in line with the latest climate science. In fact, global emissions in the buildings sector will have to decrease to close to zero by mid-century.

China has the world's largest building stock and accounted for 25% of global building stock in 2020. Additionally, approximately 55% of China's existing buildings is likely to remain in use in 2050. Recently, China announced a new 2060 carbon neutrality goal to set the country towards a path of decarbonization, making it one of the few countries to take such ambitious action. To meet the 2060 carbon neutrality goal, the buildings sector needs to peak and decrease its emissions immediately and be fully decarbonized by 2050. How quickly China will be able to decrease emissions from its existing building stock and any planned new buildings will be instrumental for its decarbonization efforts.

This report focuses on lessons from two innovative retrofitting programs that have significantly contributed to market transformation in hard-to-reach building sectors, specifically for public buildings and commercial and industrial buildings. To inform China's 14th five-year plan, we provide two examples from this report on successful building energy retrofit strategies that will also help inform its 2060 carbon neutrality goal.

Compared to new buildings, decarbonizing existing buildings is more challenging for various reasons. For example, the building envelope's efficiency and emissions tend to get locked in from the time it was built. Public sector deep retrofitting requires changes in regulations, policies, and institutional setup in order to create enabling conditions for this work. Examples of successful implementation of deep retrofits in buildings can showcase feasible models that can help transform the market. High-performance and efficient public buildings serve as a proof of concept. There are financing tools for attracting private investment for public buildings and proving the feasibility and cost effectiveness of deep retrofits. Public-private partnerships to help decarbonize the existing building stock constitutes as a win-win for all parties involved, as it helps meet public sector decarbonization goals, and expanded investments in public building retrofits allow the private sector to accumulate more expertise in terms of efficient project design and construction.

In this report, we examine two cases that could provide lessons for different country contexts such as China. First, we investigate United State's (U.S.) Department of Energy's Federal Energy Management Program (FEMP) in detail to give Chinese policy makers some insights on how to create an enabling environment for retrofits in the public sector.

The FEMP experience is particularly relevant to China, as U.S. and Chinese policy makers are facing similar challenges in retrofitting public buildings. Also, institutional setups are similar between the two countries. In the U.S., FEMP under the Department of Energy plays a central role in coordinating public building retrofitting in the U.S., where the General Services Administration (GSA) is responsible for leasing and maintaining U.S. public buildings. Similarly, the Chinese Ministry of Housing and Urban-Rural Development (MOHURD) leads the development of buildings sector policies, whereas the Government Office Administration (GOA) manages public buildings. How FEMP helps coordinate across agencies provide insights into institutional issues related to retrofits in public buildings. Second, a favorable regulatory framework is critical to the success of energy efficiency retrofits in the public sector. Enabling legislation mandates energy efficiency retrofits in public buildings, encourage the use of business models in public building retrofits, and provide budgetary guidance on financing.

The broad enabling legislative framework gives FEMP the authority to act in a central coordination role and provide guidance for public building energy efficiency retrofits that could be instructive in the China context. Third, FEMP uses business models to leverage third-party financing to retrofit public buildings at scale to help decarbonize a significant source of emissions in the U.S. In particular, it streamlines the process of applying various business models (energy performance savings contracts or utility energy service contracts) to fund energy efficiency improvement through cost savings. Finally, FEMP monitors and tracks progress and helps creates an overall system of accountability within the national government. Using databases created by FEMP, the Office of Management and Budget (OMB) creates public agency scorecards that rank agencies' progress towards meeting required energy saving goals.

The FEMP case study investigates the following issues that are critical to energy efficiency retrofits in public buildings:

1) **Policy and institutional framework enables FEMP to deploy energy efficiency in public facilities and improves cross-collaboration in public agencies.** Regulations, such as the National Energy Conservation Policy Act (NECPA), the Energy Policy Act (EPAct), and the Energy Independence and Security Act (EISA) are some key policies that mandate energy saving targets of federal facilities, designate energy managers and/or energy conservation officers within agencies, and authorize the use of public-private financing mechanisms to achieve energy savings. OMB also set budgetary guidance for public agency to use financing mechanisms. These policies have set the national government on a path of progress for building decarbonization.
2) **Financing mechanisms and business models that address financing barriers and scale up retrofits in public buildings.** FEMP provides expert guidance for public agencies to meet energy saving targets through key financing mechanisms, such as utilizing Energy Performance Saving Contracts (ESPCs), Energy Savings Agreement (ESA), Utility Energy Service Contracts (UESCs), and other public-private financing mechanisms. These financing mechanisms allow federal agencies to enact energy efficiency with no upfront costs or special appropriations from Congress. FEMP developed two-stage tendering process and standardized business models to streamline the process of using ESPC and other mechanisms and reduce the transaction costs. In addition to direct technical assistance, FEMP provides robust online resources and training activities to build capacity across agencies and project implementers. As a result, business models such as ESPC are widely used in public retrofit projects in the U.S. Since the start of the national government utilizing ESPCs, there have been approximately 425 projects awarded, and a $7.46 billion investment in the public sector buildings and facilities[3]. On average, comprehensive ESPC projects resulted in an approximate 20% reduction in energy use, and energy-related costs[4].
3) **Enabling a tracking and accountability system to ensure the effectiveness of retrofit projects and track progress of agencies towards their energy saving goals.** FEMP tracks energy efficiency improvement in federal facilities and compiles two datasets with detailed energy information across agencies: the Federal Comprehensive Annual Energy Performance Data and the EISA Federal Covered Facility Management and Benchmarking Data. In addition, the NECPA mandates the use of scorecards to quantify the energy management activities and progress of each public agency to meet its energy reduction targets. This can serve as a motivation for public agencies whose progress and achievement, or lack of, are published publicly, and are also ranked against other public agencies. These efforts have resulted in the federal government achieving a 50% reduction in energy intensity since 1975[5].

Key takeaways from the FEMP case study on specific policy recommendations for developing building energy efficiency retrofitting programs for public buildings:

POLICY RECOMMENDATIONS FOR PUBLIC BUILDING RETROFITS

- Mandate energy saving targets that additionally increase in ambition over time;
- Explicitly encourage use of public-private financing models such as ESPCs through policies and executive guidance;
- Provide budgetary guidance for public institutions to use ESPC and other third-party financing;
- Streamline the procurement process to allow two-stage tendering with an appointed contracting expert team or office that helps facilitate the process;
- Develop technical guidelines and supporting documents to enable use of public-private financing models for public building retrofits;
- Outline roles and responsibilities of respective ministries or public agencies;
- Promote cross-agency coordination through regular stakeholder engagement that establishes dialogue and performs a transparency and tracking mechanism;
- Establish a system to measure and track progress formally through a database system with mandated regular reporting and provide a mechanism for scoring ministry or public agency progress on targets.

FEMP evolved over many decades to provide innovative solutions to address institutional, financial, and technical barriers on a national level. The key conditions explained in the FEMP example have enabled the national government to tackle public buildings at scale, decreasing building emissions from its largest energy user. Though not all of the FEMP case study is directly applicable to China, it sheds light on several issues that are critical to advance energy efficiency retrofits in public buildings in China. Considering the different country context, this example can provide important lessons for the framework that China can implement to successfully decrease its own emissions from the buildings sector. Decarbonizing the buildings sector will be critical to meeting China's long term 2060 climate goal.

The public sector should lead the clean energy transformation with existing proven technologies and models. It has many tools to leverage to help transition the buildings energy efficiency market. It should also help spur innovation, bringing down the cost of technologies in hard-to-reach sectors, and pioneer new models of deployment.

In this report, we also investigate the New York State Energy Development Agency (NYSERDA)'s Commercial and Industrial Carbon Challenge and how it encourages the deployment of novel technologies and complements other NYSERDA programs to transform the commercial and industrial buildings market in New York state.

Buildings currently constitute approximately 60% of the total energy use in New York state[6]. Specifically, commercial and industrial buildings account for 33% of the energy related greenhouse gas emissions in the state[7]. To meet the state-wide goal of improving energy efficiency and decreasing consumption, NYSERDA developed a voluntary challenge mechanism to motivate private investment and provide greater flexibility in allocating public sector sources for highly cost-effective opportunities. Through developing the Commercial & Industrial Carbon Challenge, NYSERDA's strategy for incentivizing private market investments from large energy users has shifted from offering direct incentives, to providing an enabling environment for new technologies and market-based programs for the commercial and industrial sector.

The NYSERDA case study investigates the following issues that are critical to energy efficiency retrofits in commercial buildings:

1) the development of a voluntary incentive framework and strategy for commercial and industrial building retrofits;
2) early and continual stakeholder engagement with private sector entities and primary research has informed the development of a voluntary challenge program to meet the state's overall policy goals;
3) designing a challenge-based program so that companies leverage their own funding and resources and are incentivized to account for their own emissions reductions.

Key takeaways from the NYSERDA case on specific policy recommendations for commercial buildings are:

RECOMMENDATIONS FOR COMMERCIAL BUILDING RETROFITS

- Conduct market research through a mix of primary research and/or robust stakeholder engagement to understand the barriers and readiness of private engagement of commercial retrofit projects and design proper incentives;
- Design and execute pilot projects to test the feasibility and scalability of commercial retrofit projects based on information gathering from stakeholders;
- Provide flexibility for private sector entities within pilot projects to allow for innovation;
- Provide or mandate use of M&V services in order to monitor and track progress;
- Provide a single point of contact or office to help streamline technical assistance and guidance;
- Through proper design of voluntary programs such as competitions or challenges and incentives, private companies can be motivated to engage in retrofitting activities and carbon emissions reductions and accounting
- Gaining technical assistance and the use of public recognition to highlight companies' performance and engagement in public sector initiatives can be a strong motivator for the private sector

The NSYERDA case provides the enabling conditions and key strategies to tackle retrofitting the commercial and industrial sector. This case in particular highlights New York state's policy strategy to motivate the private sector and bring them in closer alignment to its climate and energy goals.

Both cases highlight the successful strategies undertaken by the public sector to incentivize private engagement at different levels of programs maturity. **In both cases we found the following successful strategies for building retrofits.**

Successful Strategies to Incentivize Building Retrofits:

- An overarching, ambitious policy was enacted by the public sector that set specific energy efficiency targets and/or goals that increased in ambition over time.
- In the policy or legislation, or through executive communication, there are clearly delineated roles and responsibilities of various public agencies involved in carrying out the targets and/or goals.
- The public sector can provide a comprehensive set of services, for example, in a program approach, to help address many of the barriers to retrofitting public or commercial buildings.
  - Such services or incentives can include:
    - Funding or financing for retrofitting existing buildings;
    - Monitoring, accountability, and tracking progress towards meeting targets or goals;
    - Technical assistance and support;
    - Opportunity for public recognition, as well as documenting and communicating lessons learned.
- Stakeholder engagement must be executed early, and regularly, to gain buy-in and support and to ensure that the designed policies and programs are accessible and attractive to incentivize the private sector to engage in building retrofits.
- The public sector can develop overall policies and programs that allow for flexibility and innovation for the private sector and incentivize them to bring their expertise to market.
- The public sector can use business models, standardize procedures and processes, and reduce transaction costs that are prohibitive for the private sector to participate in retrofit projects on their own.

These lessons learned can help inform China's strategies to decarbonization its building sector. China has set targets of retrofitting more than 500 million m^2 of residential buildings and 100 million m^2 of public buildings by 2020. However, these programs only cover a small fraction of China's building floorspace and how to finance and coordinate the building retrofits remains a main challenge in the future. Therefore, more ambitious efforts and innovative policy instruments and programs are needed to enhance energy efficiency in existing buildings in China. With its new 2060 carbon neutrality goal, more effort will have to focus on reducing emissions from its large building stock. These cases provide two models of how to develop policies and programs for the buildings sector, especially how to conduct retrofitting activities in hard-to-reach sectors through motivating the private sector to engage in retrofitting activities with the goal of decarbonization.

1. INTRODUCTION

1.1 GLOBAL PERSPECTIVE

Building construction and operation currently accounts for 40% of global greenhouse gas (GHG) emissions[8]. The need to reduce emissions from existing buildings is critical as the large majority of existing buildings will remain in-use by mid-century and China's buildings account for over half of the country's emissions. China's goal to be carbon neutral by 2060 given the inherent lifecycle of buildings and their emissions creates a challenge but a huge opportunity for energy efficiency. Building decarbonization through energy efficiency is an essential mitigation strategy to meet China's carbon neutrality goals. In fact, retrofits will need to be carried out in most existing buildings by 2050 to enable countries to meet net zero goals[9].

Retrofitting buildings with energy efficiency upgrades is more challenging than simply constructing a new building at a more efficient building code or standard, such as a net-zero energy goal or standard. This means modifying the building infrastructure or appliances or equipment to increase overall efficiency or decrease energy intensity. Retrofitting existing buildings with the goal of high-performance, low-carbon or net-zero energy buildings are a priority, as roughly 65% of the total building stock of the largest developed countries is already built today[10]. The scale of this challenge requires rapid deployment of ambitious policies and low-carbon technologies to drive the transition to building decarbonization.

The main barriers retrofitting existing buildings typically include the split-incentive issue, uncertainty of efficiency gains or cost reductions, competing priorities, lack of finance or incentives, and large upfront costs and long payback periods. Any, or a combination of all of these barriers presents a predicament for attracting building developers and contractors to perform the retrofit work, and the private sector may perceive these types of projects as unattractive or too challenging.

