Unlocking the Mission Critical Building Decarbonization Opportunity in the SMB Sector

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accelerating clean energy

Introduction

In this whitepaper, Sustainable Real Estate Solutions, Inc. (SRS) analyzes the ambitious goal to reduce U.S. commercial and multifamily buildings' greenhouse gas (GHG) emissions by 50% by 2030. The report describes the market for energy-consuming equipment replacement and the potential for GHG emissions reduction by sector.

It also explores the barriers to energy efficiency upgrades in small and medium-sized buildings (SMB) which are responsible for an estimated 41% of GHG emissions from commercial and multifamily buildings – a sector that is mission critical if the U.S. is to achieve its GHG emissions reduction goal.

Finally, the report discusses policy implications and tools to align stakeholders' interests and accelerate the industry's decarbonization initiative.

Greenhouse Gas Emissions Reduction Targets

Responding to the ever-growing health and economic threats posed by greenhouse gas (GHG) emissions, the Biden administration has established an ambitious new goal to reduce the nation's GHG emissions from 2005 levels by 50% by 2030.[1] Moreover, 24 states and the District of Columbia have established GHG emissions reduction goals.[2] The goals of select states are presented in the following Table 1.[3]

Table 1. Select States GHG Emissions Reduction Goals

State	% Reduction	Baseline Level	By
CA	40	1990	2030
CO	50	2005	2030
CT	45	2001	2030
MA	80	1990	2050
MD	40	2006	2030
ME	45	1990	2030
MN	30	2005	2025
NJ	80	2006	2050
NV	45	2005	2030
NY	40	1990	2030
OR	75	1990	2050
RI	45	1990	2035
VT	40	1990	2030
WA	45	1990	2030

Fossil fuel combustion attributed to commercial and residential buildings accounts for approximately 40% of U.S. total energy consumption and 29% of total U.S. GHG emissions.[2,4] Improvements in energy efficiency have led to GHG emissions reduction in the commercial and residential sectors of 11.4% and 17.3%, respectively, since a 2005 peak. Nevertheless, there remains a long way to go if the nation is to achieve a 50% reduction by 2030.

In New York City for example, buildings account for approximately two-thirds of the City's GHG emissions. In 2019, as part of its plan to achieve carbon neutrality by 2050, the City passed its Climate Mobilization Act – Local Law 97 (LL97), which is designed to achieve a 40% reduction in GHG emissions from buildings by 2030. Under LL97, most buildings over 25,000 square feet (SF) will be required to meet new energy efficiency and GHG emission limits (effectively a cap on GHG emissions) by 2024, with stricter limits coming into effect in 2030. If a building's reported GHG emissions exceed the allowable cap (viewed as a non-compliance situation), the building's owner will be fined $268 per ton of emissions that exceed the limit. LL97 has become a model for other cities throughout the country, e.g., Boston, MA, Denver, CO and Seattle, WA also recently passed performance standards for existing buildings.[5]

Given the commercial building sector's significant GHG emissions and the industry's increasing urgency to reduce its environmental and climate impact, today's forward-thinking building owners are planning and implementing GHG emissions reduction measures. A key component of these building GHG emissions reduction plans is the installation of more energy efficient equipment.

U.S. Commercial Building Market

The commercial building market includes both non-residential commercial buildings and multifamily apartment buildings with five or more units (refer to Table 2.).

