

Decarbonizing the Building Sector: A Human-Centered Study Focused on Small/Light Commercial Building Energy Equity

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ABSTRACT

Decarbonization of the building sector is no small feat; buildings account for 40% of primary energy consumption, and fossil-fuel combustion in buildings leads to roughly 30% of total greenhouse gas emissions. Energy efficiency, electrification and smart technologies are fundamental strategies to reduce consumption and shift away from fossil-fuel use in buildings. This energy transition carries significant societal risks unless the shift is carried out with equity and justice as a top priority. Low-income, vulnerable and communities of color have higher energy burdens compared to affluent populations. Furthermore, systemic racism and historic exclusionary policies have resulted in increased risks (environmental, climatic, economic, and social) to low-income and communities of color, and underserved communities often do not have financial resources for, or access to, advanced building technologies. The U.S. Department of Energy is funding research to characterize and develop solutions to the challenges of equity and justice that complicate the ability of communities to contribute to goals for decarbonization. Our project has a specific focus on small commercial buildings and the businesses that occupy them. Significantly less is known about the burdens and risks these businesses experience or the challenges they face in pursuing decarbonization, or how those are affected by income and race, in comparison to research on energy equity and justice for diverse households. The project team includes the Pacific Northwest National Laboratory, Arizona State University and Clark Atlanta University. Researchers are conducting semi-structured interviews with small business owners in underserved communities in Phoenix and Atlanta, followed by a survey distributed to the larger community to learn more about the equity and justice issues that communities with different racial, economic, and cultural backgrounds face. Results will help inform an actionable and replicable framework for engaging small commercial building owners/operators to catalyze the reduction of energy burdens and increase equity.

Introduction

In 2021, the Biden Administration announced an effort to reduce U.S. greenhouse gas emissions by 50-52% from 2005 levels, as part of the Build Back Better initiative (Whitehouse.gov 2022). The building sector is a large target for reductions since buildings consume 13.6 quads of electricity, and produce 826 million metric tons (16% of all U.S. carbon dioxide emissions) of greenhouse gas emissions every year (EIA 2020). Underpinning the entire energy transition is the willingness and ability of occupants to make decisions that support decarbonization. Decarbonization refers to the removal of fossil fuel consumption in the building

sector, meaning a transition to electrical systems and devices, or to alternative, “net zero” fuels. This transition will be made possible through a systems-approach to building technology, that includes highly efficient electric equipment for heating and cooling, energy management systems and highly efficient building envelopes.

Energy transitions are frequently defined in terms of “the change in the composition (structure) of primary energy supply, the gradual shift from a specific pattern of energy provision to a new state of an energy system” (Smil 2017) or, more generally, “anytime a large group of people began to obtain heat, light, and power in a new manner” (Jones 2014). For the purposes of this paper, it is important to highlight that energy transitions often include significant reorganizations of socio-energy systems (i.e., the social and institutional configurations that characterize energy systems), including the kinds of entities that provide energy, how they are managed and governed, how they relate to their customers, and the kinds of social practices and financial arrangements that customers participate in as they purchase and use energy (Miller et al. 2015).

Historic energy transitions (Allen 2009; Ayres and Warr 2009; Batoletto and Rubio 2008; Gales et al. 2007) have catalyzed the social, political, and economic transformations in the world. At one side, transition to the gas, electricity, and railways (Leunig 2006) in the nineteenth and early twentieth centuries have revolutionized some parts of the world (usually urban centers), on the other side, poor communities became marginalized over several decades. For example, early adoption of the automobile (as a new technology for converting gasoline into mobility) occurred predominantly among urban wealthy elites, while middle-income and rural populations occurred later, and around differently configured models designed to meet their needs (Kline and Pinch 1996).

Over time, as electrification has reached low-income, minority, and underserved communities, other challenges have arisen, including higher energy burdens (defined as the percentage of monthly income that goes to pay for energy), higher costs for energy services (typically because they have lower efficiency equipment or less insulation), disinvestment in electricity system upgrades, and environmental justice issues such as community proximity to energy infrastructure causing higher exposure to environmental pollution and health risks (Drehobl and Ross, 2020; Lewis, Hernandez and Geronimus, 2020; Jessel, Sawyer and Hernandez, 2019).