According to the International Energy Agency, global investments in energy efficiency is the buildings sector has remained relatively flat since 2016. New or strengthened support for buildings efficiency investment was advanced in Canada, Norway, Spain and Switzerland in 2019, and two-fifths of the overall investments in buildings efficiency was in Europe, where energy efficiency investment growth has outpaced new building construction in some countries[11]. In China, investment in buildings efficiency was 29.9 billion USD in 2019, and private investment in energy efficiency around four times the level of public spending[12]. It is estimated that to reach net zero goals by mid-century, annual investment in clean energy such as building energy efficiency will have to triple by 2030[13].

Private investment in building energy efficiency is a key strategy to addressing a major barrier in retrofitting existing buildings – the need for capital and high upfront costs. This is especially the case in public and commercial buildings, two traditionally hard-to-reach building sectors. Examples of successful financial tools where the public sector leverages its dollar to attract the private sector dollar at scale is evident through use of Energy Savings Performance Contract (ESPCs). This tool has proven an effective method to perform retrofits for the national government.

The main lever of the public sector, however, is designing an enabling environment through legislation and policies to help move the market towards its desired results. Crafting a framework and incentives to attract private investment and technical expertise to tackle large-scale building retrofitting is within public sector control. The role of public policies to help address market gaps, lack of financing, and other barriers to building retrofitting is crucial.

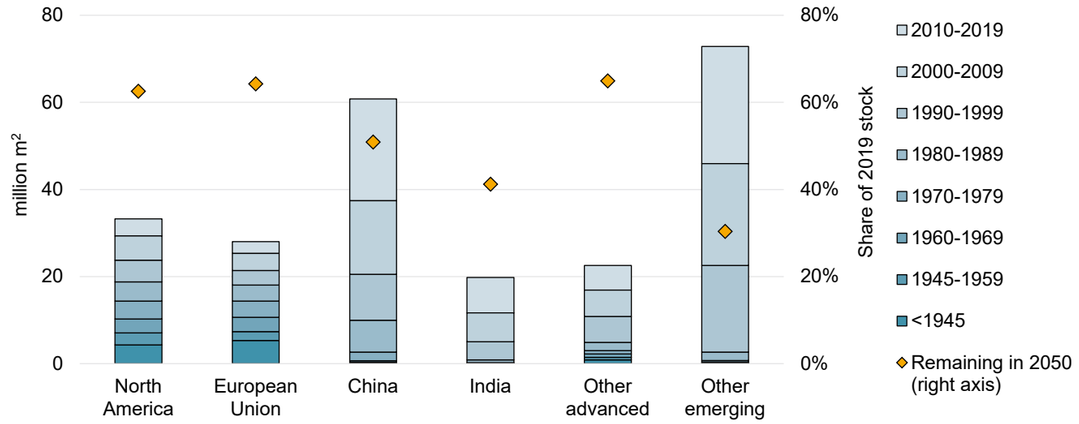
Enabling policies for retrofitting can provide a comprehensive solution for common barriers or lack of incentives for building owners and developers to make energy efficiency improvements. Public sector agencies can offer various types of benefits and incentives designed to engage the contractors and developers to retrofit existing buildings and leverage their technical expertise. These benefits and incentives can take the form of national, state, or city programs containing tools and resources to address common barriers such as financing, and monitoring, benchmarking, and data disclosure. The complexity of barriers means that a program or one-stop-shop approach can be a useful solution to facilitate existing building retrofits.

Therefore, looking at program approaches can be instructive to understand how to address barriers and incentivize building retrofits hollistically. In particular, looking at comprehensive retrofitting programs from a national-level and state-level provide a useful view of the framework, policies, and resources to address hard-to-reach sectors. Public sector buildings and commercial sector buildings are commonly difficult to reach due to the common barriers discussed. These two sectors in particular, are the largest area of opportunity, and the least tackled across the globe from the U.S., Europe, and China.

1.2 CHINA CONTEXT

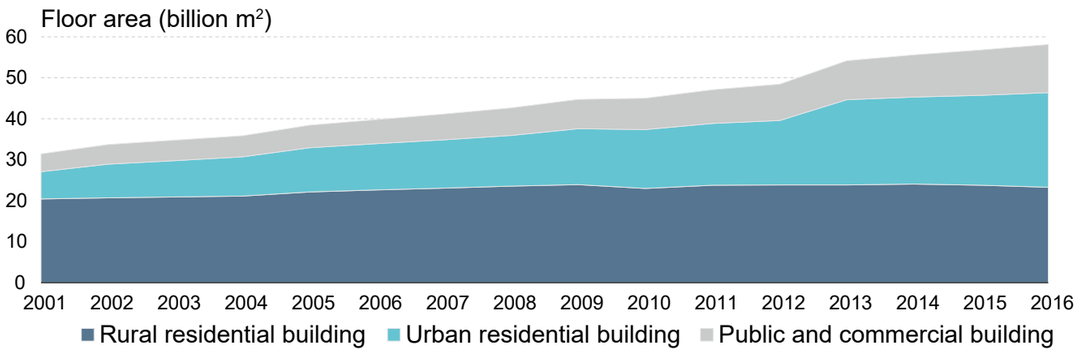
China has the world's largest building stock and accounts for 25% of global building stock in 2020, and about 55% of China's existing buildings is likely to remain in use in 2050 (see Figure 1A). The growth of building stock in China was largely driven by urban residential buildings (see Figure 1B). Decarbonizing buildings in China is not only key to China's 2060 carbon neutrality goal, but also critical to global decarbonization.

FIGURE 1A. BUILDING STOCK BY YEAR OF CONSTRUCTION AND SHARE OF STOCK THAT REMAINS IN 2050



Source: Energy Technology Perspectives 2020, IEA[14]

FIGURE 1B. CHINA'S EXISTING BUILDING STOCK BY BUILDING TYPE (2001-2016)



Source: China Building Energy Use 2018, Building Energy Research Center of Tsinghua University[15]

Compared to new buildings, retrofitting existing buildings is more challenging. The Chinese government has developed a series of policies and programs to promote energy efficiency retrofits in existing buildings and set targets of retrofitting more than 500 million m^2 of residential buildings and 100 million m^2 of public buildings by 2020 (see Table 1). In 2016, Ministry of Housing and Urban-Rural Development adopted the Evaluation Standard for Green Retrofitting of Existing Buildings, which set up standards for comprehensive evaluation and planning of building retrofits. However, these programs only cover a small fraction of China's building floorspace and more ambitious efforts are needed to enhance energy efficiency in existing buildings in China[16].

TABLE 1 BUILDING RETROFITS PLANS AND PROGRAMS IN CHINA.

TITLE	DEPARTMENT OF ISSUE	DATE OF ISSUE	WHAT IT DOES
Medium- and Long-Term Special Plan for Energy Conservation[17]	National Development and Reform Commission (NDRC)	1 November 2004	Implement energy-saving renovation of existing residential buildings and public buildings in combination with urban reconstruction, with the retrofit area objectives of 25% in large cities, 15% in medium cities, and 10% in small cities.
Action Plan for Green Building[18]	NDRC; MOHURD	1 January 2013	During the 12th Five-Year Plan period, the renovation of heat metering and energy-saving for existing residential building in north heating area will exceed 400 million m^2; energy-saving renovation of existing residential building in hot summer and cold winter zone will reach 50 million m^2; energy-saving renovation of public buildings and public office buildings will reach 120 million m^2.
Action Plan for Energy Development Strategy[19]	State Council	19 November 2014	Promote design standard for 75% energy conservation of residential buildings; accelerate the renovation of existing buildings; implement public building energy use limits, green building rating and labeling system; accelerate the reform of heating metering; implement heating metering charges for new buildings and existing buildings after heating metering renovation.
Action Plan for Urban Adaptation to Climate Change[20]	NDRC, MOHURD	4 February 2016	Implement urban renewal and comprehensive transformation of aged residential buildings; raise the renovation standard of energy and water saving for the existing buildings
The 13th Five-year Plan Guideline for National Economic and Social Development[21]	State Council	18 March 2016	Comprehensively implement energy conservation in building and public institutions; implement whole industrial chain development plan of building energy efficiency improvement and green building; complete the energy conservation standard system; increase the building energy conservation standards.
The 13th Five-year Comprehensive Work Plan for Building Energy Conservation and Green Building Development[22]	State Council	5 January 2017	By 2020, the energy-saving renovation area of existing residential building and public building will exceed 500 million m^2 and 100 million m^2.

Successfully retrofitting existing buildings at scale will be critical to realize China's 2060 carbon neutral goal, as buildings represent 30-50% of China's emissions[23]. Deep retrofits create both near-term and long-term benefits for building occupants and owners. The near-term benefits include increased comfort due to more efficient lightening and weatherization sealing, improved indoor air health, and energy conservation and a reduction of cost on energy bills. The long-term benefits also include increased property values for owners due to building retrofits, continued cost-savings that accrue over longer time periods, as well as better health outcomes due to better indoor air quality. For example, making building energy end-uses more efficient and all-electric through installed heat pumps helps reduce emissions from the buildings sector and creates better results for indoor air quality for owners and occupants.

Deep building retrofits also result in significant economic and societal benefits, with positive implications for China's 1.4 billion residents. China has the world's largest population, all who live and work in residential and commercial buildings, thus making the efficiency, cost-savings, and health upgrades in buildings an immense opportunity for improving citizens quality of life. Housing as a building type and improvements to the building stock should be considered a key opportunity for a just transition for China's low-income residents, where substandard living conditions contribute to lesser health and economic outcomes. An policy approach that encompasses not solely an economic and environmental focus but a holistic societal approach that takes into account where people live and work and acknowledges the access to clean, safe, and affordable housing as part of the clean energy transition.

The average building lifetime in China is around 30 years, indicating a high stock turnover rate. On average, around 1.5 billion m^2 of building floorspace was demolished each year in the past decade. Energy efficiency retrofits can help extend building lifetime and avoid early demolition, which would effectively reduce embodied energy and emissions in buildings.

The barriers to building retrofits requires that regulatory, policy, and institutional framework ultimately create enabling conditions for these types of projects. The successful implementation of deep retrofits in public buildings can showcase a feasible model and help transform the market. Retrofitting public buildings to be high-performance, energy efficient and cost effective by attracting private investment serves as proof of concept and progress in this sector. Continued investments in public building retrofits allows the private sector to gain more expertise in terms of efficient project design and construction and allows for economies of scale. The more retrofitting projects and programs advance, the private sector can reap the benefits in terms of continued business in building energy efficiency, and the public sector can meet policy goals for decarbonization.

1.3 CASE STUDY EXAMPLES

In this report, we examine the U.S. Department of Energy's Federal Energy Management Program (FEMP) and the New York State Energy Research Development Agency's (NYSERDA) Commercial & Industrial Carbon Challenge in detail.

The FEMP experience is particularly relevant to China, as U.S. and Chinese policy makers are facing similar challenges in retrofitting public buildings. First, the institutional set-up is similar between the two countries. In the U.S., FEMP in the Department of Energy plays a central role in coordinating public building retrofit projects in the U.S., where the General Services Administration (GSA) is responsible for leasing and general maintenance of U.S. public buildings. Similarly, the Chinese Ministry of Housing and Urban-Rural Development (MOHURD) leads the development of building sector policies, whereas the Government Office Administration (GOA) manages public buildings.

First, we investigate the enabling conditions for FEMP's mandate to coordinate across public agencies that provides crucial insights into overcoming institutional issues related to retrofits in public buildings. Second, we identify the regulatory framework as an example that has been central to the success of energy efficiency retrofits in the public sector. Enabling policies that specifically call for energy conservation or energy efficiency retrofits in public buildings, that encourage the use of business models to perform these projects and financing provide critical enabling conditions for successful retrofitting at scale. Third, the regulatory framework in place provides

FEMP with authority to provide overall guidance and expertise to leverage third-party financing to retrofit public buildings at scale. In particular, FEMP streamlines the process of applying various business models (e.g. Energy Savings Performance Contracts or Utility Energy Service Contracts) to fund energy efficiency improvement through cost savings. Finally, FEMP monitors and tracks the progress and helps creates an overall system of accountability within the national government. Using databases created by FEMP, OMB creates public agency scorecards that rank agencies' progress towards meeting required energy saving goals. Due to regulatory enactments and modifications, and executive communications, FEMP has evolved over many decades to provide innovative solutions that address institutional, financial, and technical barriers to public sector retrofits.

The NYSERDA case study provides valuable strategies for commercial buildings, another hard-to-reach building sector with similar barriers. First, exploring the overarching climate and energy targets, market activation goals, and key public agencies that shape New York state's energy landscape. We investigate the steps NYSERDA has taken to develop strategies specifically for the commercial building sector and incentivize private sector engagement. It is through leveraging its role as a public sector agency, building upon previous models of success in enacting voluntary strategies, and deep engagement with the business sector or solution providers have enabled an innovation approach to leveraging private sector financing for deep retrofit strategies in this commercial and industrial sector challenge. NYSERDA acts in a similar one-stop shop manner to provide measurement and verification (M&V) services, streamlining technical assistance and expert guidance, stakeholder engagement, and highlighting success stories of its partners engaged in retrofit work.

The NYSERDA case is compelling because it illustrates what voluntary structures and incentives could motivate private investment. And the FEMP case demonstrates successful strategies in a similar institutional set-ups as China for a public-private partnership model. Although not every aspect of the FEMP program or NYSERDA approach is directly applicable to the China context, it can shed light on several strategies to address traditional barriers to retrofitting public and commercial buildings, and highlight important criteria to successful retrofitting programs. Energy efficiency is a critical building decarbonization strategy, and these cases provide helpful strategies to advancing building energy efficiency retrofits in China.

