

Opportunities to decarbonize small commercial buildings leveraging energy efficiency

Kassandra Grimes, PhD, ORISE Fellow, Building Technologies Office, US DOE^{1,2}

Rois Langner, National Renewable Energy Laboratory (NREL)

Diana Raggio, Office of Financial Assistance, US DOE²

Cedar Blazeck, Building Technologies Office, US DOE²

ABSTRACT

Small commercial buildings that are less than 50,000 square feet make up almost 95% of the U.S. commercial building stock and consume more than 40% of commercial building energy. These buildings often house spaces that build community such as small businesses, houses of worship, schools, civic centers, and offices. It is a broad and expansive sector and small commercial building owners and tenants often do not have the resources, awareness, capital, or capacity to consider energy efficiency improvements. These challenges make small commercial buildings a hard-to-reach segment for decarbonizing the U.S. building stock. In addition, stresses caused by the COVID-19 pandemic have further exacerbated the already capacity-strained small commercial building sector. In order to achieve national net zero emissions goals, cultivate healthy indoor air quality, and support the economy, it is imperative to prioritize efforts to reach small commercial buildings.

In this paper, we build on the U.S. Department of Energy (DOE) Building Technologies Office's (BTO) lessons learned from efforts focused on small commercial buildings including NREL small buildings research and initiatives, the Green Lease Leaders program, several BTO cooperative agreement demonstration projects, findings from six recent BTO small commercial building stakeholder engagement efforts, and the Industrial Assessment Centers (IAC) commercial building assessment pilots. Summarizing these efforts, we describe barriers and challenges for small commercial buildings to implement energy efficiency solutions, best practices, opportunities, and lessons learned from each activity. We end with synthesized strategies for developing more compelling programs for small commercial buildings, particularly emphasizing solutions for underserved communities.

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Introduction

The small commercial building sector is vast and very diverse. Small commercial buildings, defined as 50,000 sq. ft. or less, make up 94% of the U.S. commercial building stock by number (Figure 1a), 51% of square footage, and account for 44% of national commercial building energy consumption (Figure 1b) (CBECS 2012 and 2018). Furthermore, the majority of commercial buildings (over 70%) are smaller than 10,000 sq. ft., and often house small businesses (CBECS 2018 and Langner 2013). These small commercial buildings and businesses are essential for communities to function and thrive as they often include schools, houses of worship, community centers, retail, restaurants, food sales, inpatient healthcare, and offices (Figure 2).

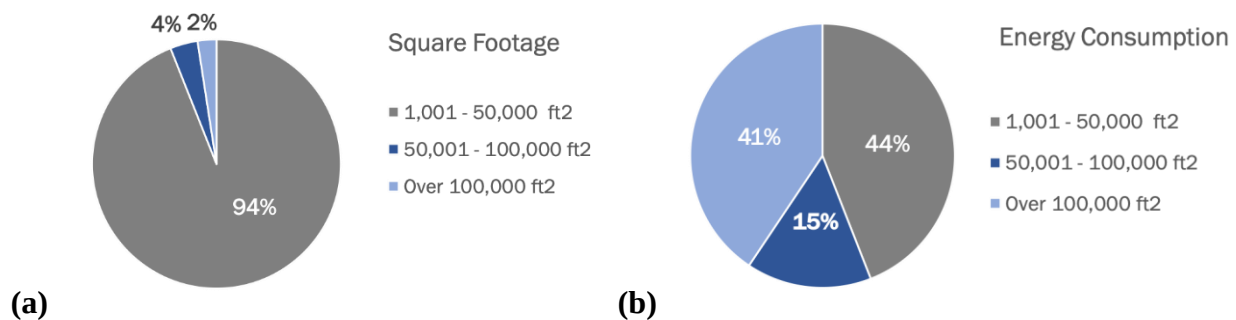


Figure 1. Breakdown of U.S. commercial building sector by (a) percentage of total buildings that fall within three square footage categories and (b) percentage of energy consumption for the three square footage categories. *Source data:* CBECS 2012.