This situation is potentially as important for small businesses and small commercial buildings as it is for households. Small businesses, especially those owned/operated by people that are part of underrepresented groups, often have limited resources, fewer choices, or lack sufficient capabilities to escape the energy-poverty nexus or to reduce the carbon footprint of their businesses (Sen 2014). These businesses inhabiting small commercial buildings can face high energy burdens (e.g., due to inefficient devices, lack of insulation, or other inability to access energy upgrades), causing significant reduction in profitability and thus ability of owners to derive living wages.

While these issues have been studied in the residential sector, much less is known about the challenges faced by owners and occupants of small commercial buildings, especially those that are part of underserved communities. To better frame these issues, the U.S. Department of Energy is funding human-centered research in the small commercial building sector (buildings under 50,000 square feet) to understand the opportunities and barriers to decarbonization. This research is conducted through an equity lens and is designed to engage with communities that have been traditionally left out of the energy discourse. Using two field teams, small business

owners are being engaged in the Phoenix, AZ and Atlanta, GA metropolitan areas to identify energy equity issues present in urban areas. This paper will help understand energy-poverty nexus in small businesses as well as equity and justice implications for these businesses to achieve carbon neutrality.

Background

Carbon emissions from fossil fuels are intensifying the climate crises. This carbon burden could be eliminated through decarbonizing all sectors of the economy. Decarbonization poses complex and different sets of challenges to each part of the economy and every group of a community in a society. According to the Brookings' report, small businesses in the U.S. are responsible for 60-70% of total industrial emissions (Lashitew, 2021). In order to ensure the nation achieves decarbonization and energy transition benefits everyone, small businesses should be of focus. However, a better understanding of how they depend on energy, their ability to invest in energy upgrades (financial and otherwise), and resources available to assist small businesses is first needed and is the task of this project. Energy transition for these businesses will mean supporting these businesses in overcoming equity and justice challenges so that they can smoothly transition to reducing their carbon footprint.

Small commercial businesses are distributed, therefore, draw less attention of the research and energy efficiency organizations that might recommend energy upgrades. Small commercial buildings include offices, retail shops, warehouses, restaurants, and more. They are different than industrial units, residential buildings, apartment complexes in their energy consumption, number of occupants and the total space required for their operations. Small commercial buildings that are less than 50,000 square feet account for 90% of the total number of commercial buildings in the U.S. (Santiago, Vazquez and Parrish, 2016). A study undertaken by a group of researchers at ASU focused on energy savings potential of 31 small commercial spaces like offices, food sales, mercantile, multi-family residentia and a public building across different climate zones in the U.S (Santiago, Vazquez and Parrish, 2016). The finding suggests that commercial buildings are capable of at least 20% energy savings through energy efficiency retrofit measures.

Different governmental and non-governmental programs have been focusing on empowering small commercial businesses and buildings to reduce energy consumption by adoption efficiency measures (Carley and Konisky 2020). For example, the 2030 district network non-profit organization works throughout the world with a goal to establish a global network of high-performance building districts and cities. They have set up a technical toolkit for small commercial buildings like offices and retail buildings to guide building owners and operators in improving their building performance (The 2030 District Network). Challenges with HVAC and plug load retrofits were identified as these are more labor and cost intensive. Also, the Local First Arizona (LFA) non-profit organization works with small businesses through their "SCALE-UP" and "We Rise" programs. They offer support to bring sustainability into business practices. "We Rise" is business accelerator program at LFA that provides start-ups and minority-owned businesses support to gain skills and build successful and sustainable businesses.

Also crucial is the recognition that small business are highly differentiated, in their business operations and financial models. Thus, although small commercial buildings may have a lot of similarities, from an energy perspective, such as availability of electricity and natural gas, HVAC systems, etc., the small businesses that occupy these buildings and rely on these technologies integrate them into their businesses in very different ways.

Our goal is to answer a series of questions and help frame the complex issues that small commercial building owners and operators face. Specific goals of this research include:

- Identifying opportunities and barriers for small commercial businesses located in low-income areas to uptake energy efficiency measures such as efficient HVAC, added envelope efficiency and onsite renewables.
- Establishing an understanding about what energy transitions mean to small, minority-owned businesses and explore paths for decarbonization.
- Understanding the socio-economic and political challenges these business face in their energy transition pathway and how well they are prepared to overcome those challenges with/without incentives.
- Identifying gaps that energy policies can fill in order to have full participation and contribution from small businesses that are part of low-income communities regarding building decarbonization.