2. ENERGY EFFICIENCY RETROFITS IN PUBLIC BUILDINGS: THE U.S. FEDERAL ENERGY MANAGEMENT PROGRAM (FEMP)

2.1 BACKGROUND OF FEMP

The U.S. national government manages over 350,000 buildings and facilities nation-wide[24], making the savings opportunity significant from the public sector. In the mid-1970s, the U.S. Congress took note of the high energy consumption from the public sector and enacted a series of energy policies that were designed to reduce energy consumption and increase energy efficiency of its public buildings and facilities. As Congress recently has been disinclined to appropriate public sector dollars specifically for energy efficiency[25], there arose a need to leverage financing in order to meet legislative mandates to increase efficiency and find cost savings. Few public agencies had sufficient funds in their shrinking budgets for adequate maintenance and repair of public buildings and facilities, let alone the improvements needed to achieve the mandated energy savings[26].

The United States Department of Energy (DOE)'s Federal Energy Management Program (FEMP) has been charged by law to work with public agencies to meet energy-related goals, identify affordable solutions, facilitate public-private partnerships, and provide national leadership by identifying and leveraging best practices[27].

Thus, by design it provides technical and legal assistance for public-private financing mechanisms and energy efficiency and renewable technologies. Understanding the processes of how this office enacts a large-scale retrofitting program for public buildings with energy savings performance contracting can be instructive to other countries like China to reduce energy consumption and increase energy efficiency in public infrastructure.

This case study investigates the following issues that are critical to energy efficiency retrofits in public buildings:

1) The policy and institutional framework that enables FEMP to deploy energy efficiency in public facilities effectively, and improves cross-collaboration in public agencies;
2) The financing mechanisms and business models that address traditional financing barriers and enables retrofits public buildings at scale;
3) Enabling a tracking and accountability system to ensure the effectiveness of retrofit projects and track progress of agencies towards their energy saving targets and/or goals.

TABLE 2. POLICY, INSTITUTIONAL AND REGULATORY FRAMEWORK*

TITLE	DEPARTMENT OF ISSUE	DATE OF ISSUE	WHAT IT DOES
Department of Energy Organization Act	Establishes the Department of Energy	1977	■ Established and consolidated energy policy administration and functions to DOE to achieve a strong national energy program. ■ Required consultations with other agencies to encourage the establishment of policies consistent with a coordinated energy policy, and to promote energy conservation throughout the national government[28].
National Energy Conservation Policy Act (NECPA) amended[29]	Department of Energy, General Services Administration, and others	1978	■ Established energy management measures for the national government and required a preliminary energy audit of all existing buildings. ■ Designated energy conservation officers across public agencies, requires energy training for managers of public buildings and facilities, and established interagency taskforces assess the progress of the various agencies in achieving energy savings. ■ Required public agencies to submit an annual report to that describes activities to meet the energy goals and authorized use of OMB scorecards to help quantify energy management activities and progress of each public agency to meet their energy reduction targets. ■ Required coordination with GSA on building energy efficiency and reports to Congress on energy conservation efforts ■ Encouraged public agencies to utilize ESPCs, UESCs, and other public-private financing mechanisms for the purpose of achieving energy savings.
Energy Policy Act (EPAct)[30]	Department of Energy and its national laboratories, and others	1992	■ Mandated that all public agencies apply energy saving measures to public buildings from 2%-30% from 2006-2015 below a 2003 baseline (amended NECPA) [31]. ■ Included public building facilities and laboratories to fall under requirement for energy savings and required public agencies to install energy conservation measures. ■ Re-authorized the use of ESPCs for energy improvements in public buildings extending use through 2016. ■ Approved procurement of energy efficient products (either ENERGYSTAR or a FEMP designated product). ■ Required energy metering for energy management data collection and reporting.
Energy Independence and Security Act (EISA)		2007	■ Increased energy reduction goals from 2% per year to 3% per year resulting in 30% greater efficiency by 2015 (amended NECPA),[32] and established performance standards eliminating fossil fuel reductions for new public buildings and those undergoing renovations by 80% by 2020 to 100% by 2030[33]. ■ Required public agencies must designate an energy manager to be responsible for implementing the requirements at each covered facility. ■ Permitted agencies to use a combination of appropriated funds and private financing for ESPCs, included seven provisions that provided flexibility in funding ESPCS, increased their contract life and scope, and made their authorization permanent[34]. ■ Required DOE to develop a building energy use benchmarking system for each type of building and to issue guidance for use of the system and comprehensive fiscal year reporting to meet the various energy management requirements in these laws and associated executive orders, and for benchmarking and reporting on evaluations for implementation and reporting efficiency measures at facilities[35].
White House	Office of Management and Budget (OMB) memos	1998, 2012**	■ A 1998 OMB memo, OMB outlined budgetary guidance for public agency use of ESPCs, it also provided guidance for public agencies to consult with FEMP early in the ESPC procurement process[36]. ■ A 2012 OMB memo outlined how it would score ESPC and UESC projects. It requested that FEMP report on energy performance management and cost savings of ESPCs and UESCs and encourages public agencies to coordinate with FEMP on ESPCs[37].

*Note: Legislation has typically been amended or expanded through executive orders, building on energy saving goals or targets, but for the purpose of this table we focused on the enabling policies for key strategies to retrofit public buildings and FEMP's role.
**Note: OMB issues memos regularly, for the purpose of this report we include two that pertained to ESPCs and budgetary guidance and FEMP's role.

2.1.1 Setting energy savings targets

The National Energy Conservation Policy Act (NECPA) established in 1978 was the first comprehensive legislation that created a set of measures designed to improve energy efficiency in public buildings[38]. NECPA was the lynchpin for retrofitting public buildings on a national scale. It was amended by the Energy Policy Act (EPAct) of 2005 to mandate that all public agencies apply energy saving measures to existing buildings in the period of 2006 to 2015 to achieve reductions below a 2003 baseline[39]. The Energy Independence and Security Act (EISA) in 2007 increased the federal energy reduction goal from 2% per year established by EPAct in 2005 to 3% per year, resulting in 30% greater efficiency by 2015[40]. In addition, over decades, several Executive Orders have utilized the power of the Executive Branch to build on energy savings goals for the national government, setting new targets to spur further energy savings for the national government[41].

2.1.2 Improving cross-agency coordination

Enabling legislation and coordinated assistance help address retrofitting challenges in public buildings. Therefore, FEMP acts as a one-stop shop to coordinate public building retrofitting. Cross-agency collaboration and coordination is important for sector regulatory changes. FEMP chairs several interagency energy management taskforces with energy managers and representatives from various public agencies for the sole purpose of coordinating the energy savings of existing public sector buildings. This regular coordination allows FEMP to collect and disseminate information to public agencies on contracting best practices and energy efficiency technologies. Key public agency relationships for the purposes of public building retrofits include FEMP and OMB, and FEMP and GSA. FEMP and OMB work closely on reporting requirements for the national government. FEMP also works with the GSA to coordinate on retrofitting public buildings.

FEMP and the GSA both have responsibilities for improving public building infrastructure. FEMP is charged with coordinating and promoting energy savings for public buildings. However, the overall operation and leasing of public buildings is In GSA's control. In effect, GSA is the acting landlord, and FEMP coordinates energy improvements in public buildings and works with agencies to initiate contracts. GSA focuses on managing and maintaining public buildings while FEMP helps those buildings become more energy efficient. Ensuring a smooth delivery of energy savings for public buildings and coordination between these two agencies is important. Some of the public-private financing mechanisms that FEMP coordinates are implemented through the GSA contracting process, while following overall ESPC standards and best practices.

Early interactions with FEMP in the ESPC process help to reduce some of the overall transaction costs in some of the initial stages of contracting, which is where FEMP has a key leverage point and can provide value. This is a critical strategy to eliminate redundancies and streamlining processes for energy service companies (ESCOs), which in turn creates an incentive for them to engage in public sector projects. For ESCOs, once some of the transaction costs are eliminated, public sector projects are attractive to bid on considering that the contracts are long-term, high-dollar contracts.

FEMP provides overall guidance on energy efficiency and renewable energy technologies, training and financing support for public agencies engaging in public-private contracting agreements such as ESPCs, UESCs, and other energy saving activities. FEMP helps implement mandated targets for energy savings through stakeholder engagement with other public agencies, and standardizes and streamlines processes for the public agencies. This allows FEMP to assess progress among the agencies towards achieving energy savings, collecting and disseminating information in coordinate with the White House to promote energy savings.

2.1.3 Facilitating ESPC and other public-private financing mechanisms for public sector retrofits

FEMP facilitates and provides training on the use of ESPCs and other financing mechanisms for public agencies to take advantage of these tools to promote building retrofits.

2.1.4 Allowing long-term contracts for deep retrofits

Legislation that encourages the use of a performance savings type contract for the purpose of energy improvements and cost savings has proven to be key. Current legislation enables a longer-term contract which allows for deeper, more comprehensive set of energy conservation measures (ECMs)to be enacted. NECPA allows for ESPCs to last a maximum of 25 years with many projects exceeding 10 years. Additionally, FEMP facilitates, and has expertise in a few different financing mechanisms that allow for flexibility in terms of public agencies procuring one ECM or bundling several measures into one contract.

2.1.5 Streamlining procurement process

Typically, a building owner or in this case, a public agency would have to pay upfront for the costs of procuring, installing, and commissioning ECMs such as lighting, heating, ventilation, and air conditioning (HVAC), building controls, roofs, and windows from their own budget. This is a barrier for public agencies that do not have appropriated funds to do building efficiency upgrades. There can also be a lack of incentive to make these types of upgrades because the cost savings are not readily apparent. With ESPCs, the ESCO shoulders the upfront cost and burden of procuring and maintaining the equipment and performing the work within an agreed upon timeframe in an ESPC. In addition, in public sector ESPCs, the ESCO will guarantee the cost savings from the project and if for any reason the costs exceed the savings, the ESCO agrees to pay the costs out of pocket. This makes it a no-risk endeavor for the public agency.

FEMP works with public agencies to help streamline the ESPC process for both the public agencies and ESCOs to be able to utilize ESPCs. The goal of the ESPC program is to ensure procurements are as practical and cost-effective as possible. For ESPC indefinite-delivery, indefinite-quantity (IDIQs) there have been several procedures that have been standardized to reduce transaction costs for all parties. This type of contract has also been referred to as a “super ESPC”. The IDIQ arrangement includes an undefined number of services over a long-term fixed amount of time of up to 25 years, allowing for innovation and flexibility within the contract.

2.1.6 Setting budgetary guidance

In 1998, OMB provided a budgetary guidance memo for public sector use of ESPCs. The existing law authorized use of competitive, multi-year ESPCs as long as agency funds are available and adequate for payment of the first fiscal year costs. It requires Congressional notice for any contract that exceeded $750,000 and required agencies to report on those contracts semi-annually to OMB. The guidance OMB set forth pertains to agencies use of discretionary spending and ESPCs.

OMB set the guidance that ESPC funding would be from discretionary spending. Therefore, for public agencies, there must be sufficient discretionary budgetary resources to complete the first fiscal year’s contract costs; and for each of the subsequent fiscal years, discretionary budget authority and outlays will be recognized annually to the extent that payments are made on the contract[42]. Over time, the ESPC would inevitably reduce overall energy costs whereas the Congressional appropriations is varied annually[43].

2.1.7 Mandating reporting and evaluation

Several key policies have mandated comprehensive reporting on energy savings for the purpose of tracking and reporting on progress to meet targets. Therefore, M&V is mandatory for public buildings. In addition, regular reporting helps articulate the cost savings of a project. Aging infrastructure is inefficient and costly to maintain, and deferred maintenance will lead to greater costs in the long-term. All the while public agencies may face decreasing budgets for operations and maintenance (O&M) as well as for utility or energy costs. These types of improvements can increase the resale value of the building or facility and cost of O&M for the public agency.

NECPA in 1978 and EISA of 2007 required comprehensive fiscal year reporting to meet the various energy management requirements in these laws and associated executive orders, including benchmarking and reporting on evaluations for implementing and reporting efficiency measures at facilities[44]. In 2007, EISA amended a section of NECPA to require FEMP to issue guidance on a requirement for public agencies to identify "covered facilities" that constitute at least 75% of their total facility energy use as subject to the

requirements of the statute[45].

EISA instructed DOE to develop a building energy use benchmarking system for each type of building and to issue guidance for use of the system by 2008. EISA requires public agencies to report progress toward these requirements using the FEMP's tracking system including:

1) Estimated costs and savings for projects;
2) Measured savings for implemented projects;
3) Annual benchmarking information for buildings[46].

OMB has reinforcing these policies by issuing memos that provide further guidance, and will occasionally issue new policies such as new energy goals. For example, its memos have required public agencies to report to FEMP for the purposes of tracking energy savings and providing annual scorecards that ranks public agency performance. FEMP coordinates with OMB to track and report on public agency progress towards energy goals. This creates an important transparency mechanism. If policies mandate the use of annual and comprehensive benchmarking, tracking, and reporting, energy management of public buildings, cost savings, and other benefits and performance measures, these important measures can be tracked, utilized, and reported.

This data collected by FEMP can be utilized for different energy-related purposes and in this case, it is used for scoring public agency performance towards meeting energy goals. FEMP maintains a tracking system and provides training and issues guidance on how to use these data systems. Ultimately the streamlined and aggregated results provided by FEMP help simplify the process for public agencies and helps to highlight their process made towards their energy savings goals.