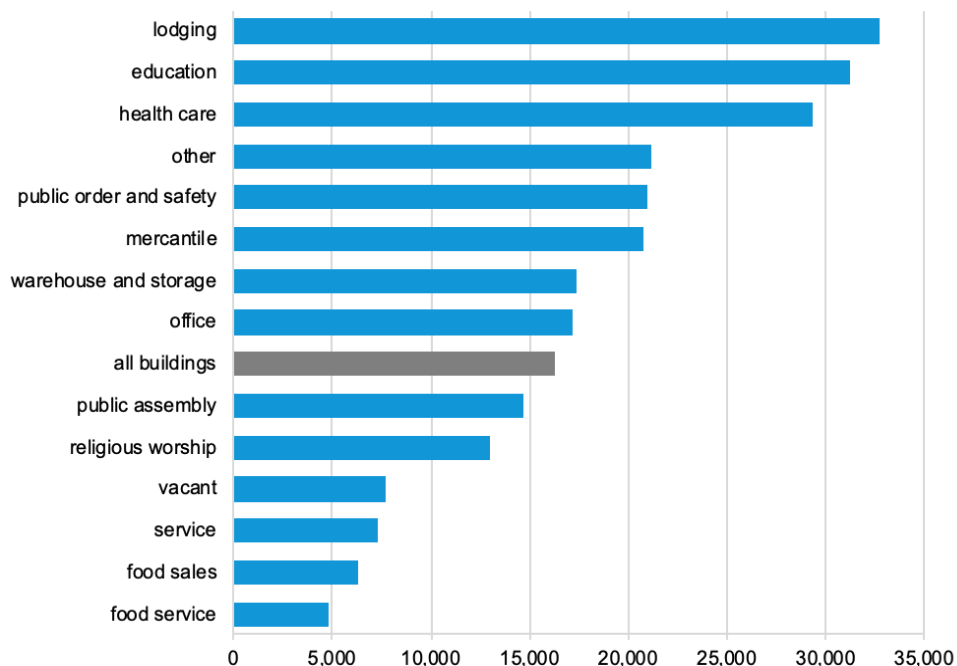


Figure 2. Average floorspace by principal building activity (sq. ft. per building). *Source:* CBECS 2018.

Small commercial buildings are frequently left behind in the energy efficiency marketplace because financial and technical resources have historically flowed to larger commercial buildings (Langner 2013). In addition, small commercial buildings and small businesses face many barriers; the largest reported include (Langner 2013):

- Limited capital
- Higher transaction costs relative to energy cost savings
- Lack of time to research and implement energy efficiency solutions
- Split incentive obstacles between owners and tenants
- Lack of available sector-specific resources and technologies

Other barriers exist as well, especially for small commercial building owners and tenants in low-income, rural, and underserved communities. Although these barriers were published in 2013, more recent stakeholder engagement and outreach efforts, documented in the “Small Commercial Business Webinar Series Findings” section of this paper, confirm that these barriers still exist today. Energy and financial markets often cater to larger players, and energy efficiency solutions are more easily adopted by companies with larger building portfolios (Langner 2013). Small commercial buildings are also similar to the residential buildings market in that decisions are often motivated by convenience and emotional drivers (Langner 2013). Additionally, small commercial buildings typically do not have a designated building operator or maintenance worker to handle energy upgrades and properly maintain equipment. Furthermore, many small commercial buildings are leased spaces and may frequently cycle through new tenants, so it can be challenging to track long-term energy use and maintenance data for the building.

Despite the challenges, the small commercial building sector remains a large segment of the U.S. building stock and proportion of U.S. building energy consumption (Figure 1). In order to achieve the nation’s goal of net-zero emissions no later than 2050, decarbonization of the small commercial building sector needs to be addressed and realized. Showcasing best practices from successful decarbonization programs tailored to small commercial buildings, and scaling and replicating these across regions can help the U.S. stay on course to achieving this important climate goal.

The U.S. Department of Energy (DOE) Building Technologies Office (BTO) has recognized the hurdles and has worked with the small commercial building sector through several programs and projects to address barriers and accelerate the uptake of decarbonization technologies and techniques. This paper reflects on those efforts, identifying common barriers and summarizing successes, lessons learned, and best practices. Efforts summarized include focused research on small commercial buildings conducted by NREL, DOE’s Green Lease Leaders program, several DOE cooperative funding awards focused on energy efficiency solutions for small and medium commercial buildings, BTO’s Small Commercial Business webinar series, and preliminary outcomes from the new DOE IAC commercial building assessment pilot program.

The goal of this paper is to share guidance and valuable lessons learned with other energy efficiency program administrators including, but not limited to, state and local governments, utilities, contractors and trade associations, industry, nonprofits engaging with communities on decarbonization, and other entities developing energy efficiency incentive programs.