Many studies have established that low-income households and households of color are likely to live in energy inefficient houses, with energy inefficient appliances and high energy burdens that exacerbate their poverty situation (Carley and Konisky 2020; Dreholbe and Ross 2016; Hernandez Phillips and Siegel 2016; Reames 2016). In households, energy insecurity can contribute to poverty. Small businesses can face a similar set of energy insecurity challenges that cause high energy burdens, including difficulty paying their energy bills and compromising other business necessities. Because they often operate in rented buildings, they often have little or no control over building energy efficiency retrofits. As more data are collected, we will be able to present examples to understand the complexities and different facets of energy-poverty nexus in small and minority owned businesses.

Study Design & Methods

Human-centered approach. While small businesses may use similar energy sources, they have different consumption patterns and relationships with energy systems. Businesses also have different characteristics, such as business models and operational routines and practices, into which their energy consumption fits. Therefore, a human-centered or user-centered research approach was adopted to extract the practices, finances, values, socio-economic challenges and needs of small business owners to achieve carbon neutrality. This approach includes interviewing and surveying small business owners about their buildings, energy use and business operations.

Research method and the sampling strategy. The research employs participant observations and exploratory sequential design of a mixed methods approach. The study has two phases, focused in Phoenix, AZ and Atlanta, GA. The First phase of the study will be a qualitative exploration of energy transition phenomenon that will include collecting data on socio-economic and ethical dimensions of the commercial activities in buildings that are housing small businesses in the cities of Phoenix and Tempe in Arizona. Both are located in Maricopa County, one of the fastest growing urban regions in the country and a region with significant Hispanic, Native American, and Asian populations. In Georgia, the research team is led by Clark Atlanta University, and interviews will be focused on urban, Black/African American-owned and operated businesses. From this initial interviews with open-ended questions, the qualitative

findings will be used to develop assessment measures that can be administered to a larger sample, via an online survey.

Snowball sampling technique will be employed to recruit participants for the study. Business owners and other organizations with close connections to small businesses will be asked about organizations and other businesses that might be able to provide insights on the energy justice and related challenges. Initially 5-10 interviews will be undertaken as pilot testing to inform the interview process for another 40 participants in location targeted in this project. Data from the interviews will be used to inform survey design for 200 small commercial businesses per location. Targeted businesses are expected to will meet the following criteria:

- They conduct business in a commercial (non-residential) building less than 50,000 sf
- A large portion of business activities take place in a building space
- They pay energy bill(s) (electric, gas, etc.)
- ~75% of interviews our interviews to be with business owners that are part of underrepresented populations. The other ~25% are to be from more affluent populations.

Interviews. An interview protocol was submitted to and approved by the Institutional Review Board (IRB) that oversees human subjects research. A consent form was developed to get consent of the participants prior to interviews. A semi-structured interview is followed by a questionnaire about the building energy use and characteristics for each business. The semi-structured interview includes open-ended questions designed to address the following:

What do different stakeholders (owners, occupants, managers, decision makers in buildings know about energy efficiency, climate change and decarbonization? What knowledge and capabilities do they have about:

- Energy use: How much energy is being used? To do what? At what cost?
- Energy and climate: How does energy use contribute to climate change? What forms of carbon-based energy are being used in the building? How much CO₂ is emitted by the building, or by the organizations operating within the building? Have they done an inventory of CO₂ emissions? Are they aware of the importance of decarbonization to solving climate change?
- Decarbonization: What options are available for reducing CO₂ emissions? Do they have a carbon neutrality plan or vision? How do they think decarbonization would impact their organization (for good or ill)? Does their city or state offer programs to help with decarbonization? Have they taken advantage of such policies?
- What is the actual energy profile and energy burdens of the businesses?
- What kind of energy sources, services and technologies are being used by different kind of businesses?
- What fraction of their operating costs are energy costs?
- In what ways is energy important to different aspects of the business?

What are the barriers to decarbonization? What are the motivations or disincentives to act on decarbonization?

- Financial: how much ability to pay, how much willingness to pay?