2.2 OVERVIEW OF FINANCING MECHANISMS

Over the past few decades, FEMP has developed expertise in contracting for ESPCs to unlock public building retrofitting at scale. However, FEMP facilitates a diversified set of financing mechanisms and models to improve energy efficiency and renewable energy deployment in public buildings and facilities (Table 3). These mechanisms have been developed to serve projects with different sizes, structures, and time periods that provide flexibility for agencies.

TABLE 3. DIFFERENT TYPES OF FINANCING MECHANISMS

DIFFERENT TYPES OF FINANCING MECHANISMS				
	ESPC IDIQ	ESPC ENABLE	ESPC ESA	UESC
Financing Size of Project	At least $2 million-no maximum award	At least $200,000	Unspecified	Unspecified
Purpose	Allows public agencies to procure energy savings and building improvements through partnering with ESCOs, with no up-front capital costs or special appropriations from Congress.	Same benefits of a ESPC IDIQ however there are no size or cost limits, so ESPC ENABLE is suitable for smaller projects.	A power purchase agreement for energy savings. It follows an Energy Savings Agreement project structure.	Limited-source contract between a public agency and utility for energy- and water-efficiency improvements and demand-reduction services.
Energy efficiency and/or renewable energy technologies covered	Yes	Yes	Yes	Yes
Project contract period	Up to 25 years	Up to 25 years (though public agencies could see realized energy savings in 6-12 months)	Less than or equal to 20 years. Other ECMs could be contracted for up to 25 years, as allowed by the ESPCs.	Up to 25 years
Procurement process	Task orders are administered under ESPC IDIQs	Under GSA contract implementation, but follows general ESPC requirements	Under GSA contract implementation, but follows general ESPC requirements	Under GSA contract implementation, but follows general ESPC requirements

Source: Energy.gov[47,48]

ESPCs can be a useful tool to address an aging public building stock along with increasing maintenance and operating costs, while utilizing private sector technical expertise that is low risk to the public sector. The three types of distinct ESPCS are ESPC IDIQ, ESPC ENABLE, or ESPC energy savings agreement (ESA) as shown above in Table 3. ESPCs are a third-party financing mechanism that allows building owners or public agencies to fund energy-saving improvements. ESPCs are a critical financing mechanism that agencies can take advantage of with an ESCO to deliver energy savings in buildings.

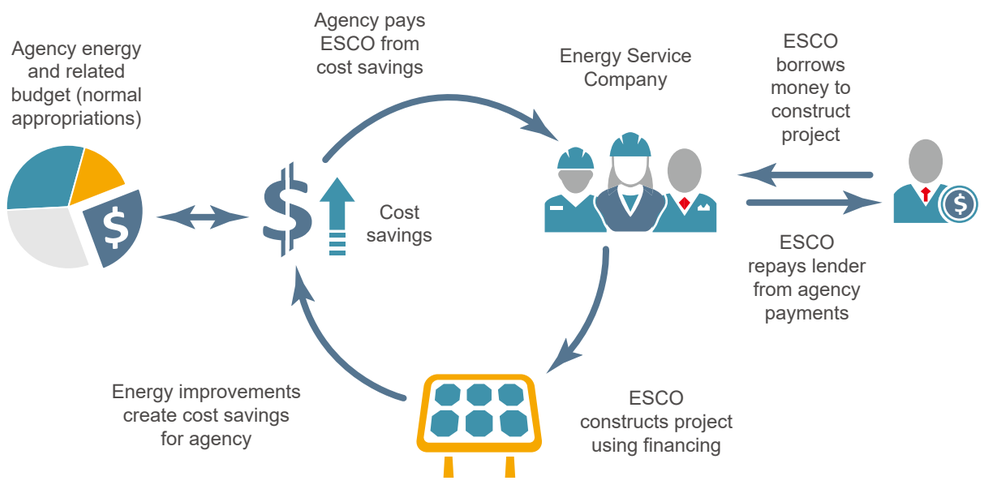
TABLE 4. KEY CHARACTERISTICS AND BENEFITS OF ESPCS

KEY CHARACTERISTICS	KEY BENEFITS
■ The legislated purpose is to achieve energy savings and ancillary benefits. ■ Savings guarantees are mandatory. ■ The measurement and verification process is mandatory. ■ Savings must exceed payments for each contract year. ■ Contract term cannot exceed 25 years.	■ Infrastructure improvements that can pay for themselves over time. ■ Ability to purchase long-payback-period equipment by bundling with short-payback-period ECMs. ■ Reduced vulnerability to budget impacts from utility rate hikes and extreme weather. ■ Enhanced ability to plan and budget accounts. ■ Guaranteed cost savings and equipment performance from the energy service company.

Source: Energy.gov[49]

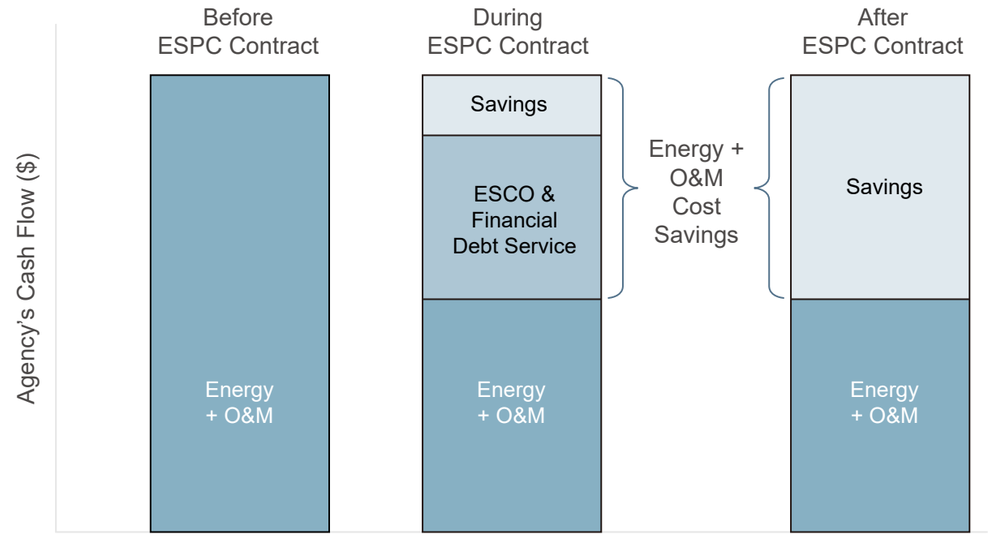
The following section discusses the ESPC IDIQ contract in detail, highlighting how this contracting mechanism, as well as other similar mechanisms, addresses institutional and financing barriers and reduces transaction costs.

FIGURE 2. HOW THE ESPC PROCESS WORKS AND THE ROLES OF EACH PARTY



Description: The process for procurement of ESPCs includes the energy services company (ESCO) structuring and financing the project's energy savings, saving the agency the upfront cost of purchasing equipment or installing measures itself. The public agency pays the ESCO back out of the cost savings accrued by the project, which the ESCO guarantees at the onset of the project. ESPCs allow the public sector to finance energy projects without using appropriated budget funds. Source: Energy.gov[50]

FIGURE 3. HOW ESPCS PROVIDE GUARANTEED COST SAVINGS



Description: This figure demonstrates the before, during, and after savings from an ESPC. Therefore, public agencies only stand to benefit from utilizing ESPCs to retrofit and improve their public buildings because there are realized cost savings. Source: NREL[51]

2.3 FEMP'S ESPC IDIQ PROGRAM

2.3.1 Overview of ESPC IDIQs

The following section will mainly cover the ESPC IDIQ process, which serves as a type of umbrella contract for public agencies. Many of the key procedures of an ESPC IDIQ are similar to other types of ESPC mechanisms, as well as the stakeholders and benefits. Some of the key features of ESPC IDIQs are its flexibility. For example, a one-time energy saving measure that an agency was considering installing on its own, could be included in an ESPC IDIQ contract and then paid within that project. With the ESCO guaranteeing the cost savings, the agency's payments to the ESCO can be negotiated as being less than the guaranteed savings, minimizing risk and costs to the public agency, from energy savings. In addition, ESCOs are encouraged to propose comprehensive and innovation solutions to public sector projects. Throughout the process, the core competencies of each party and ownership of the process are maintained and supporting documentation occurs at each stage of the project.

2.3.2 Roles of stakeholders

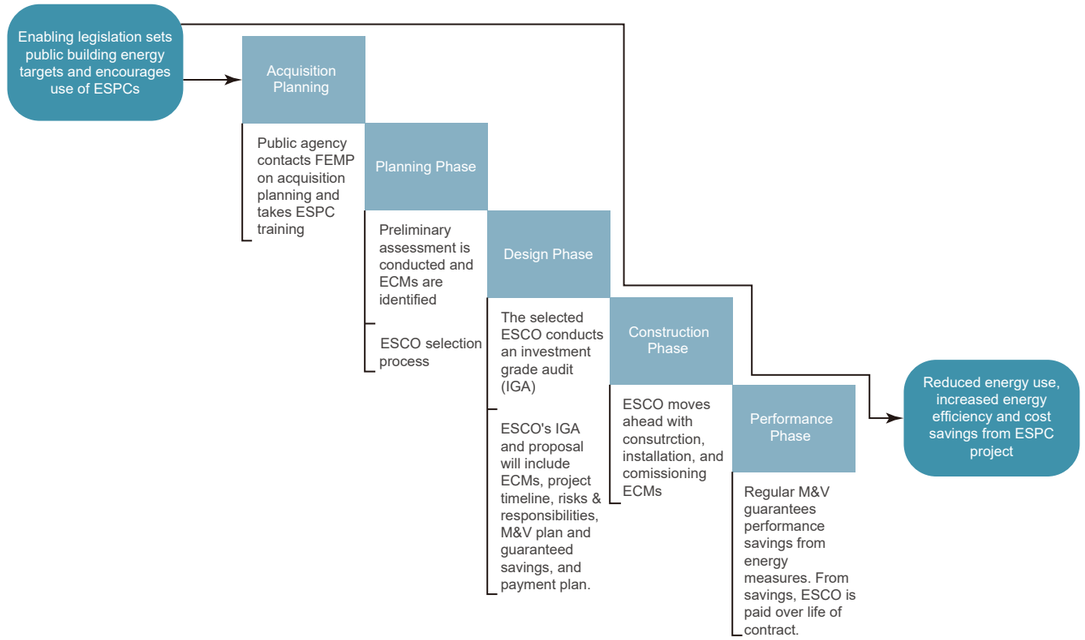
There are three main parties, including FEMP, the ESCO, and the public agency that is ordering the ESPC, involved in the ESPC IDIQs process. Each party involved in the ESPC process plays a critical and unique role. There may be even more parties involved, such as a third-party financier if the ESCO is not financing the project directly (shown in Figure 2), DOE national laboratories that FEMP may enlist for their energy technology expertise, or GSA who leases and maintains public buildings on behalf of the national government. However, these three main parties are central for understanding the ESPC program as a whole.

For example, FEMP provides training and assistance on the administration of ESPCs and on other financing models, training on its data tracking platforms for monitoring & verification, and other energy-related training to public agencies. However, the public agency is the one initiating the ESPC, documenting the process, making payments to the ESCO, and conducting M&V and reporting on progress. The ESCO is the one with the expertise and resources to install energy saving measures in the public agency facility, conducting operations and maintenance and M&V. FEMP serves as a facilitator of the overall ESPC process, providing critical expertise, however the contract is between the agency and the ESCO.

Each party – the public agency, ESCO, and FEMP – is key to the success of the ESPC program. Its organized to build up capacity within the public agency, ensuring that there is a capacity within the public agency to contract with the ESCO for a smooth delivery of services, and greatly relies on the ESCO for its expertise in designing and installing large-scale energy saving projects. Core competencies of each party is maintained throughout the ESPC process. And FEMP providing training and expertise on ESPCS and overall coordination among these parties helps ensure high-value and long-term energy savings projects.

2.3.3 Overview of the ESPC IDIQ process

FIGURE 4. OVERVIEW OF THE ESPC PROCESS



Description: this figure illustrates the overall process of FEMP's ESPC program. Enabling legislation sets the stage through public building energy targets, and importantly encourages the use of ESPCs. Through FEMP's role streamlining processes at various stages of acquisition, planning, design, construction, and performance, contracts entered by public agencies and ESCOs to perform retrofit projects in public buildings results in reduced energy use, increased energy efficiency and cost savings.

The Planning Phase: Procurement

In the initial project planning, FEMP encourages public agencies to assign a primary contact or team within their organization that is responsible for overseeing the project, including (1) maintaining contact with FEMP throughout the life of the ESPC, and (2) maintaining continuity of documentation and awareness of the ESPC throughout the performance period[52]. On their end, FEMP can provide technical and legal expertise in ESPC contracting and knowledge of best practices in engaging with ESCOs. In addition, FEMP utilizes national laboratory expertise for technical assistance on energy technologies. With their overall assistance, the public agency outlines the project scope and sets the general parameters and issues a notice of opportunity.

Public agencies will post the notice of opportunity and all ESCOs that have been pre-screened and pre-qualified by FEMP are eligible to bid on the opportunity. Regardless of how many ESCOs respond to the notice, after interviews and down-selecting, only one or two ESCO will move forward to perform a preliminary assessment for the agency. There are a couple of public sector selection methods for ESCOs, however FEMP recommends qualifications-based criteria as public agencies have had the most success with this selection method for choosing an ESCO to perform the work.