Table 2. Non-residential Commercial and Apartment Building Market Characterization

Non-residential Commercial Buildings[(6)]

Number of Bldgs.	Size (SF)	% of Total	Billion SF	% of Total SF	Avg. SF/Bldg.	Median Age (years)
5,558,000	<= 50,000	94%	48.6	50%	8,739	36
360,000	> 50,000	6%	48.4	50%	134,564	30

Multifamily Apartment Buildings (5 or more units)[(7)]

Number of Bldgs.	Units	Billion SF	Avg. SF/Bldg.	Avg. SF/Unit	Avg. Units/Bldg.
1,587,087	21,100,000	18.7	11,783	798*	13

**Assumes 10% of total multifamily building square feet (SF) is common area.*

Buildings with floor areas not exceeding 50,000 SF are referred to as the small and medium-sized buildings (SMB) market. Large buildings, exceeding 50,000 SF, are often referred to as the institutional market. Office, warehouse, mercantile and service buildings in the non-residential market account for 57% of the buildings and more than 50% of the floorspace. Seven percent of all buildings are dedicated to education, yet they contain 14% of the total floor space in the non-residential building sector.

In view of the fractured and hard-to-reach nature of the SMB sector (Class B and C buildings), it is not surprising that, as compared to large institutionally owned buildings (Class A), SMBs have received little attention in the growing energy efficiency marketplace.

Each year it is estimated that an average of 5% of the existing building stock will have energy consuming equipment reaching or exceeding its useful life.[(8)] Typically, in the SMB sector, replacement equipment is selected by the building owner or their contractor to comply with minimum local building energy code requirements, which rarely reflect the state-of-the-art in energy efficiency performance. Installing the highest efficiency equipment therefore represents a significant opportunity for SMB owners to further reduce energy costs and GHG emissions. While such equipment is often more expensive (typically a 20-30% premium) than minimally code-compliant equipment, the energy savings (reduced energy consumption and energy demand) can often cover the extra cost in a few years, making the return on investment attractive.

For owners of large buildings (>50,000 SF), the attractive return on investment associated with the highest energy efficiency equipment makes the choice obvious. Unfortunately, the same cannot be said for many SMB building owners.

SMB Building Challenge

Commercial Sector: When owners of buildings over 50,000 SF contemplate multi-million-dollar energy improvement projects, they typically contract with energy engineers who first conduct a comprehensive energy audit of the building. This audit evaluates the business case for investment in high efficiency equipment. For owners of SMB buildings, energy improvement projects typically involve less than a few hundred thousand dollars. As a result of the relatively low average cost of SMB projects, energy audits are often deemed to be too costly and unnecessary.

Table 3. Estimated Typical Project Installed Cost for an Average-Size SMB and Average-Size Large Building[9]

Bldg. Type	Avg. Size (SF)	Cooling Tons	Heating BTUH	Energy Improvements	Avg. Project Cost
SMB	8,739	25	350,000	HVAC/LED Lighting	$ 150,000
Large	134,564	350	5,500,000	HVAC/LED Lighting	$ 2,000,000

Multifamily Sector: Assuming an average building with 13 units, a typical comprehensive energy improvement project that incorporates the highest energy efficiency equipment that services tenant units and the common area is estimated to cost approximately $100,000.[9]

Total Market: The typical comprehensive energy improvement project will include the installation of both HVAC and LED lighting upgrades. Under this scenario, the size of the HVAC and LED lighting replacement market can be estimated (refer to Table 4.). Interestingly, the investment (and therefore, the market size) required to replace energy-consuming equipment in SMB buildings is larger than the replacement market for large buildings.

Table 4. Total Annual Installed Cost Replacement Market and Potential Value of Installing "Above Code" Rather than "Code-compliant" Equipment

Market	Total Annual Replacement Market Assuming MEEPA Equipment*	Cost Premium Paid for "Above Code Compliant" MEEPA Equipment*[10]
SMB Buildings	$41.7 Billion	$10.4 Billion
Large Buildings	$36.0 Billion	$9.0 Billion
Apartment Buildings	$7.9 Billion	$2.0 Billion

**Maximum Energy Efficiency Practically Achievable (MEEPA) for HVAC and LED lighting. 5% of all buildings are assumed to have equipment that reaches or exceeds its useful life each year.*

Assuming the most energy efficient equipment is installed when the existing equipment reaches its end of useful life, the estimated annual equipment replacement market is provided in Table 5.