NREL Small Buildings Research and Initiatives

DOE's BTO recognized the large potential for energy savings in the small commercial buildings sector and the need for sector-specific resources to accelerate adoption of energy efficient technologies and practices. Funded by DOE, NREL published a report in 2013 on the small commercial building sector that identified key barriers, approaches, and strategic priorities that BTO could explore to support this sector in implementing high-potential energy efficiency opportunities (Langner 2013). In this report, the authors highlighted a large link between small buildings and small businesses, acknowledging that small businesses are a major driver of the U.S. economy, even though they operate on slim profit margins (Forbes 2022). Reducing energy expenditures would greatly impact small business bottom lines (Langner 2013). This relationship sparked further research and collaboration with Main Street America, the U.S. Small Business Administration (SBA), a nonprofit green bank, Michigan Saves, and an energy insurance company. Output from these efforts included:

- A simple spreadsheet tool for small commercial office buildings to identify cost-effective energy efficiency technology packages (Langner 2014a)
- A report focused on reducing transaction costs and analysis of economic risk associated with building performance uncertainties (Langner 2014b)
- Stakeholder engagement with Main Street America and SBA, along with a series of guides and online resources for SBA borrowers and lenders (NREL 2015)

Several observations and key takeaways were noted from this multi-year effort. While the resources created under this effort contributed to a wealth of knowledge about and for this sector, the adoption of suggested practices was limited. The following observations explain some of the hurdles and opportunities this work highlighted:

- **Small businesses lack time, motivation, and resources to invest in building upgrades.** Small business owners are often so focused on their business, there is little room to focus on anything else, including building upgrades. If a small business is motivated to upgrade their building, the motivation is often based on convenience and emotional drivers. Typically, small businesses lack the time and expertise to research and implement appropriate energy efficiency solutions. Capital can also be limited, even though various financing opportunities exist. Many small businesses take the approach that “if it ain’t broke, don’t fix it,” and when something does fail, a contractor is called and typically a less efficient piece of equipment is installed. In addition, if a small business is a tenant in a small commercial building, split incentive obstacles between the owners and tenants can be a significant barrier to implementing any energy efficiency upgrades.
- **Analysis tools are often either too complex or too simplified to support small businesses and small commercial buildings.** Simplified tools that show potential cost-effectiveness of energy efficient technology packages are often not specific enough to individual projects. Stakeholders found the results of the developed spreadsheet tool for small commercial office buildings interesting, but not helpful in determining upgrades for particular projects. Larger efforts to engage with and train contractors to regularly install efficient technologies would be more impactful to this sector. Existing supply chains should also be reexamined to ensure contractors have easy access to the most efficient

technologies available and that financial incentives (often through utilities) are streamlined to offset equipment costs. If contractors were regularly installing higher-efficiency technologies, this would also help drive greater energy equity across the sector, especially in disadvantaged and rural communities.

- **Bottom-up leadership is crucial.** Local, trusted community organizations can reach wider audiences of small buildings and businesses more effectively because they are integrated community members. Supplying information and resources to support these types of organizations could better position them to drive even bigger impact within their jurisdictions. Community organizations like these are critical in impacting the hardest-to-reach small commercial buildings, especially those found in disadvantaged and rural communities, because of the trust they have built in their communities.
- **Top-down leadership also drives success.** When engaging with larger organizations that have missions to serve small businesses and small commercial buildings, top-down leadership is critical to the success of their programs. The work conducted with Main Street America and the SBA was enthusiastically received; however, top-down leadership was not established to maintain stakeholder engagement and participation quickly dissipated after DOE support ended. It would also be beneficial to have executive leadership in these organizations and agencies approve the integration of better information on energy efficiency into existing systems and processes, so that energy efficiency is not an added consideration, but part of standard processes.

A tremendous amount of work is needed to support the small commercial building sector in improving building performance. Energy equity and justice should be at the forefront of this work, with a focus on reaching the hardest-to-reach small commercial building stakeholders. When those stakeholders are supported, the rest of the sector will see vast improvements.

Green Lease Leaders

Over 30% of small commercial buildings in the U.S. are occupied by tenants who lease the spaces they occupy (CBECS 2018). Traditional commercial real estate leases present a problem of the “split-incentive,” where the benefits of investment in energy efficiency upgrades are received by the tenant, while the landlord bears the cost of equipment upgrades. Tenants must rely on the equipment that is already in place, or equipment that a landlord selects. Landlords are not incentivized to pay higher upfront costs for energy efficient equipment because they will not be receiving the payback over time.

In order to address the split incentive challenge, DOE’s Better Buildings Alliance and the Institute for Market Transformation (IMT) launched the Green Lease Leaders program in 2014 to provide a framework and set the standard for what constitutes a “green lease” between landlords and tenants in commercial spaces. The program hosts a website that provides green lease resources such as sample lease language that organizations can incorporate. Each year, the Green Lease Leaders program recognizes landlords and tenants who have successfully incorporated green language into their standard leases. To date, nearly 50 organizations representing over 4 billion square feet of real estate have applied for recognition.