BOX: HOW PRE-QUALIFYING REDUCES TRANSACTION COSTS AND INCREASES TRANSPARENCY

ESCOs who undergo a pre-selection process are eligible to bid on public sector contracts. Public sector projects can range in terms of costs and resources but can be a lucrative contract for ESCOs. The project cost of service is usually greater than $200,000, however there is no up limits on the award of an ESPC. The largest award to date has been approximately $344 million in FY2019[53].

ESCOs can apply to be on the pre-qualifying list at any point of the year. The process to become pre-qualified includes completing standard forms on their qualifications and references. ESCOs must have prior experience with ESPCs and installing ECMs in general, and with the type of facilities that are typical in public sector agencies such as office buildings and other relevant types of facilities. Experience with both designing and installing full scale projects is also a requirement. The applying ESCO must be the main contractor and point of contact.

A DOE qualification review board evaluates ESCO applications to be on the official ESCO pre-qualified list. This enables them to bid on public sector notice of opportunities. The review process typically takes three months. The board evaluates the ESCO on its previous client's rating of their work and past experience applicable to public sector energy savings projects. FEMP requires that ESCOs re-qualify annually to bid on public sector contracts.

Another requirement is that ESCOs must not be at risk for insolvency, reduces risk for the public sector. ESCOs must also be in good financial standing. The process and standards FEMP implements to qualify expert ESCOs to bid on public agency projects reduces transaction costs for both public agencies and ESCOs, especially in terms of the overall bidding process. It increases the overall transparency for both the public and private sector.

Public agencies are encouraged to keep the initial notice of opportunity as broad as possible to allow ESCOs to propose comprehensive and innovative solutions[54]. From the beginning of the process, initial communications between FEMP and the public agency, the ESCO and FEMP, and the public agency and the ESCO are encouraged. This helps set expectations and scope the project. With FEMP's assistance, the public agency can understand the general ESPC process, establish the preliminary scope and goals for the project, determine a payment plan, and develop support and identify a team within the agency needed to successfully initiate a project.

The agency conducts an initial meeting with the ESCO, and afterwards the ESCO will conduct a site visit and submit its preliminary assessment. The ESCO is responsible for identifying energy saving opportunities within the agency's facilities and ultimately guarantees the cost savings. Through an ESCOs prior technical expertise of implementing ECMs in projects, they will propose specific ECMs for the agency's building or facility. Typical ECMs include energy efficiency measures like lighting, HVAC and equipment, water conservation measures, and solar photovoltaic. This is negotiated prior to the execution of the project during the preliminary assessment.

The agency reviews the preliminary assessment and then determines viability to move ahead with the project. FEMP will check that the proposed ECMs identified by the ESCO fall within the scope of the approved task list. This is useful because public agencies do not have to be knowledgeable about what constitutes an ECM and/or their building or facilities' energy consumption. Since other agencies' missions focus on other critical public policy areas but not necessarily on energy technologies and conservation, FEMP's energy and contracting expertise and coordination role plays and important role in implementation of ESPCs.

In terms of the public agency and ESCO, at this point they are both acting under good faith, in that 1) that the project has been scoped to the best of the public agency's knowledge (assisted by FEMP); and 2) the preliminary assessment conducted by the ESCO is to the best of their expertise. The continued communication among all parties and initial scoping of ECMs can provide the ESCO some reassurance that the project will move forward. However at this point, the public agency is under no obligation to contract with the ESCO.

The Design Phase: Project Development and Planning

The public agency will select one ESCO to move forward to the project development and planning stage. The ESCO will conduct an in-depth site survey and investment grade audit. It details the ECMs that the ESCO will install and guarantees the cost savings from the ECMs to the agency. This is considered the ESCO's baseline assessment. This is both a costly and resource-intensive activity from their side. It details the O&M roles of both the ESCO and the public agency. O&M tends to be a long-term resource-intensive activity. By this point of the process, there has been regular communication between parties, so in effect, the ESCO is accepting the opportunity cost of the work in a pre-award period. For the ESCO in particular, their reputation can carry forward for future projects, so they have incentive to be transparent and provide a quality baseline assessment.

The ESCO's baseline measurements conducted at the site visit are also independently verified by the public agency. Then the ESCO submits an official proposal with the audit included, which is reviewed. The payments to the ESCO can be negotiated to be lower than the cost savings seen throughout the life of the project, which is known after the ESCO submits their baseline assessment. FEMP assists the public agency on ESPC financing and contracting. The public agency can pre-negotiate their payment plan and amount to the ESCO before the project begins. This is a critical juncture where all contract items are negotiated, reviewed, verified between the public agency and the ESCO until a final agreement is reached.

Communication and coordination among parties occurs before the proposal is submitted – after the initial notice of opportunity through contract approval. This essentially ensures that there will be alignment of expectations from all of the parties involved. Clear roles and responsibilities are laid out in the risk responsibility and performance matrix (RRPM), which summarizes all the various risks in the contract, and assigns and clarifies who is taking what risk. The RRPM will establish the overall project timeline. The public agency reviews and approves this step. This eliminates some of the ESCO's risk in guaranteeing costs, by assigning and clarifying O&M and M&V roles and responsibilities. In this step, the ESCO submits the project design and overall package for approval by the public agency.

If the public agency decides to move forward with the selected ESCO's proposal, the notice of intent to award and the task order request for proposals is issued. The public agency will then notify FEMP of the proposed task order amount and move the project to the construction phase. Then FEMP will provide an authorization to award the project, the ESCO will sign the task order, and the agency will award the task order.

As shown in Figure 4, this pre-award period where acquisition, planning, and design take place helps reduce transaction costs. This is where FEMP's expert coordination and standardization comes into play to help streamline the overall ESPC process and provides valuable cost savings to both the public and private sector.

Construction Phase: Project Implementation

In the start of the construction phase, the ESCO moves forward with installation of the ECMs in the project timeline. During this period, ESCO may also perform services such as O&M or M&V, all of which have been agreed upon in the contract. The roles and responsibilities of who conducts the O&M and M&V have been clarified among the public agency, the ESCO, and FEMP in prior stages. FEMP continues to act as a facilitator of the ESPC process throughout the project, even though the agreement is between the ESCO and the public agency. Therefore, work continues to be enacted by all three parties, however in this stage, ECMs are implemented, as well as other services as agreed upon for building retrofits.

Performance Phase: M&V

M&V for ESPCs are required by legislation, and built-in to the project from start to finish. Public agencies assign a witness to accompany the ESCO during the baseline assessment, post-installation M&V activities, and annual M&V activities. This is not for real-time approval of the ESCO's M&V activities, but to provide an independent verification from the public agency. FEMP provides training and guidance for proper M&V activities and part of the capacity building aspect for public agencies as part of the overall ESPC program.

The public agency will inspect all of the installed ECMs and compare them against the ESCO's proposal of cost savings. They will compare the proposed results from ECMs in the investment grade audit to the actual results in M&V checks throughout the performance period. This verification is used to sign-off on payments to the ESCO. This is critical as the ESCO has guaranteed cost savings to the public agency, and if costs exceed the baseline measurements, then the additional costs will come out of the ESCO's pocket. The ESCO will complete and submit periodic M&V reports to the public agency through the performance period, and even after if agreed upon as part of the contract. The various checks and reviews occur among all parties to help counterbalance the reviews and create transparency.

If necessary, the public agency and ESCO can reconcile shortfalls in performance or savings. FEMP would play a role and assist in that reconciliation process. The public agency would administer task order modifications as needed. Once the project is complete, the agency closes out the ESPC IDIQ task order and notifies FEMP of project completion.

BOX: DOCUMENTATION IS CRITICAL FOR ESPC PROJECTS

A key feature of ESPC IDIQs is the long timeframe for projects, which can last up to 25 years. Over the course of the project, it is critical to have proper documentation over the lifetime of the project. From initial communications at the preliminary assessment through the audit phase, through to the project initiation and construction, M&V checks, task order modifications, to the close-out of the project, are key procedures to document. The lifetime of the project makes it likely that there will be changes in personnel among the different parties, therefore having detailed records allows other personnel from any party to pick up at various points of the project and move it forward successfully. Additionally, if each party documents the process, it makes it easier to refer back to various stages of the performance period for clarity around the intent of the project and its scope. The public sector is encouraged to conduct adequate record keeping for transparency. For FEMP, this task would likely fall on the contracting officer. And for the public agency, it would be the designated contact and/or team for managing the ESPC contract with the ESCO. Of course, the ESCO is also in charge of maintaining records on roles and responsibilities and M&V. Through the course of the project, documentation can be used to re-evaluate projects if needed, and/or gather lessons learned for the dissemination of ESPC best practices.

2.4 OTHER BUSINESS MODELS

2.4.1 ESPC ENABLE

Public agencies who want to make building improvements and see energy savings in a matter of months, not years, might use an ESPC ENABLE contract. This type of contract is more suitable for smaller facilities (such those less than 200,000 square feet, although there are no specific size restrictions[55]) and installing targeted ECMs and renewable energy technologies like solar through a standardized and streamlined process. A key feature of an ESPC ENABLE project is that agencies can target a specific small facility or bundle many small facilities into one contract. However, the features that are attractive for agencies and useful for ESCOs still apply, such as no upfront costs to the public sector and the guaranteed energy cost savings are sufficient to pay for the project, the ECMs are identified, designed and installed by the selected ESCO, and M&V to ensure that energy savings are achieved[56]. The difference between ESPC IDIQ and ESPC ENABLE mainly is the scope and timing of projects, however both leverage FEMP's expertise and technical assistance in streamlining the overall process.

2.4.2 Other types of public-private financing that leverage utilities

Other financing mechanisms that FEMP coordinates are the ESPC Energy Sales Agreement (ESA) and the Utility Energy Service Contracts (UESC). Both types of financing engage utility services and leverage the role of the public sector in terms of streamlining processes and implementing standard procedures that has been shown to be instrumental in the ESPC program success.

An ESPC Energy Sales Agreement (ESA) is similar to a power purchase agreement. Unlike traditional ESPCs, the ESA ECM is initially privately owned for tax incentive purposes, and the public agency purchases the electricity produced from a utility[57]. There is a similar bundling feature to ESPC ESAs, where agencies can procure a single ECM within the ESPC ESA contract that is site-specific, or bundle several ECMs. An agency would consider an ESPC ESA if interested in cost savings through an on-site distributed energy source, have limited long-term contracting authority options, lack upfront capital for such a project, and think that the project might benefit from tax incentives[58]. The ESCO would have to be eligible for tax incentives and ultimately be responsible for obtaining, for example, renewable energy tax credits. If applicable to the project, the tax credits could lower the cost of the contract for the public agency. Many key features of an ESPC authority apply to an ESPC ESA contract, including the multi-year contract, no required upfront capital, and guaranteed cost savings.

Another financing mechanism that FEMP has expertise in is UESCs which occurs between agencies utilities for energy efficiency and water efficiency improvements, and other energy services like demand-reduction services[59]. The enabling policy for UESCs is the Energy Policy Act (EPAct) of 2005, and because the arrangement is between the agency and the utility, these contracts fall under GSA contract implementation. It allows agencies to pay for the services over time, either on their utility bill or through a separate financing agreement[60]. It leverages similar FEMP key competencies such as streamlining and standardizing processes, and utilities take a similar role as ESCOs in terms of designing and implementing energy efficiency measures, or ECMs, to improve public sector infrastructure.

2.5 TRACKING PROGRESS AND ACCOUNTABILITY

2.5.1 ESPC program success

These types of performance contracts for energy savings are a useful tool to modernize aging infrastructure, meet new energy targets and/or goals to reduce energy waste, and address budgetary concerns. For infrastructure improvements such as public building retrofits, FEMP's facilitation of public-private financial partnerships have been successful in allocating billions of dollars of energy efficiency improvements, promoting cost savings and innovation.

Since the inception of the ESPC IDIQs, there have been approximately 425 projects awarded, and approximately a $7.46 billion investment in public sector infrastructure[61]. On average, comprehensive ESPC projects have resulted in about a 19-20% reduction in energy use – and energy and energy-related costs[62]. Beyond just energy savings, there are the ancillary benefits that have positive impacts such as improved indoor air quality, improved worker productivity, and greater resiliency to factors such as extreme weather events and fluctuating energy prices.

Fiscal year (FY) 2020 has been the most successful year in the 24-year history of the DOE IDIQ ESPC program. The total ESPC project investment value for FY 2020 is nearly $842 million, which is the third consecutive record year in program history[63]. The total ESPC project investment value for FY 2019 and FY 2018 was nearly $819 million and nearly $810 million respectively[64]. This is evidence that the use of ESPCs to retrofit public sector infrastructure projects is growing in both adoption and success. And findings show that projects have more savings that initially scoped and guaranteed by ESCOs. For example, in 2018, of the 172 projects that year, the total estimated cost savings were $298.4 million, total reported cost savings were $296.1 million, and total guaranteed cost savings were $274.4 million[65]. Therefore, the cost savings guaranteed by the ESCOs in 2018 were actually exceeded by the actual cost savings from the ESPC projects. This was a win-win for all parties involved.

The role that FEMP has played in streamlining the ESPC program has helped moved the market forward for this public-private partnership financing mechanism, and has helped ESPCs become a well-adopted tool and success story in retrofitting the public sector building stock.