Table 5. Estimated Annual Market Size for MEEPA Equipment and Equipment Installation

Cost Category	Estimated Total Annual Replacement Market for MEEPA Equipment	Cost Premium Paid for "Above Code Compliant" MEEPA Equipment
Highest Efficiency HVAC Equipment	$32.0 Billion	$8.0 Billion
Highest Efficiency LED Lighting	$11.0 Billion	$2.8 Billion
Equipment Installation	$43.0 Billion	$10.8 Billion

Installing equipment with the Maximum Energy Efficiency Practically Achievable (MEEPA) creates an "everyone wins" scenario in which HVAC, LED lighting manufacturers and distributors can increase annual equipment revenue by an estimated $10.8 billion. The cost of installation increases by an estimated $10.8 billion, revenue that goes directly to contractors. Building owners optimize energy cost savings and GHG emissions reduction while earning an attractive return on investment.

Barriers to High Efficiency Upgrades

Institutional owners of large buildings are increasingly more open to the cost premium associated with higher energy efficiency equipment that is needed to meet their sustainability and Environmental, Social, and Governance (ESG) program goals. Moreover, the greater lifetime energy cost savings, cash flow benefits, GHG emissions reductions and the increase in property value make for an attractive investment.

This is not typically the case with SMB owners who often focus solely on first cost, which is usually the only cost provided in contractor proposals supporting the SMB owner's investment due diligence. That is understandable as the typical installation contractor is unable to provide an estimate of lifetime energy cost savings, impact on cash flow, and GHG emissions reduction.

In addition to the cost premium associated with higher efficiency equipment, there is also the split incentive issue for buildings with triple net leases, which is a common lease type in commercial buildings. With such leases, the tenant is responsible for utility costs. Hence, the building owner's question arises: "Why should I pay for the highest efficiency equipment when the tenant gains the benefit, i.e., lower energy cost?"

Fortunately, so-called "green leases" have emerged to help overcome this split incentive by creating win-win agreements for building owners and tenants that equitably align the costs and benefits of energy efficiency investments for both parties.

Potential GHG Emissions Reduction

Table 6 provides an estimate of the annual energy consumption and savings from the installation of MEEPA equipment[1]. Table 7 provides an estimate of potential annual and lifetime GHG emissions reduction.

The GHG emission factors[(11)] used in Tables 6 and 7 below are:

- 117.1805 lbs. CO_2e/MMBtu fuel (assumed to be natural gas) saved
- 440.6325 lbs. CO_2e/MMBtu of electricity saved.

Table 6. Annual Energy Consumption of Existing Buildings Requiring Replacement Equipment and Potential Savings from MEEPA Equipment Installation

Building Type	Existing Annual HVAC/Lighting Energy Consumption in Buildings Requiring Replacements[(12)]	Potential Annual HVAC/Lighting Energy Savings in Buildings Requiring Replacements[(9)]
SMB Buildings	116 Trillion Btu/yr.	38 Trillion Btu/yr.
Large Buildings	102 Trillion Btu/yr.	36 Trillion Btu/yr.
Apartment Buildings	46 Trillion Btu/yr.	9 Trillion Btu/yr.
Total	**264 Trillion Btu/yr.**	**83 Trillion Btu/yr.**

Table 7. Estimated Annual and Lifetime GHG Emissions Reduction

Building Type	Metric Tons CO_2e Reduced/yr.	Metric Tons CO_2e Reduced/Lifetime[(13)]
SMB Buildings	4.8 Million Tons	96.0 Million Tons
Large Buildings	5.2 Million Tons	104.0 Million Tons
Apartment Buildings	1.1 Million Tons	23.0 Million Tons
Total	**11.1 Million Tons**	**223.0 Million Tons**

It is noteworthy that, assuming MEEPA equipment is installed, the potential annual GHG emissions reduction from SMBs is approximately the same as the GHG emissions reduction from large buildings.