The multiple case studies produced by the Green Lease Leaders program provide insight into strategies for engaging small commercial building tenants in energy efficiency measures. Although the Green Lease Leaders program often caters to large Class A office space landlords, several small commercial building landlords have also been recognized. MAN Holdings LLC is

a privately owned real estate firm that rehabilitates, renovates and stabilizes existing Class B and C commercial office spaces as well as affordable multifamily housing. To improve their leasing structure, MAN Holdings LLC incorporated clear expectations for tenant energy use based on example leases from IMT including water use, expectations for office air conditioning, and turning off lights after business hours. MAN Holdings LLC also partnered with the local chamber of commerce for the City of Cleveland, which began emphasizing energy efficiency in the early 2010s, to seek out incentives and financing for improvements made in their leased spaces (Green Lease Leaders 2019).

The COVID-19 global pandemic has presented new challenges for maintaining health and safety in occupied commercial spaces. TD Bank, a long-standing champion of sustainability and a major owner and operator of small commercial buildings, encourages landlords to prioritize health and wellness by incorporating indoor environmental quality metrics for air filtration and outdoor air delivery that meet ASHRAE and WELL building standards and recommends employee access to fitness and nutrition options in their lease language (Green Lease Leaders 2018). Throughout the pandemic, Kimco, a platinum Green Lease Leader and Real Estate Investment trust with over 500 properties, sent regular communications to tenants about critical government updates and health notices, and even provided a “Tenant Assistance Program” to connect tenants with government-sponsored relief funding (Green Lease Leaders 2021a). The health and safety of building occupants should always be a priority and presents a unique opportunity to capitalize on the dual benefits of healthy and efficient investments. For example, many commercial buildings capitalized on lower building occupancy during lockdowns and performed upgrades to HVAC systems, resulting in both enhanced filtration of COVID-19 viral particles and improved energy efficiency (Green Lease Leaders 2021b).

The following recommendations for small commercial building owners and energy efficiency program administrators have emerged through the Green Lease Leaders program:

- **Incorporate “green language” into leases.** Small commercial building energy efficiency programs should share green lease language and other resources to support building owners who wish to lease more efficient spaces. Likewise, tenant organizations should familiarize themselves with typical green lease language and work with landlords to incorporate mutually beneficial clauses. As stated by Green Lease Leaders, “Green leasing is a key tool for cities and chambers of commerce across the country to inform businesses on city-wide action plans, helping them to participate in initiatives that benefit them directly and connect them to city services and resources.” (Green Lease Leaders 2019)
- **Leverage local energy efficiency champions.** Small commercial business owners can partner with local chambers of commerce or energy efficiency organizations to locate incentives and financing for projects.
- **Provide additional services.** Chambers of commerce are often successful because they provide a variety of resources to meet the needs of local businesses and are a trusted organization within a community. Energy efficiency programs and organizations can investigate opportunities to extend their suite of services or team up with other local organizations to become a “one-stop-shop” for fulfilling multiple business owner needs.
- **Emphasize mutual benefits.** Energy efficiency programs focused on small businesses should emphasize the non-energy benefits (NEBs) of energy efficiency, such as healthier indoor environments from improved ventilation, better lighting, and more comfortable

temperatures. Certain investments, such as newer HVAC equipment and smart thermostats, can lead to greater occupant comfort and higher employee satisfaction.

BTO Small Commercial Building Cooperative Agreement Projects

The Commercial Buildings Integration (CBI) program of BTO plays an important role in identifying and developing strategies and technologies to reduce commercial building energy consumption. CBI frequently funds projects to demonstrate underutilized but innovative and cost-effective technologies and measures that produce significant energy savings and improve overall building performance. BTO developed two funding opportunity announcements (FOAs) in 2013 and 2015 to address barriers identified by stakeholders and the industry at large for small- to medium-sized commercial buildings.