Enabling legislation and policies has been the basis for creating a system of transparency and accountability, such as NECPA, EPAct, EISA, and associated executive orders[66]. These policies require public agencies to benchmark and report on progress, which FEMP then communicates on public agencies' progress towards meeting energy saving goals. FEMP is placed in charge of several different tracking and accountability mechanisms, working with public agencies and providing technical assistance and guidance for how to use them. Part of the role that FEMP performs is both an aggregator and a disseminator of information through engagement with other agencies. It plays a crucial interlocking role, helping to create an overall system of accountability within the national government.

FEMP provides two data platforms for aggregating data, the Federal Comprehensive Annual Energy Performance Data, and the EISA Federal Covered Facility Management and Benchmarking Data[67]. Additionally, beyond the initial enabling legislation, White House Executive Orders passed over the past decade have strengthened and expanded efforts to reduce energy waste, promote energy and water efficiency and overall sustainability goals in public buildings and facilities.

OMB utilizes the database results to create public agency scorecards that rank their progress towards meeting required energy saving goals. This can serve as a motivation for public agencies whose progress and achievement, or lack of, are published publicly, and are also ranked against other public agencies. It also demonstrates overall progress on energy savings goals. For example, in FY18, public agencies have achieved a 35% energy intensity reduction compared to FY03[68]. Additionally, FEMP publishes success stories of public agencies utilizing ESPCs or other financing mechanisms and successfully conducting retrofitting projects and achieving deep energy savings.

2.6 MARKET TRANSFORMATION

The FEMP case has described the policy, regulatory, and financial instruments needed for retrofitting existing public building at scale.

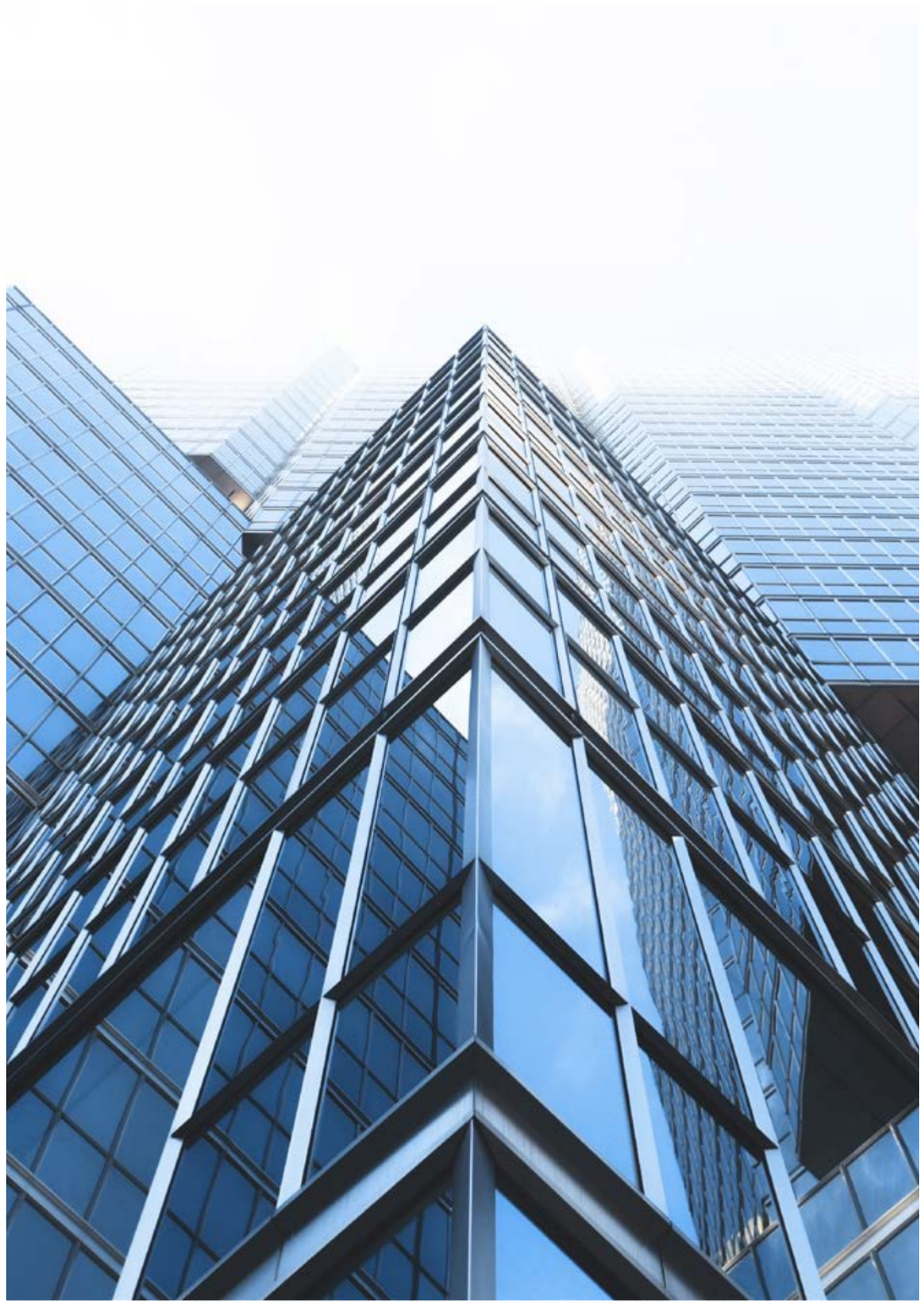
This ESPC program example has been enabled by a regulatory framework and key policies that have defined key roles and responsibilities. FEMP performs critical functions in a central coordinating role to facilitate a comprehensive program designed to enable large-scale retrofitting. Enacting a comprehensive program approach can address many barriers to retrofitting buildings. For example, leveraging its regulatory framework and

policies to help create system of benchmarking and accountability has been key to addressing some of the institutional issues to retrofitting the public building stock. FEMP also encourages sound practices such as stakeholder engagement, M&V, accountability, and helps to highlights national government success in addressing building modernization and deep retrofits.

FEMP's expertise and role coordinating the ESPC program have contributed to its success. The reduction in transaction costs for the private sector through its role in streamlining processes has been a key accomplishment, as it has in turn created an attractive market for companies to engage in public sector building retrofits. In this case, FEMP's role in coordinating the ESPC program and providing critical contracting and energy technology expertise have facilitated large-scale projects. This case demonstrates how a comprehensive program approach have helped transform the market to take on the largest investment in the public building stock to date.

This case demonstrates how public-private financing can be leveraged in an enabled policy environment. Legislation and executive guidance has explicitly encouraged use of public-private financing, such as ESPCs and other financing tools to help meet public sector energy conservation and efficiency goals. In this case, the public sector utilized its policymaking tools and set forth guidance to unleash private sector market activation. Importantly, regulations and policies have defined and centralized FEMP's facilitation role in retrofitting public buildings. In this case, FEMP's services and expertise have resulted in market innovation to address a variety of issues and transaction costs in retrofitting projects.

The term innovation often evokes the concept of a new product. However, the term can also mean a new process of improvement for a desired result - whether for cost savings, GHG reductions, or building modernization. There are many state and local government examples of public retrofitting programs that can contain many similar features as FEMP by providing similar one-stop shop approach, providing technical assistance, and streamlined processes and reducing transaction costs. Public building retroftting is a challenge that many other regions and countries are currently tackling. In particular, China has a similar institutional structure as the U.S. and therefore exploring the FEMP program can be instrumental for learning strategies to address some common barriers in retrofitting public buildings.



3. ENERGY EFFICIENCY RETROFITS IN COMMERCIAL BUILDINGS: THE COMMERCIAL & INDUSTRIAL CARBON CHALLENGE

This case study focuses on the vision, landscape, and enabling policies for energy efficiency in commercial buildings. It showcases a voluntary incentive strategy to attract private sector investment for commercial building retrofitting, and explores how a comprehensive program approach can help address barriers to retrofitting. The program and voluntary strategy highlighted is New York State Research Development Agency (NYSERDA)'s Commercial & Industrial Carbon Challenge.

3.1 BACKGROUND ON ENABLING POLICIES FOR COMMERCIAL BUILDING STRATEGIES

New York is one of the largest state economies in the U.S., and known for its leadership in passing ambitious and innovative energy and climate policies. In 2014, the New York Governor developed an overarching vision for the state's clean energy economy, called Reforming the Energy Vision (REV). The state energy plan, released in 2015, coordinated the overall clean energy vision for the state of New York. The goal was to reduce GHG emissions to 40% below 1990 levels by 2030, also known as the "40 by 30" goal, and a 23% decrease from 2012 levels for energy consumption in buildings[69]. It also set a mid-century goal. Through the Governor's order, several key players such as the New York Public Service Commission, the New York Energy Research and Development Authority, the New York Power Authority, and the Long Island Power Authority were tasked to implement this vision.

REV's goals set out New York's broad strategic plans for retrofitting buildings that included hard-to-reach markets, such as commercial and industrial buildings. One of REV's primary goals is to enact a broad suite of policies to attract greater private capital into the state's clean energy markets. It seeks to shift the majority of clean energy activity from being reliant on publicly financed incentives to new business models designed to respond to demands of an dynamic and distributed consumer market[70]. The desired outcome will be a data-centric clean energy economy as New York's energy industry responds and progresses through REV initiatives to become more distributed, dynamic, and consumer-focused.

The REV goals include:

1) Reduce costs of energy efficiency retrofits to enable greater market adoption
2) Unlock value, specifically value to the energy system
3) Deploy technology and data, and
4) Pull in from the market sources of innovation and investment that have not yet engaged, by assuring stability and markets at scale[71].

BOX: WHAT IS THE NEW YORK STATE ENERGY RESEARCH DEVELOPMENT AGENCY

The organization responsible for advancing New York's energy and climate goals is the New York State Energy Research Development Agency, also known as NYSERDA. Since 1975, NYSERDA has been developing partnerships to advance innovative energy solutions in the state, and serving as a catalyst to advance energy innovation, technology, and investments to transform the state's economy[72]. It conducts stakeholder engagement with residents, organizations, businesses, and many others. It also works closely with the New York Public Service Commission, the New York Power Authority, and the Long Island Power Authority, and other New York public agencies. NYSERDA conducts primary research, stakeholder development, and develops programs and initiatives to achieve the state's energy and climate goals.

Embedded in one of REV's three strategic strategic pillars is the Clean Energy Fund (CEF), a key strategy to achieving New York's vision for a clean energy economy. Approved in 2016, CEF is a 10-year, $5.3 billion fund designed to accelerate the use of clean energy and energy innovation[73], that is funded by the systems benefit charge. CEF is a key instrument for NYSERDA to leverage to help drive overall state activity towards more market acceleration efforts. Through the CEF, NYSERDA is investing more than $2 billion in funding over the CEF's 10-year life span to support energy efficiency[74]. Many of these activities are designed to provide a test bed for strategies to induce market activity and build market scale for clean energy[75].

The REV framework clearly outlines which agencies are responsible for enacting which part of New York's energy strategy. Other efforts or pillars are led by other key agencies, e.g., the New York State Public Service Commission focuses on utility regulation reform. The (DPS) focuses on utility regulation reform. Achieving the ambitious clean energy targets will be possible through coordinating the New York Public Service Commission, the New York Power Authority, the Long Island Power Authority, and NYSERDA's roles and responsibilities through the REV framework and CEF[76]. NYSERDA focuses on market activation for clean energy technologies.

Energy efficiency is a core strategy to achieving New York's overall goals, delivering nearly one-third of the GHG emissions reductions needed to meet New York's 40 by 30 climate goal[77]. Designing a more ambitious energy efficiency target will accelerate progress towards their overall climate and energy goals sooner, and better position NYSERDA to achieve its key strategic goals for the commercial buildings sector. Energy efficiency is consideried a benchmark technology for NYSERDA, as they realize that the cheapest energy is energy not consumed[78].

In 2018, NYSERDA and the DPS set a new energy efficiency target to be achieved by 2025. NYSERDA realized the state would exceed its original 2030 target, achieving more energy efficiency than predicted. The new 2025 energy efficiency target was tied to New York's overarching policies, included all fuels and covered the buildings and the industrial sector (while excluding the transportation sector)[79]. It is correlated to its original 2030 goal. It is estimated that meeting this new 2025 energy savings target will cut more than 22 million metric tons of CO_2e annually, and deliver nearly one-third of emissions reductions needed to meet its 40 by 30 climate goal[80]. In a white paper detailing the new energy efficiency target included a set of activities to achieve the new energy efficiency goal, with the intention of being a better defined goal for its key stakeholders.

NEW YORK'S STRATEGIES FOR BUILDING ENERGY EFFICIENCY:

- Drive deeper levels of efficiency and carbon savings in buildings using a variety of strategies including peer-based challenges, support of long-term energy planning within the capital improvement cycle, and development and demonstration of new solutions to deliver higher performing/healthier buildings.
- Develop a roadmap for a statewide carbon neutral building stock which incorporates deep efficiency, more efficient heating and cooling technologies, and grid-connected capability.
- Increase consumer awareness and provide decision-quality information on energy efficiency opportunities for building owners and tenants — capitalizing on key points in a building life cycle (e.g., tenant turnover, major renovations, property transfer).
- Leverage comparative data and information through strategies such as building benchmarking and labeling to drive consumer adoption of energy efficiency.
- Support statewide improvement in energy efficiency through improved appliance standards and adoption of advanced building codes, with a goal of establishing a statewide mandatory net zero-carbon building code by 2031.