- Values: Do they see sustainability and reducing carbon emissions as an important responsibility of their organization? Are they motivated to make changes? Why or why not? What led them to those values?
- Organizational/Ownership: Do they have authority over building energy use? Would they be allowed to make changes if they wanted to? Do they see people or organizations like themselves as having an important role to play in decarbonization?
- What actions have they taken to improve their energy profile and reduce CO₂ emissions?
- Have they made investments or considered investing in energy improvements (efficiency, conservation, renewable energy, electrification)? Why or why not?
 - If yes, what did they do? What helped them make that decision? Did they take advantage of (or otherwise respond to) policies (e.g., incentives or tax credits or regulations)?
 - If not, what prevented them? What might have helped them get past that barrier?
- Have they seen other organizations take actions? What did they think?
- Are they getting pressure from their supply chains or from their customers to decarbonize?

What are the equity and justice issues in energy transition facing businesses in small commercial buildings in cities?

- Do minority owned small businesses face different challenges?
- Do businesses situated in different affluent vs low-income face different kind of challenges?
- Do businesses in different sectors face different kinds of challenges?
- Do they have different knowledge, vision and capabilities differ?

Small Business Survey Instrument. Once interviews are completed in Phoenix and Atlanta, a survey instrument will be developed to broaden the research out into the local small business communities. The framework and individual survey questions will be developed based on information gathered during the interview period. The research team will host the survey online, and work with a local recruiter to distribute the survey instrument. The final survey data will be analyzed along with the interview outcomes to frame small business equity issues, and inform a national framework that can be replicated throughout the U.S. as well as inform policies and activities that may assist and empower small businesses to participate in the clean energy transition.

Results

As of June 2022, the research team has begun field research in Phoenix, AZ and has completed approximately two-fifths of the anticipated 50 interviews for the first phase of the project. These interviews have been conducted with owners or leaders of small businesses, including minority-owned businesses, as well as non-profit organizations, all of which occupy or use small commercial building spaces in some fashion. Of the 20 initial interview 25% are with owners or leaders that are part of underrepresented groups. The other 75% are from affluent groups. The majority of interviewees were participants in the Local First Arizona sustainability programs for small businesses, so were already thinking about integrating sustainability or energy conservation solutions into their business operations. One defining characteristic of the

organizations that have been surveyed is that they are very small. Definitions of small organizations and businesses vary, but the majority of organizations that have been interviewed so far are managed by the owner her-/him-self or as a family-run business with fewer than 5 employees, while the others have typically had fewer than 20 employees. The table below describes the businesses interviewed to date.

Table 1. Businesses Interviewed to Date

Type of business	Number surveyed	Areas of business activity
Retail Sales	3	Food product sales Home construction products
Service	13	Tourism Photography B2B support Automobile service Restaurant Healthcare Law Events
Light Manufacturing	1	Food production
Non-Profit	4	Religious worship Product upcycling and reuse

Finding 1: Energy is an integral part of small business operations in highly diverse ways

A preliminary finding suggests that energy is key for all small businesses and non-profit organizations. Each entity interviewed requires energy for a variety of core operations. Many also typically use more than one different source of energy, with different organizations using electricity, natural gas, gasoline, diesel, propane, and others, in a variety of forms (e.g., pumped fuel, fuel canisters, the electricity grid, solar electricity, and electricity generators). Examples of diverse energy uses including cooking of food with gas, propane, and electric equipment, charging or fueling vehicles, and electricity for lighting, refrigeration, and computer equipment.

Perhaps even more important than the diversity of energy sources and uses are the diverse ways in which energy use is integrated into the operations of different organizations. Even similar businesses may use energy for different purposes or in different ways. Consider cooking, for example, which occurs for many of the interviewed businesses. Some use traditional electric or natural gas stoves and/or ovens, but others use specialized cooking equipment, such as a coffee roaster, an espresso machine, an electric rice cooker, or a specialty bread oven. Some prepare food for immediate consumption, e.g., in restaurants and coffee shops, while others make prepared food for shipping to customers to use at other times and places.

Each use of energy combines a source of energy, an energy conversion device such as an appliance or piece of equipment, a purpose, a time and place of use, and a set of knowledge or

skills on the part of the user. Each is also integrated into the organization's financial model, involving the cost of the energy supplied (e.g., to make a latte using an espresso machine), the cost of the equipment to use the energy for the relevant purpose (the espresso machine), and the potential revenue from the product or service that results from the energy use (the sale of the latte). An organization then combines multiple uses of energy into an organized set of activities and arrangements that allows them to serve their customers or patrons.