In 2013, BTO published DE-FOA-0000822 entitled ““Turn Key” Open Source Software Solutions for Energy Management of Small to Medium Sized Buildings,” focused on software solutions to manage energy consumption in small- to medium-sized buildings. Over 90% of the buildings in the U.S. are either small (<5,000 sq. ft.) or medium (5,000 sq. ft. - 50,000 sq. ft.) in size (Building Technologies Office 2013). These buildings were identified as the primary target because they historically did not use building automation systems (BASs) to monitor and control their building systems from a central location. A significant portion of the energy consumed in buildings is wasted because of the lack of building controls or the inability to use existing BASs properly, which represents a major gap in the market (Building Technologies Office 2013). This FOA sought to develop “turn key” BAS solutions using Open-Source software and architecture tailored to advance opportunities for energy efficiency for small and medium buildings. BTO selected projects with the University of California, Virginia Tech, and Carnegie Mellon University. The University of California (Peffer 2015) and Virginia Tech (Rahman 2017) successfully demonstrated the functionality and capability of their individual software platforms within at least one medium-sized commercial building. The platforms included the integration of HVAC, lighting, and general-purpose controllers. The Virginia Tech software solution, BEMOSS, offers publicly accessible source code, installation, and developer guides (Rahman 2017). The University of California-Berkeley software is also publicly accessible (Peffer 2015). Despite the success of the BAS systems during demonstration, it remains unclear whether or not the platforms have been useful for small- or medium-sized commercial buildings outside of the projects. A lesson learned from this project is that market uptake of advanced systems technologies are unlikely to penetrate the market without companion programs that can provide more targeted support for installing BAS in small and medium commercial buildings.

In 2015, BTO published DE-FOA-0001385 entitled “Solutions to Improve the Energy Efficiency of U.S. Small and Medium Commercial Buildings,” with a focus on solutions to market barriers that hinder the growth of energy efficiency in small and medium commercial buildings such as split incentives, inadequate information, higher upfront costs and high investment rates (Building Technologies Office 2015). The objective was to create pathways for scalable market-ready solutions to be used across the U.S. to improve commercial building energy efficiency. Projects of interest were those that impacted a significant geographic and/or market sector and operated at least 100 buildings or separately metered tenant spaces. Six projects were selected and funded under the FOA, representing a range of stakeholders across the

country: ICAST; City of Seattle; Institute for Market Transformation; Association of Bay Area Governments; NextEnergy Center, and Lime Energy Company. All the projects submitted publicly available final technical reports through DOE's Office of Science and Technical Information website.

The City of Seattle successfully engaged with the small and medium commercial building market. The City created a program entitled "Building Tune-Up Accelerator" to encourage mid-sized commercial buildings of 50,000 – 100,000 sq. ft. and smaller commercial buildings 20,000 – 50,000 sq. ft. to meet the requirements of a building energy and water performance mandate earlier than scheduled (Ballinger 2020). During the life of the project, 102 mid-sized buildings completed the Tune-Up program, representing 6.9 million sq. ft., 67.9 million kBtu per year of projected energy savings, and a 12% reduction in greenhouse gas emissions. The City's utility collaboration to create incentivized early compliance paths and engage both the building owner and the service provider was cited as the key to meeting their energy and climate goals.

Five of the awards completed their projects, but some experienced scope and schedule delays among other difficulties with participant sites. One of the project teams recognized that more robust engagement strategies, marketing, and methodologies were needed and the lack of utility incentives in their region restricted payback terms and diminished appeal to customers. Other awards established guides and resources that are publicly available (Freed 2019), while another incorporated pilot activities into standard energy efficiency programming (Osborn 2020).

The two BTO FOAs and their subsequent awards illustrated that there are still critical barriers for small- to medium-sized commercial buildings including lack of capacity to evaluate and implement energy efficiency updates, focus on short-term return on investment rather than the long-term benefits, market education, and limited access to low-cost and low-hassle financing for upgrades.

Small Commercial Business Webinar Series Findings

Spanning January through March of 2021, BTO hosted a series of 5 "small portfolio" webinar discussions centered on small businesses and other hard-to-reach small commercial building sectors. The sessions involved over 60 participants from various U.S. regions and sectors including utility providers, nonprofits, higher education, state and local government, and industry. The goal of the webinars was to hear from stakeholders about challenges and best practices for engaging small commercial buildings in energy efficiency programs. The topics discussed ranged from energy efficiency implementation challenges to strategies for catalyzing local energy efficiency workforce capacity in underserved communities.

Several barriers to energy efficiency for individuals and organizations operating small commercial buildings were identified by webinar participants. Insufficient awareness and market education of energy efficiency measures was the greatest barrier followed by lack of access to capital, issues with split incentives for leased spaces, lack of access to financing options, and lack of time to focus on energy efficiency, especially for small business owners and mission-driven organizations who are juggling many other priorities.

Despite challenges faced by small commercial building stakeholders, webinar participants also cited several motivations for energy efficient upgrades in small commercial buildings. The most common motivation is equipment failure (typically HVAC, lighting, and refrigeration), so opportunities to replace equipment that provide cost-savings and NEBs such as

improved indoor air quality are likely to drive small commercial building owners toward energy efficient options. For small businesses, implementing energy efficiency measures and setting decarbonization goals may also improve their bottom line. When businesses implement sustainability measures, it often improves employee morale and can boost sales, especially among customers who are climate conscious. In some locales that have set climate goals, small commercial building stakeholders are motivated to participate in energy efficiency programs to adhere to local policies and take part in incentive programs.