Source: New York's Toward a Clean Energy Future: A Strategic Outlook 2020–2023*

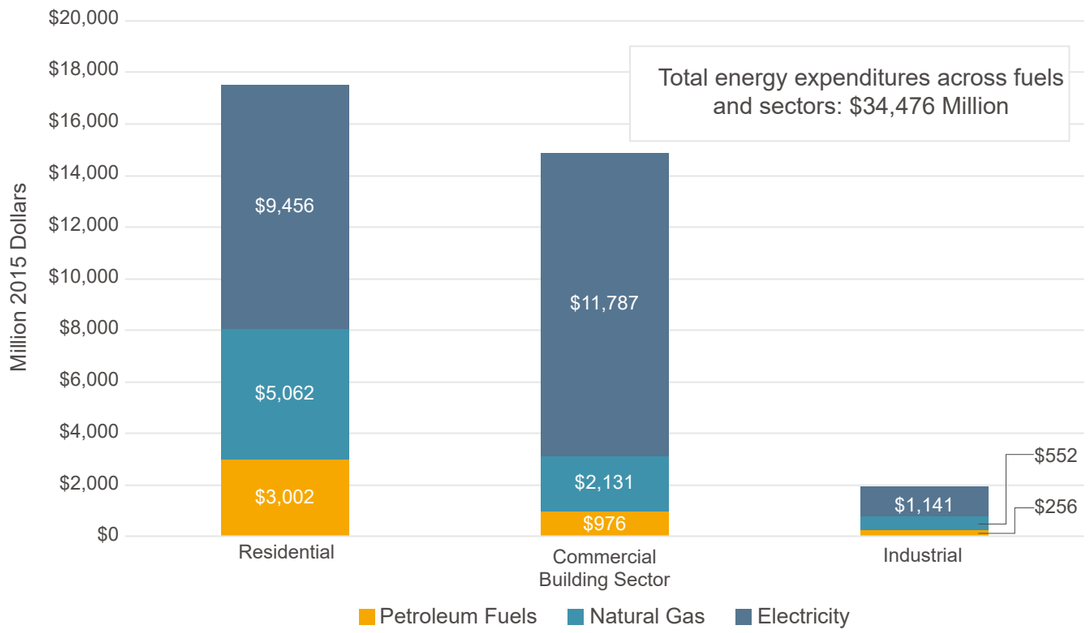
3.2 CHALLENGES AND OPPORTUNITIES IN NEW YORK STATE'S COMMERCIAL BUILDINGS

Buildings currently constitute approximately 60% of the total energy use in New York state[81]. Specifically, commercial and industrial buildings account for 33% of the energy-related GHG emissions in the state[82]. Common barriers in the commercial retrofitting space include the split incentive issue between building owners and tenants, lack of financing, and lack of defined cost savings due to lack of benchmarking/data collection, among others. These individual issues and/or a combination of these issues can lead to a lack of incentive and uptake in commercial retrofit projects from the private sector. According to Figure 5, the commercial building sector in New York spent nearly $15 million in energy expenditures in 2015, making the size of opportunity in energy savings significant[83].

One of REV's policy goals was to decrease energy consumption of buildings by 23% from 2012 levels[84]. In addition, NYSERDA has a goal to increase private investment in clean energy in the state, that is embedded and will be enacted through the CEF. NYSERDA realized that to maximize the benefits of clean energy, they needed to ensure that energy was being consumed more efficiently by end-users at scale.[85] Their findings concluded that investments in energy efficiency lowers risk, increases net operating income, and reduces exposure, which by extension, has the potential to increase borrowing capacity and property valuation in the buildings sector[86].

* New York's Toward a Clean Energy Future: A Strategic Outlook 2020–2023. New York State Energy and Research Development Authority. http://nescaum-dataservices-assets.s3.amazonaws.com/resources/production/strategic-outlook%20%281%29.pdf

FIGURE 5. NEW YORK STATE BUILDING ENERGY EXPENDITURES IN 2015



Source: Patterns and Trends: New York State Energy Profiles, 2001–2015 [87]

Along with the establishment of CEF in 2016, the DPS established a Clean Energy Advisory Council (CEAC) that it co-chaired with NYSERDA. The CEAC ordered a report that would investigate barriers and develop recommendations for voluntary incentives for the commercial sector to help design retrofitting strategies for commercial buildings. Specifically, the DPS requested a proposal that maximized energy efficiency in the commercial and industrial sectors through incentives for voluntary investments in clean energy technology that help accelerate and increase achievement of the state's energy and climate goals[88]. To comply with the DPS directives, the CEAC coordinated working groups to conduct research and analysis and to prepare their recommendations[89].

As a result, a CEAC working group developed a report to better understand the parameters necessary to facilitate voluntary investment pilots for commercial buildings retrofits. In addition, NYSERDA, in collaboration with the DPS, conducted a Commercial Statewide Baseline Study. Results from this study were used as an input into the design and planning of energy efficiency market transformation initiatives for the commercial sector[90]. NYSERDA also received feedback from large commercial and industrial (C&I) customers indicating that greater flexibility in the allocation of NYSERDA's CEF resources could unlock highly cost-effective opportunities[91]. The inputs from both NYSERDA's own baseline assessments, a report on voluntary incentives and pilots to motivate private investment, and stakeholder feedback lead to NYSERDA's development of a voluntary challenge mechanism for the commercial buildings sector.

BOX: BARRIERS TO CLEAN ENERGY INVESTMENTS IN COMMERCIAL BUILDINGS:

- Limited customer awareness, and confidence in the energy efficiency solutions, as "proof points" are not abundant
- Resource constraints of the customer, including energy savings not core to business plan; competing need for human resources and capacity; time constraints, e.g., construction cycles for energy efficiency
- Administrative barriers such as staff time/knowledge needed to design/implement projects or complexity of the project to the customer, whether real or perceived
- Fiscal constraints or inadequate cost-benefit ratio
- Uncertainty; confidence in product offerings, quality control, or new revenue streams
- Payback timelines on investment
- Sector-specific financing, such as in-sector differentiation may exist (particularly true for the municipalities, universities, schools, and hospitals e.g. MUSH sector), or access to capital for certain business structures (like franchises)

Source: NYSERDA and NYPS[92] and NYSERDA's Voluntary Investment Pilot Parameter's report[93]

Additionally, in 2018, NYSERDA held listening sessions in which the service providers or companies, and environmental advocates indicated their readiness to perform energy efficiency savings[94]. In their role as service providers, they indicated that in order to drive innovation in the state, they needed access to data and a better definition of market roles; and also emphasized a need for long-term clarity and consistency with respect to program offerings to create the conditions for businesses to build, develop, and sustain innovative models that deliver energy efficiency in ways that better align with building owners' needs[95]. NYSERDA responded to stakeholders' feedback in the development of the challenge described below.

3.3 THE COMMERCIAL & INDUSTRIAL CARBON CHALLENGE

In 2018, NYSERDA announced the Commercial & Industrial (C&I) Carbon Challenge which allowed large commercial and industrial customers to propose carbon reduction goals and funding requests. This challenge gave large energy consumers the flexibility to tap into their in-house expertise to reduce their carbon footprint and control their energy costs, thus allowing for private sector innovation along the state's overall climate and energy goals. In this effort, NYSERDA will capture these market-based opportunities from large energy users by providing flexible funding for advancing energy efficiency and other types of clean energy. The projects developed through the challenge would increase market-based clean energy activity in a manner that would result in benefits comparable to or better than public programs[96]. The C&I Carbon Challenge is administered through CEF, New York's market based activation initiative[97]. NYSERDA will administer 15 million of funding as part of this challenge, ranging from 500,000 to 5 million in grants[98].

NYSERDA's strategy for incentivizing private market investments from large energy users once focused on offering direct incentives. Recently the state has adopted a model to shift from offering direct incentives to an approach to enable new technologies and market-based programs for the service providers in the commercial sector. NYSERDA realized that energy services companies, or ESCOs, initially might suggest technologies most familiar to them for projects, and not necessarily the most novel or efficient technologies available. NYSERDA as a public sector entity is uniquely positioned to help bring new technology to market and enable broader market adoption through leveraging flexible funding opportunities and aligning economic and energy benefits. This approach was pursued through the C&I Carbon Challenge.

One of NYSERDA's hypothesis was whether the flexible use of funding by large commercial and

industrial customers can prove more cost effective than NYSERDA public benefit programs otherwise available to them. This was measured by carbon emission reduction per dollar allocated[99]. Therefore, NYSERDA chose a blind bid mechanism where service providers or applicants would request a certain level of funding and thus commit to reducing a set amount of CO_2 equivalent in its request for proposals in response to the challenge. They evaluated the proposals based on the ratio of the funding request over the total proposed metric tons of carbon reduced. This strategy ultimately shifts from the public sector attempting to hold the private sector responsible for carbon reduction strategies, to incentivizing and empowering companies to be responsible for their own CO_2 building emissions.

The more private investment a company was willing to commit in their proposal, the more competitive and favorably the proposal would be scored by NYSERDA. For example, if a service provider or applicant proposed a project with a total cost 10 million and a carbon reduction potential of 500,000 mt, and they requested 5 million in grant funding from NYSERDA and planned to fund 5 million with their own capital, their ratio is 10/mt (5 million grant/500,000 mt)[100] . Even better, if the applicant was willing to commit 7.5 million of their own funding, their ratio drops to $5/mt, and thus improves NYSERDA's evaluation of their proposal[101] and likely success.

Applicants were also evaluated based on the proposals' alignment to REV's goals. In particular, NYSERDA assessed the energy technologies and analysis proposed in the projects. They also evaluated the organizational goals of the applicants, such as companies' overall sustainability goals and transparency around public facing sustainability goals, to get a sense of accountability to act on their stated goals. They also looked at the applicant's personnel or teams that was dedicated to their sustainability goals as a means to ensure success and their overall requisite experience to be able to deliver on the proposed projects. These were all factors that influenced NYSERDA's selection process.

BOX: BENEFITS OF THE C&I CARBON CHALLENGE TO COMMERCIAL AND INDUSTRIAL AWARDEES

Through the C&I Carbon Challenge, selected awardees worked directly with a dedicated project manager on all their NYSERDA projects and initiatives. This was beneficial to the awardees. Rather than navigating multiple different NYSERDA or utility initiatives, this streamlined approach aligned overall support and technical assistance delivery to awardees. Projects in the challenge proposed could be a single site or a bundle of different projects, such as a campus setting. NYSERDA provides support in updating, refining, and implementing their carbon reduction strategies proposed in their projects over a three-year award cycle. The dedicated NYSERDA project manager and technical specialist tracks progress, provides feedback and guidance on energy efficiency measures to be implemented, and collaborates with other NYSERDA partners and awardees for peer learning.

NYSERDA also offers M&V to help track progress and report annually on projects conducted by a third-party contractor. Awardees must be in a position to be able to disclose data, so that NYSERDA can gather and share lessons learned for broader technology and program adoption. NYSERDA handles the contracting for M&V, and awardees simply have to make their data available for M&V. This positions NYSERDA as a one-stop shop, where awardees are getting technical assistance, funding, and M&V services from one agency.

Awardees also benefit from public recognition. Their willingness to tackle big projects and success stories are highlighted in press releases and other forms of recognition. NYSERDA will partner with the awardee to help promote and highlight their work as solution providers. In particular, NYSERDA will host events to elevate success stories, as well as documenting through case studies, social media, and other strategically identified public events or media.

More broadly, NYSERDA will work with ESCOs to offer free training, best practices, and other incentives in terms of adopting novel technologies with clean energy benefits that will benefit commercial and industrial users, and advance broader goals like REV.

In 2018, NYSERDA awarded two large commercial and industrial applicants funding through the challenge. The combined expected expenditures from the applicants were 24 million of private investment, to NYSERDA's 10 million of public investment. In 2019, the estimated values from applicants' total expenditures will be 49 million from five commercial users, three universities, and one private large commercial real estate firm; to a 5.7 million total investment from NYSERDA[102]. For the past two past years that NYSERDA has implemented the challenge, it has been an effective way to attract private investment to help retrofit the commercial buildings sector.

Some of the technologies awardees or solution providers designed and implemented are a building heat recovery system and building controls at a university; and a large heat pump room at another university; new boilers and controls, and a data center retrofitting for commercial air handling; and a steam reduction measure induction air valve technology at a commercial real estate firm. Even if an applicant was not selected, NYSERDA will solicit informal feedback from the applicant to better understand what worked or didn't in the proposal process for their application, and how they can design programming more effectively to help bring more projects such as in their proposals to fruition in the commercial and industrial sector.

Another critical piece of the challenge includes M&V and data disclosure. NYSERDA designed the challenge with M&V conducted through a third-party company that reports on the applicant's project progress to them. In the applicant's proposal, NYSERDA assesses if the applicant has any data disclosure constraints. There is more sensitivity for this in the commercial sector, in the sense that a company's energy consumption could give away proprietary information. For NYSERDA, one of the goals of the challenge is being able to make data available so others can learn from data disclosure, which is particularly valuable for novel technology adoption. NYSERDA will actively work with its challenge partners on sharing lessons learned, so will ensure that the applicant can share data for its M&V requirements, unless it is proprietary information. This M&V practice will benefit of the commercial sector as a whole. As project results from the challenge come in, NYSERDA will be able to highlight and share cost savings and standardize information for future commercial building retrofitting challenges and incentive programs.