[1] Assuming 5% of existing non-residential commercial buildings and multifamily apartment buildings with five or more units will require replacement of energy-consuming equipment at the end of its useful life each year[(8)].

Summary

Commercial Buildings: U.S. Environmental Protection Agency (EPA) calculates that in 2005 commercial buildings (including both direct fuel combustion and indirect electricity-related emissions) emitted 619 million metric tons of GHGs as CO_2e[(14)]. A 50% reduction would reduce these emissions by approximately 310 million metric tons. By replacing equipment at the end of its useful life with MEEPA equipment, the total SMB and large buildings market can save approximately 10 million metric tons annually.

This means it could take approximately 30 years, i.e., 2050, to reach a 50% GHG emissions reduction target for the commercial buildings market. Moreover, ***both*** the SMB and large building sectors are mission critical to achieving a 50% reduction goal.

To achieve the ambitious U.S. target of a 50% reduction in GHG emissions by 2030 (20 years prior to 2050), it will be necessary to significantly accelerate the natural equipment replacement lifecycle. One option is for states (perhaps funded by the federal government) to provide financial incentives to building owners that accelerate equipment replacement prior to the end of its useful life.

Multifamily Buildings: With respect to GHG emissions from multifamily apartment buildings with five or more units, the EPA's report[(14)] does not differentiate among the many different types of residential buildings. Based on the assumption that GHG emissions are a function of residential building size, the 2015 Residential Energy Consumption Survey indicates that multifamily apartment buildings with five or more units represent approximately 18% of the total residential square footage.

EPA's report estimates GHG emissions (fuel and electricity) from the total residential market in 2005 as 1,247.1 million metric tons of CO_2e. Hence, multifamily apartment buildings with five or more units are estimated to have a GHG emissions rate in 2005 of 224 million metric tons of CO_2e. To achieve a 50% reduction would require a reduction to 112 million metric tons of CO_2e. If only equipment at the end of its useful life is upgraded with MEEPA equipment, Table 7 suggests that 1.1 million metric tons of CO_2e could be saved annually.

Assuming this to be the case, it would take approximately 100 years to reach a 50% reduction in multifamily apartment buildings' GHG emissions. As such, if state requirements dictate this level of GHG emissions reduction to be achieved by 2030, focusing solely on replacement equipment, just as with non-residential commercial building owners, existing multifamily apartment building owners will need significant incentives to accelerate replacement of equipment that is not at the end of its useful life.

Policy Implications

From this analysis, it seems evident that reaching a 50% GHG emissions reduction goal by 2030 would not be possible even if all building owners in the annual replacement cycle were to install MEEPA equipment. Many institutional investors and owners of large buildings will find the lifecycle energy cost savings and good publicity a sufficient incentive to install MEEPA equipment. However, this is unlikely to be the case for SMB owners, without whom it will be impossible to achieve U.S. GHG emissions reduction goals.

Moreover, to have a significant impact on SMB owners, contractors today would need to shift from a "lowest price proposal strategy" designed to meet minimum local energy code requirements, to a "return on investment (ROI) proposal strategy." The ROI strategy would focus not only on first cost, but also on lifecycle energy cost savings, GHG emissions reduction, and the cash flow impact which is the language of commercial building owners and investors. Fortunately, tools have emerged, as described below, that can empower equipment manufacturers, distributors, and contractors in this mission critical effort to make the business case to SMB owners for MEEPA equipment investment.

Requiring replacement equipment at the end of its useful life to be at the highest energy efficiency practically achievable (MEEPA) would necessitate revisions to local building energy codes, some of which only require equipment efficiencies at the ASHRAE 90.1-2007 levels. For example, the ASHRAE 90.1-2007 standard requires an energy efficiency ratio (EER) of 9.0 for HVAC rooftop units (RTUs) when high efficiency RTUs today can achieve EERs above 14. The 2007 standard also only requires a minimum boiler efficiency of 80% when high efficiency condensing boilers today can achieve efficiencies as high as 96%. Since requiring the highest energy efficiency practically achievable for replacement equipment at the end of its useful life would not achieve a 50% GHG emissions reduction goal by 2030, additional steps would still need to be taken.