Webinar participants also emphasized workforce skills training and local capacity building as a major priority for the U.S. clean energy transition. Participants highlighted the need for programs that give trainees hands-on experience in conducting building audits, installation, and maintenance of energy efficient equipment. Boosting workforce training programs for entry-level and transitioning workers at community colleges was identified as a key priority for building local workforce capacity in clean energy fields. Training programs with local utility, organization, and contractor partnerships can be particularly effective for developing a skilled workforce and addressing barriers for small commercial buildings.

The following section summarizes participant recommendations to energy efficiency program administrators for overcoming barriers in the small commercial building sector. To address awareness, technology, and time barriers:

- **Raise awareness of the benefits of energy efficiency measures**, especially highlight cost savings and any NEBs. Relating benefits to an organization's mission can also be a very powerful tactic. One example for a meal program facility could be converting cost savings from energy efficiency measures into additional meals that can be served.
- **Consider market analyses to identify which buildings to target for specific rebates and resources**. Use advanced metering infrastructure (AMI) data to identify buildings with the greatest potential savings for energy efficiency upgrades.
- **Partner with utilities**. Utilities can improve access to support and incentives and reduce transaction costs. Some examples include improving outreach with contractor case studies and media, expanding the list of technologies eligible for energy efficiency programs, and improving access to support through opt-out rather than opt-in approaches.
- **Partner with trusted community groups**. Trust in utilities varies in different regions and communities, so partnering with community groups and building relationships can help elevate energy efficiency as a priority while increasing visibility of community needs.
- **Partner with local small commercial building service providers**. In addition to utilities, small commercial businesses and organizations often seek support through local organizations such as economic development organizations, SBA, city/town energy committees, contractors, state/national programs, and nonprofits, so it is important to work with these groups on energy efficiency messaging.
- **Provide hands-on support**. Energy efficiency programs that act as a "one-stop shop" (i.e. facilitating the audit through implementation phases) for small commercial buildings such as Southface Good Use, Michigan Saves, and Duke Energy's Small Business Energy Saver Program have had significant success and are great models to replicate and scale. These programs also offer customers assistance with paperwork for energy efficiency implementation to help overcome time constraints and build trust.

To address financing barriers:

- **Bundle incentives to increase return on investment for small commercial buildings.** Individuals are often more familiar with solar technologies than energy efficiency, so developing incentive programs that bundle energy efficiency with renewable energy may more effectively reach small commercial building customers. Bundling measures for small buildings can also be more appealing to energy service companies and contractors.
- **Address split incentives.** Different leasing structures, such as triple net leases or green leases, or Building Performance Standards can help address split incentives.
- **Offer compelling financing options.** Small commercial building stakeholders tend to be most interested in on-bill financing with 0% interest and no up-front payments.
- **Begin with a free audit/assessment.** Spending time one-on-one with small commercial building customers through an initial free assessment helps address lack of time and capital to investigate energy efficient solutions, builds trust, and promotes interest in energy efficiency. During the Covid-19 pandemic, virtual audits have been successful in reaching small commercial buildings. Maintaining virtual audit options for small commercial buildings can improve accessibility to energy efficiency resources, especially in more remote rural regions. However, for individuals who may be distrustful of energy service providers, in-person audits may be preferable to help build trust.
- **Provide simple turn-key programs.** Turn-key and direct-install programs with pre-approved vendors can help streamline the paperwork process and decision-making and reduce capital costs.

To address workforce development and training:

- **Engage with utility network contractors** to ensure there is proper training for installation and maintenance of the latest technologies. Ensure that training includes building awareness of both energy and NEBs of a technology. Likewise, it's important for contractors to be familiar with financial incentives and regional/local utility programs.

Initial Lessons Learned from the IAC Commercial Assessment Pilots

The IAC program is administered through the Advanced Manufacturing Office (AMO) of DOE and was first established in 1976. The goal of the program is to train engineering students at Accreditation Board for Engineering and Technology, Inc. (ABET)-accredited U.S. schools in energy efficiency and to conduct free energy assessments for small and medium-sized manufacturers. The program is competitively funded on a five-year cycle and awards made to teams at 30+ universities located in different geographic regions of the U.S. The IACs have conducted >19,500 assessments since their establishment and teams typically identify >\$130,000 in potential annual savings for every manufacturer assessed. More than 60% of students trained through the IAC program have gone on to pursue energy-related careers after graduating (IAC 2022).