Each organization is thus a somewhat unique socio-energy system (Miller et al. 2015), in which energy arrangements (energy sources, energy equipment, and energy uses) are integrated into the social (knowledge, skills, work practices) and financial (revenue, costs) structures and dynamics of the organization. This is significant for planning for decarbonization, as is discussed in more detail below, as these socio-energy systems are what will need to change in order to achieve carbon neutrality for the small business and non-profit sector of the economy operating out of small commercial buildings.

Finding 2: Sustainability and the transition to carbon-neutral energy are important to small businesses

A second finding is that many small businesses and non-profit organizations consider sustainability and the transition to carbon-neutral energy to be important values. While the breadth of this support across organizations in this category should not be overestimated, prior to the large-scale survey to be conducted in phase two of the study, recent public opinion surveys in Arizona have indicated that action to address climate change has the support of over 70% of Arizona residents. Many Arizona residents are also taking personal action to address climate change, with the state ranking #3 in both the number of solar installations per capita¹ and the number of electric vehicles registered per capita.² It perhaps should not surprise us that these values also translate over into business and organizational contexts, especially among owners of very small enterprises, which comprise the majority of our interviews.

Many of the businesses and organizations interviewed expressed an interest in and support for making their business more sustainable, including with regard to energy and climate change. For some business owners and organizational leaders, this commitment stemmed from personal values to “do the right thing” and help address major environmental challenges, such as a service business that was seeking strategies to add solar energy. For others, it reflected a broader industry-wide engagement, such as the focus of many smaller coffee roasters on supporting coffee growers at risk from climate change. For still others, it reflected a sense that their customers or members would value the sustainability commitment (e.g., in a tourism business that converted to electric carts and a religious organization that was seeking to go solar as part of a larger environmental stewardship initiative). Most recognized the potential to also save money, either from energy efficiency or cheaper sources of low-carbon energy (largely solar in Arizona), although they did not fully understand what that meant or how it would impact their operations. Most respondents focused their sustainability considerations on their own operations, but a few also identified carbon embedded in the supply chain as important to them, especially those with large transportation costs in their supply chains. Most of the organizations had acted in some way on sustainability. A number had thought about energy. And a few had acted to address energy or carbon consumption. One of the organizations interviewed provided a

¹ <https://solarpower.guide/solar-energy-insights/states-most-solar-installations>

² <https://insideevs.com/news/530258/total-ev-registrations-by-state/>

specific program for other small organizations seeking to learn more about how to advance their sustainability initiatives.

Finding 3: Several significant barriers exist to decarbonizing small business energy use

While the vast majority of interviewees have thought about how sustainable energy might fit into the future of their business, and would like to find clean energy solutions, only a few have been able to take at least one action to address this goal, and none have transformed themselves into carbon-neutral organizations. Among the individual actions taken or under discussion include: installing energy efficient equipment, electrification of key operations to reduce fuel use, and adoption of solar energy. However, far fewer organizations have acted on these options, than those that expressed interest in them or that had explored possibilities. This suggests the presence of significant barriers to decarbonization that severely restrain opportunities for small businesses and non-profit organizations in the small commercial buildings sector from participating in clean energy transitions. Here we concentrate on the five most frequently mentioned.

Knowledge: Small business owners and small non-profit organizations are small, they have few employees, and those few do not include energy specialists. Only one of the organizations interviewed to date was lucky enough to have a dedicated individual working directly on energy sustainability with them, as a result of the specialized knowledge of one of their members, while a number of leaders and owners had also participated in local programs to teach them about energy, climate, and sustainability. As a result, among interviewees, a lack of knowledge was commonly identified as a key barrier to action. Knowledge shortfalls identified by interviewees included, when aggregated, knowledge about climate change and the role of energy, knowledge about how to assess an organization's carbon emissions, knowledge about potential solutions, and knowledge about where to obtain diverse forms of support in making the transition, including support addressing the other key barriers identified below. Some interviewees identified the need for a trusted, streamlined source of information about the climate and energy transition, although any such effort would need to grapple with: (a) the inevitable complexity that would arise in information needs from the many different kinds of businesses and their different needs in the transition; and (b) local heterogeneity in the kinds of solutions and support strategies open to small businesses. Access to trusted and validated information about technology, vendors, and the state-of-the-art in the energy space is a need expressed by some small business owners. Currently, there is no centralized data repository for small businesses to access this information. Owner/operator bandwidth is a challenge, often small business owners must serve multiple roles within their companies, further limiting their available time to research technology, vendors, incentive programs and then calculate investment and payback on energy-efficient less carbon-intensive equipment.