The next logical step is to focus on building owners that operate equipment near, but not at the end of its useful life. Since a mandate is unlikely, government and/or utility incentives would need to be offered to incentivize owners to accelerate equipment replacement investment.

In addition to energy efficiency improvements, another initiative than may assist in GHG emissions reduction is electrification. On the premise that utility power generation will move toward renewables such as solar and wind (meaning a decarbonized power grid), building electrification will also reduce GHG emissions. By eliminating natural gas or other fossil fuel-fired heating sources and replacing these with electric heating (such as with conventional or variable refrigerant flow heat pumps) could provide a significant boost. Initially, electrification may only focus on replacement equipment, e.g., fossil fuel-fired boilers at the end of their useful life. However, a more aggressive requirement would likely be necessary to achieve a 50% GHG emissions reduction goal by 2030.

The above analysis focuses on existing buildings without consideration of ongoing new building construction impacts. Notwithstanding, there are three policy considerations that could assist in accelerating GHG emissions reduction. These include:

- Revising building energy codes to require equipment with the highest energy efficiency practically achievable (MEEPA).
- Implementing building energy performance standards.
- Establishing carbon neutral and net-zero building requirements.

Tools Supporting Energy Efficiency Improvements

As indicated previously, a common problem with the sale of HVAC equipment having the highest energy efficiency practically achievable, particularly in the SMB market, is that equipment distributors and contractors would need to shift from a "lowest price proposal strategy" designed solely to meet minimum local energy code requirements to a "ROI proposal strategy." The ROI strategy would focus not only on first cost, but also on lifecycle energy cost savings, GHG emissions reduction, and the impact on cash flow to make the "business case" for the building owner to invest in high efficiency equipment.

Today, tools such as Sustainable Real Estate Solutions' (SRS) Energy Performance Improvement Calculator (EPIC™) can assist equipment manufacturers, distributors and contractors in this effort.[(9)] These tools enable comparisons of equipment alternatives, including, for example, "minimally code compliant" equipment versus equipment having the highest energy efficiency practically achievable. The tools also provide estimates of annual and lifetime:

- Energy cost savings
- GHG emissions reduction
- Cash flow impact under different project financing scenarios.

Use of such tools can align stakeholder interests and facilitate the "**everyone wins**" scenario that the industry needs to accelerate U.S. commercial and multifamily building GHG emissions reduction.

- **Building owners** win as they have the information needed to make a confident investment decision, particularly when more expensive, but more energy efficient equipment is purchased.

- **Equipment manufacturers** win as they accelerate sales of higher efficiency equipment.

- **Equipment distributors** win as they increase the percentage of higher efficiency equipment sales while earning a greater share of their contractors' business.

- **Contractors** win as their increased sales of higher efficiency equipment drives ticket size and profit margin and enables the inclusion of utility incentives which reduce project cost for their clients.

- **Utility program administrators** win as they accelerate high efficiency equipment projects for which incentives can be awarded. As a result, utility program administrators can take credit for the energy savings and the GHG emissions reduction captured via these projects.

- **State and local governments** win as they can take credit for GHG emissions reduction captured via these projects and can more quickly reach their ambitious GHG emissions reduction goals.

Conclusions

- States are moving aggressively to reduce building GHG emissions with a 40-50% reduction goal by 2030 as the average target.

- Commercial and residential buildings account for approximately 40% of total U.S. energy consumption and 29% of U.S. GHG emissions.

- SMBs (less than 50,000 SF) account for 94% of non-residential commercial buildings and 50% of the gross floor area. If multifamily apartment buildings with five or more units are added to the SMB sector, the category includes 95% of all commercial buildings and occupies 58% of the gross floor area. For this reason, unlocking the decarbonization opportunity in the SMB sector is mission critical if the U.S. is to achieve its ambitious GHG emissions reduction goal.