The challenge was directly aligned to one of REV's larger goals of reducing costs of energy efficiency retrofits for greater market adoption, deploying technology and data, and enabling innovation and investment not yet engaged from the market. NYSERDA borrowed features from other challenges and competitions conducted in the past that they found to be successful, such as the REV Campus challenge and Energy to Lead Competition. Through implementing a challenge or competition concept, there have been compelling results in terms of driving down costs of programs. They also taken inspiration from some national level programs such as the U.S. Department of Energy's Better Buildings Challenges, of which they are also active state partners and NYSERDA has been highlighted as a successful partner.

Additionally, in the past the NYSERDA commercial and industrial team have conducted an open enrollment process, and given its success, they opted to keep the same method of applications and model of funding for the C&I Carbon Challenge.

The award system in the voluntary challenge was based on leveraging private financing and novel technologies to address commercial building retrofitting.

3.4 MARKET TRANSFORMATION

NYSERDA presents a compelling model of setting overarching policy goals, conducting research and engagement to inform strategies to meet those goals, building on past strategies and successfully aligning the market to New York's broader climate and energy goals. In this example, NYSERDA along with NYS leadership and other public agencies has set overarching policy goals with an enabling framework that informed their retrofitting strategies for commercial buildings. The C&I Carbon Challenge was designed on past program successes that was based on providing incentives that encouraged desired behavior from the private sector.

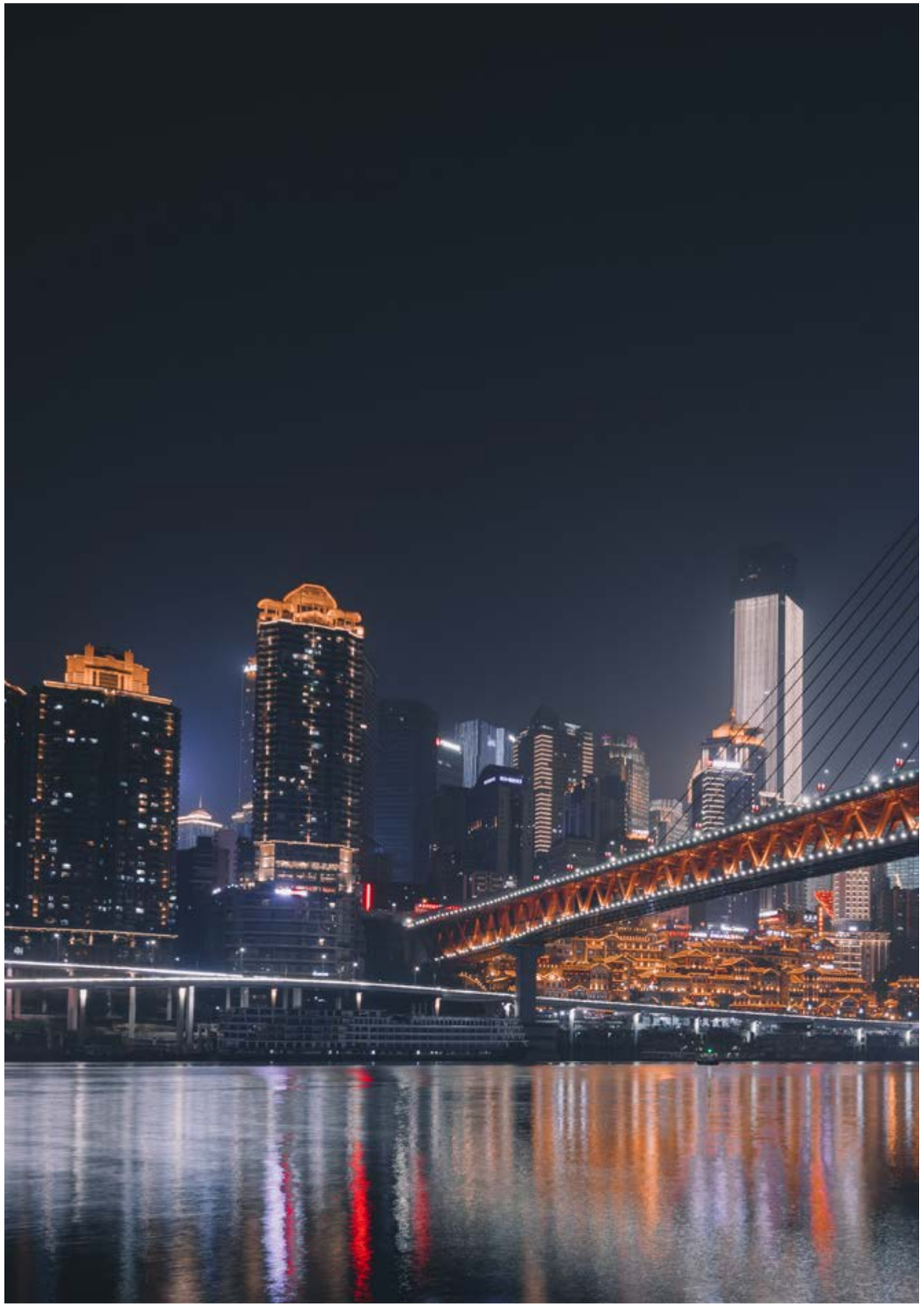
NYSERDA has setup a framework that aligns the private sector to its primary overarching policies through REV and CEF, which set out a goal of market activation

as a key strategy to meeting its climate and energy goals. NYSERDA's deep understanding of their own market needs to meet their goals, combined with early and regular stakeholder engagement, informed the type of programs and incentives that service providers companies would be responsive to and thus actively engage in projects. With previous successes in the voluntary structures like challenges and competitions to bring private investment to bear in specific sectors, NYSERDA has found early success and good feedback from the C&I Carbon Challenge.

The C&I Carbon Challenge provided a competitive data driven process, leveraging the role of the private sector to inform further energy efficiency and commercial building strategies. The use of a voluntary pilot projects to test out strategies that could be scaled informed by past efforts and provides a promising example of how to design voluntary programs to meet overarching policy goals to transform the market for the commercial buildings sector. It sets forth an impressive method for public sector agencies shifting away from trying to hold companies accountable themselves by having companies account for their own GHG emissions. This was embedded in this challenge.

In the short term, NYSERDA has successfully leveraged private investment for commercial retrofitting, which it can use to enable peer learning around implementing low carbon technologies. And in the long-term, NYSERDA continues to strategize how to design short term programming to have strategic alignment around its long-term goals of deep carbon reductions. Through funding primary research on sectors and barriers and working with their stakeholders, NYSERDA understood unique leverage points in terms of buying down the cost of novel technologies through pilots and voluntary initiatives for broader market adoption.

In addition, NYSERDA is moving towards implementing clean energy technology project classes to increase incentives in the market, thus increasing the points for technologies that are less carbon intensive for proposals in the C&I Carbon Challenge. The aim is to leverage its public sector role to help buy down the cost of these interventions, gain insight into more novel technologies in real-world applications with the goal of spurring further investment in the most promising solutions. The intention is that over a longer period, NYSERDA will be able to develop strategic relationships with the state's highest energy users to help shift their behaviors to better align them to the goals of REV. NYSERDA is uniquely positioned to provide incentives for these larger energy users to focus on carbon reduction, while opening the door for newer technologies to invest and retrofit the commercial building sector.



4. CONCLUSION

CHINA CONTEXT

The Chinese government has developed a series of policies and programs to promote energy efficiency retrofits in existing buildings. These programs include Medium-and Long-Term Special Plan for Energy Conservation adopted, Action Plan for Green Building adopted, Building Energy Conversation and Green Building Development adopted. China set targets of retrofitting more than 500 million m^2 of residential buildings and 100 million m^2 of public buildings by 2020. However, these programs only cover a small fraction of China's building floorspace and how to finance the building retrofits remain as a main challenge. Therefore, more ambitious effort, innovative policy instruments and public-private financing mechanisms are needed to enhance energy efficiency in existing buildings in China.

How the case studies can provide models for building energy efficiency retrofitting

The case studies demonstrate the role of the public sector to incentivize the private: sector to engage and help move the market towards its overall stated goals, in legislation, broad-based transformational goal setting, programs and processes. Both the public and private sector play complementary roles in market transformation. These cases have illustrated models to retrofit public and commercial buildings, two typically hard-to-reach sectors.

There are key takeaways from both case studies, that include an overarching broad goal that clearly delineates roles and responsibilities for different public sector agencies. Building policies must mandate specific efficiency targets or goals for reducing emissions. Both public agencies explored in this paper utilized their roles to standardize procedures and reduce transaction costs to make retrofitting projects more attractive to the private sector. Public agencies can work in partnership with the private sector, to help design a process and reduce overall costs where companies can bring their technical expertise to bear, helping to retrofitting public and commercial buildings. Both included robust stakeholder engagement, working in tandem with other agencies to deliver on goals and targets. In both cases, early and continual stakeholder engagement was conducted to ensure that the designed policies and programs are accessible and attractive, in order to incentivize the private sector to bring their expertise to market.

These cases demonstrate market transformation in a couple of different ways. FEMP was enabled by legislation to help enact energy savings targets and financing for the national government. To support that goal, FEMP provides training and contracting assistance, building capacity and facilitating public-private partnerships among different public agencies to deliver big retrofitting projects. NYSERDA conducts its own market research and engagement with companies to design targeted pilots that deliver progress on their overall goals. Both are essentially buying down the cost of interventions for, and building capacity within, the private sector to perform retrofits. In providing services such as technical assistance, M&V and reporting, rolled up into a comprehensive program, they help address many of the barriers to large-scale retrofitting for hard-to-reach sectors. Additionally, by documenting and communicating lessons learned, they can identify and provide resources to reduce barriers to retrofitting.

In the case of FEMP, being a central coordination role enabled a standard process for many public agencies, and ESCOs to follow. The mandated use of ESPCs has been crucial, but it has been supported by FEMP's role in standardizing the use of ESPCs. This has been a critical component of making ESPCs with the public sector attractive to ESCOs, that FEMP has greatly reduced the transaction costs and addressed institutional barriers to retrofitting. For NYSERDA, through use of market research and targeted engagement with companies, has also developed a process for which companies are incentivized to participate in energy efficiency programs through committing to leverage their own funds to gain the technical assistance and public recognition from NYS. Public sector agencies can provide technical support services and a platform that help bring novel technologies to market or help enable the market for private-public financial models that advances retrofitting for public or commercial buildings.

Public sector agencies can develop overall policies and programs that allow for flexibility and innovation for the private sector. Such flexibility and innovation can be brought to bear in public-private financing models such as ESPCs in the FEMP case, and in the companies bidding in response to NYSERDA's C&I Challenge Request For Proposal. By standardizing procedures, processes, and reducing transaction costs, they play a vital role in incentivizing the private sector to perform existing building retrofits. In particular, by allowing flexibility and innovation with longer-timeframes for work such as in the FEMP case, it allows companies and ESCOs to perform more comprehensive retrofits. It is through prioritizing comprehensive retrofits that will lead to deeper emissions reductions from buildings. In fact, facilitating a path to net-zero emissions from buildings will be needed to meet China's 2060 carbon neutrality goal.

Specific policy recommendations for developing building energy efficiency retrofitting programs:

BOX: POLICY RECOMMENDATIONS FOR DEVELOPING ENERGY EFFICIENCY RETROFITTING PROGRAMS FOR PUBLIC BUILDINGS

- Mandate energy saving targets increase in ambition over time
- Explicitly encourage use of public-private financing such as ESPCs through policies and executive guidance through policies and/or executive guidance
- Provide budgetary guidance for public institutions to use ESPC and other third-party financing
- Streamline the procurement process to allow two-stage tendering with an appointed contracting expert team or office that helps facilitate the process
- Develop technical guidelines and supporting documents to enable use of public-private financing models for public building retrofits
- Outline roles and responsibilities of respective ministries or public agencies
- Promote cross-agency coordination through regular stakeholder engagement that establishes dialogue and performs a transparency and tracking mechanism
- Establish a system to measure and track progress formally through a database system with mandated regular reporting and provide a mechanism for scoring ministry or public agency progress on targets

BOX: POLICY RECOMMENDATIONS FOR DEVELOPING ENERGY EFFICIENCY RETROFITTING PROGRAMS FOR COMMERCIAL BUILDINGS

- Conducting market research through a mix of primary research or robust stakeholder engagement to understand the barriers of private engagement of commercial retrofit projects
- Design and develop pilot projects to test the feasibility and scalability of commercial retrofit projects
- Provide flexibility in pilot projects to allow for innovation
- Provide or mandate use of M&V services in order to monitor and track progress
- Provide a single point of contact or office to help streamline technical assistance
- Through use of voluntary programs such as competitions or challenges incentives private companies to engage in their own retrofitting and carbon emissions reductions
- Use of public recognition to highlight companies that perform well and are engaged in public sector initiatives can be a strong motivator

Building retrofits are critical to achieve emission reduction in existing buildings, which is a huge area of opportunity for China, and other developed and developing countries. Building energy efficiency is a key strategy of decarbonization, and by enacting ambitious building energy efficiency programs, can help achieve China's carbon neutrality goal by 2060. The cases included in this report provide a roadmap of how some leading programs in the U.S. have tackled the public and commercial sector buildings energy efficiency retrofits by leveraging and motivating private actors. Highlighted in these case studies was how to design and leverage innovative financing models for building energy efficiency retrofits. The cases explored here where at different stages of maturity – one has been leveraging ESPCs for decades, and the other was at a nascent stage of leveraging funding from the private sector. Both shed light on the comprehensive nature of retrofitting programs in order to achieve results. Such an approach will be necessary to decarbonize China's building sector in order to meet its 2060 carbon neutrality goal.

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