Small- and medium-sized manufacturers are eligible to receive a no-cost IAC assessment if they meet certain criteria related to size, annual sales, and annual energy costs. The IAC assessment process involves a 1-2-day site visit to take measurements and a detailed analysis to develop specific recommendations and estimates of performance, costs, and payback times.

Within one year after the initial assessment, the IAC checks in with manufacturers to verify which recommendations have been implemented. A database of assessments, recommendations, and case studies for the IAC program are publicly available on their website (IAC 2022).

For the 2021 IAC FOA cycle, AMO and BTO developed a second topic for a pilot commercial building assessment program in which IACs would partner with local community colleges. Aligned with the IAC model, the commercial assessment pilots train students in conducting no-cost energy efficiency assessments of commercial buildings in their locales that are 100,000 sq. ft. or less. The pilots develop curricula for trainees, recruit commercial building clients, and conduct hands-on assessment training, and follow-up with clients on implementation. Nine commercial building assessment pilots were selected through the 2021 IAC FOA. Although the program was recently established, two of the awarded pilots have already started the client recruitment process and one has completed several commercial building assessments.

Oregon State University (OSU) and Lane Community College (LCC) are planning several retail space assessments this semester. LCC and OSU are partnered with Energy Trust of Oregon to connect clients with energy efficiency incentive programs and subject matter experts to help with the implementation process. Energy Trust also provides supplemental wage funding to support on-the-job training for new apprentices. LCC and OSU are working with the diversity, equity, and inclusion (DEI) manager of Energy Trust to identify k-12 schools in underserved areas that will also be prioritized for upcoming assessments.

Louisiana State University (LSU) has completed seven commercial building assessments in partnership with Entergy Solutions, a regional utility based in Louisiana. Entergy Solutions offers a range of incentive programs for commercial building efficiency upgrades and provides training to a pre-approved network of local trade ally contractors. So far, the team has conducted assessments and identified an average of 35% energy savings for museums, retail spaces, and warehouses. LSU is scheduling additional assessments for office spaces, hotels, and k-12 schools in the coming months.

The LSU IAC had one particularly impactful experience when they assessed a local 60,000 sq. ft. museum. The museum had reached out to the team over concerns that their energy bills had recently doubled. Their energy consumption was more than twice that of much larger buildings the LSU team had assessed. During the on-site assessment, the clients revealed they had recently upgraded to a new chiller. The team immediately identified several errors in the chiller settings and installation and were able to provide on-the-spot corrections that resulted in a 75% reduction in the client's utility bills the following month.

The LSU and Entergy Solutions team shared several lessons learned from their initial assessments. Their first lesson was to reach out to building owners rather than occupants or operators to streamline the initial energy data collection process. They found that building occupants and operators were less likely to have access to long-term records of their building that are needed to identify past performance issues and maintenance. However, in working with building owners to address building record issues, the team discovered that energy saving recommendations need to be marketed strategically since building owners are less interested in cost and energy saving benefits than tenants. The team found that marketing their energy saving recommendations as an opportunity to improve rental value, rental income, and provide a competitive advantage in the building market are more compelling incentives for building

owners. By implementing energy efficiency measures, older buildings can secure tenants more quickly and better compete with new construction.

Developing a mutually beneficial utility partnership has been critical to the team's success. LSU can provide more robust recommendations based on Entergy's incentive program offerings and connect clients with trade allies to complete the work. Six of the seven clients have already implemented at least one program incentive. Conversely, LSU has played a critical role in expanding Entergy's client outreach. LSU is highly respected in the region and the team has found that commercial building owners who were formerly distrustful of Entergy's marketing are more responsive to the same programs when backed by LSU. LSU and Entergy have also collaborated on training, which has been beneficial in expanding the educational offerings for both the LSU students and Entergy's trade allies and community college partners. The partnership has also helped students connect directly with potential employers and career advancement opportunities.

The team cited connecting with their clients beyond the assessment phase as another major lesson learned. They found that cultivating a continued relationship with clients has resulted in greater implementation success and clients who are eager to spread the word about the program, which is attracting new clients.

Furthermore, the team identified a few challenges including fewer energy saving opportunities for buildings under 20,000 sq. ft. and the need to develop additional partnerships to reach other types of buildings. In order to tap into other building types, the team is developing new partnerships with local entities such as hotel associations. Despite its early stages, the IAC commercial building pilot program is providing meaningful insights for working with small commercial buildings that will enhance future DOE programs for small commercial buildings.