- If replacement equipment is required at the maximum energy efficiency practically achievable (MEEPA), it would add approximately $11 billion to the HVAC and LED lighting equipment market size and $11 billion to the contractor installation market size (this cost would be the incremental amount above the cost for installing only "code compliant" equipment).

- HVAC and LED lighting energy savings resulting from MEEPA equipment replacement could amount to 83 trillion Btu/yr. with an annual reduction of over 11 million metric tons of GHG emissions as CO_2e. The lifetime (20 year) reduction in GHG emissions would be approximately 223 million metric tons as CO_2e.

- Even if all building owners were to install MEEPA replacement equipment, achieving a 50% reduction in GHG emissions by 2030 does not appear possible. As such, reaching this goal would require mandates on buildings with equipment not at the end of their useful life. These mandates would need to be accompanied by financially attractive government or utility incentives for building owners to accelerate their equipment replacement decisions.

- There are existing tools, such as EPIC™, that can help make the business case for more energy efficient equipment by cost effectively estimating energy cost savings, cash flow impact under various financing scenarios, and GHG emissions reduction for different scenarios including comparing "minimally code compliant" equipment versus "above code" equipment, such as might be done by comparing conventional heat pumps with more expensive, but more energy efficient variable refrigerant flow heat pumps.

In the final analysis, when more energy efficient equipment is installed, everyone wins, i.e., building owners, equipment manufacturers, distributors, installation contractors, utility program administrators and state and local governments – and the industry can accelerate its mission critical building decarbonization initiative.

References

(1) White House Release, April 22, 2021.

(2) Center for Climate and Energy Solutions, March 2021.

(3) National Conference of State Legislatures, September 22, 2021.

(4) Alliance to Save Energy, 2021.

(5) Building Energy Reporting and Disclosure Ordinance, Boston, MA, October 2021. Building Energy Performance Regulations, City and County of Denver, CO, December 2021. Executive Order 2021-09: Driving Accelerated Climate Action, Seattle, WA, November 2021.

(6) Commercial Building Energy Consumption Survey (CBECS), 2018.

(7) Residential Energy Consumption Survey (RECS), 2015.

(8) Assumed 20 year weighted average useful life of multiple energy conservation measures, e.g., high efficiency air conditioning and heating systems, LED lighting, etc.

(9) Sustainable Real Estate Solutions, Inc. (SRS), *Energy Performance Improvement Calculator* (EPIC™) past-energy improvement projects' installed cost and energy savings database, 2021.

(10) Installing equipment at state-of-the-art maximum practically achievable energy efficiency is estimated to entail a 20-30% premium.

(11) U.S. EPA 2020 AVERT v 3.1 Emission Rate Database, October 2021.

(12) Commercial Building Energy Consumption Survey (CBECS), 2012 (Note: the 2018 CBECS has not yet published energy consumption values).

(13) Assumed average lifetime of energy conservation measure bundle of 20 years.

(14) U.S. EPA's Inventory of U.S. GHG Emissions and Sinks: 1990-2019, EPA-430-R-21-005, April 2021.

About SRS

The Sustainable Real Estate Solutions, Inc. (SRS) leadership team, comprised of veterans with 25+ years' experience in the commercial real estate information services market, has a proven track record developing cutting edge technology solutions. Since 2010, SRS has pioneered new cloud-based building energy performance assessment, project optimization, and investment underwriting solutions through its proprietary software, data, and analytics platform.

SRS's latest innovation is the Energy Performance Improvement Calculator (EPIC™) – an easy-to-use app that empowers energy efficiency professionals, in real time with minimal data inputs, to estimate the energy savings, GHG emissions reduction, and financial impacts of their projects. The result is a user-friendly business case that enables a building owner to confidently invest in high efficiency equipment. For more information, please visit our website.

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