Summary: Recommendations for Programs Seeking to Decarbonize Small Commercial Buildings

The case studies discussed in this paper provide examples and lessons learned for designing successful small commercial building programs that can be replicated and scaled to other regions and organizations to promote small commercial building participation in energy efficiency and decarbonization efforts. However, it is clear that many barriers still exist in the small commercial buildings sector, and it is critical to consider local nuances and prioritize the needs of underserved and energy burdened communities in order to most effectively and equitably transition to a clean energy future. The following section synthesizes the major recommendations from the case studies discussed to help entities engaging in energy program administration better engage with small commercial buildings. Examples of primary entities who may be able to act on each recommendation are provided in italicized parentheses before each recommendation.

Recommendations to address *market awareness* of energy efficiency and decarbonization technologies:

- (*Utilities³, state and local governments, state energy offices*). Prioritize development of effective marketing materials and outreach efforts for local incentive programs and emphasize energy and NEBs. Pursue connections and partnerships with trusted community organizations to adopt and promote these resources.
- (*Utilities, state energy offices*). Develop and widely share local case studies to showcase decarbonization success stories and build interest and awareness of local program opportunities and offerings.
- (*Utilities, state and local governments, state energy offices, advocacy organizations*). In regions where multiple languages are spoken, translate marketing materials into appropriate languages so that information about decarbonization is accessible to nonnative English speakers. If your organization does not have an individual who can translate, consider hiring an external professional to translate documents.
- (*Utilities, state energy offices*). Partner with trusted community organizations such as chambers of commerce to engage with new and harder-to-reach audiences.

Recommendations for *workforce development and contractor training*:

- (*Utilities, state energy offices, contractors, workforce trainers*). Career interest and awareness begins at a young age. Consider outreach with k-12 schools to showcase opportunities in clean energy and green technologies. It is important to also engage guidance counselors, career counselors, teachers, and guardians in these activities.
- (*Utilities, state and local governments, state energy offices, workforce trainers*). Work with local allied trade partners and contractors to incorporate skill competencies for energy efficient technology installations into existing training programs. Identify existing certification programs that meet the criteria and align with incentive programs. Connect participating partners with existing incentive programs.
- (*Utilities, state and local governments, state energy offices, workforce trainers*). Equipment failure is typically the main reason upgrades are made in the small commercial sector. Programs that educate contractors on local energy efficiency programs and opportunities will be better poised to present these options to customers. Streamlining contractor access to energy efficient technologies and any associated financial incentives would also help arm contractors with more immediate access to better equipment.
- (*Utilities, state and local governments, workforce trainers*). Provide employee wage subsidies or other incentives to support participation in green technology and clean energy training programs.

³ 'Utilities' includes utility program administrators

Recommendations for *implementing decarbonization measures* in small commercial buildings:

- *(Utilities, state and local governments, state energy offices, advocacy organizations)*. Work with trusted community partners and organizations to share information about available programs and opportunities. Work with trade allies, contractors, and training providers to supply local professionals with the right information to implement efficiency measures cost-effectively.
- *(Utilities, state energy offices, contractors, researchers)*. Identify and showcase NEBs of energy technologies and relate savings to the business or organization's mission.
- *(State and local governments, state energy offices)*. Encourage and provide examples of green leases for local commercial real estate firms.

Recommendations for *program design and administration*:

- *(Utilities, state and local governments, state energy offices, advocacy organizations)*. Build opportunities for meaningful community stakeholder engagement into the program development process. This process allows stakeholders to have co-ownership of decisions impacting their community and results in more effective program development.
- *(State and local governments, state energy offices)*. Partner with local utilities to develop incentive programs and work with trusted community groups to help spread the word.
- *(State and local governments, state energy offices)*. Consider opportunities to motivate participation. This could be as simple as publicly announcing participants of a program. Providing near-term incentives can be especially effective for promoting efficiency measures that may correspond with longer payback periods (Shome 2009).
- *(Utilities, state and local governments, state energy offices)*. Be specific in eligibility criteria to ensure the target audience will receive the intended benefits. One way to do this is to designate a certain percentage of the funding toward that targeted audience (Brooks et al. 2022).
- *(Utilities, state and local governments, state energy offices, advocacy organizations)*. Translate marketing materials and application paperwork into languages spoken in the targeted region.
- *(Utilities, state and local governments, state energy offices)*. Provide technical assistance and support applicants in navigating the application process.
- *(Utilities, state and local governments, state energy offices)*. Publicize opportunities through avenues that are likely to reach small commercial building owners and occupants such as local lenders, SBA, and chambers of commerce.
- *(Utilities, state and local governments, state energy offices)*. Bundle incentives as much as possible for greater energy and cost savings impacts.

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