Planning support for integrated socio-energy system redesign: As identified above, each of the organizations interviewed constitutes a unique socio-energy system or set of integrated social and energy arrangements that work together in a systematized fashion to enable the organization to function. For example, religious organizations maintain worship and meeting spaces that bring together a community for hundreds of weekly events, large and small, all of which require air

conditioning during Arizona's extended 6-month summer. The community provides donations to the organizations, which then pay employees to help organize some of the events, as well as to purchase and operate the air conditioning systems, which are a major operational cost. These unique socio-energy systems need to be redesigned, both socially and technically, in order to make decarbonization happen. For religious organizations, for example, finding the money to pursue carbon neutrality goals means successfully persuading the community to provide the upfront capital to purchase new equipment. One religious organization interviewed had been able to successfully solicit extra donations for a major energy efficiency upgrade, which, once paid for, then reduced costs, allowing the organization to use the money for other purposes, but another religious organization had not yet been able to accomplish that. The first organization had not yet sorted out how to accomplish the same goal for going solar, however. Another organization had successfully made the shift from diesel to electric carts for their operations, with the required operational shift to ensure they could accomplish the charging of the vehicle. They now wanted to go solar for their charging but were not sure how to make that work and did not have support to do so. Another organization saw opportunities for reducing supply chain carbon emissions by coordination among buyers but did not see how to accomplish it. For coffee, for example, emissions from energy used in coffee roasters are a small fraction of overall carbon dioxide emissions involved in transporting beans before and after roasting. Win-win solutions that impact supply chain efficiency could provide huge gains for lowering business costs and reducing emissions. Several organizations noted that they had chosen equipment for its business performance, without consideration of its energy performance, and would need expertise on integrated business and energy performance to know if they had other alternatives. Planning support for engaging in this kind of socio-energy system redesign was identified by a number of interviewees as a significant barrier to decarbonization. Several organizations had gone through a local support program and begun to identify potential strategies for lowering the carbon emissions of their businesses, but were still short of specifics in terms of how to pull together the multiple dimensions of the changes needed. Hiring consultants was seen as possible by some organizations, but expensive.

Technical support: Organizations also identified technical support as a key challenge for decarbonization. Energy system redesign is rarely technically straightforward, although some options are technically easy, such as the switching out of lighting to LED bulbs that one interviewee was able to accomplish. Other organizations struggled with harder technical questions, such as whether the amount of solar panels they could install would run the electrical equipment they needed or whether it was possible to design an electric roasting device that would match the outcome or price performance of the current gas-powered roaster that was the standard in the industry. For example, a coffee roaster business indicated that people have tried electric roasters as a substitute for natural gas roasters to reduce carbon emissions, and they just do not work to properly roast the beans. This perception will limit electrification and decarbonization until new technologies arise (e.g., hydrogen roasters, better functioning electric roasters). These kind of technical questions required engineering know-how or even innovation that was unavailable to the organizations and so limited their ability to move forward on carbon neutrality.

Ownership: A key barrier to decarbonization for most organizations is the fact that many small business owners do not own their buildings and therefore do not control key decisions. One

organization had been successful in negotiating an upgrade to more energy efficient lightbulbs, but most had not had similar experiences. Several noted that their lack of building ownership prevented them from adopting solar energy solutions, despite a desire and even ability to do so, thus relegating them to relying on their electric utility to decarbonize their electricity supply. Interestingly, non-profit organizations, especially religious organizations, tended to own their properties at much higher rates and thus have the wherewithal to make investments in energy efficiency and solar energy. With their more constrained revenue streams, non-profits also had a higher incentive to cut costs. Several businesses noted that they do not even pay their energy bills directly as the bills are factored into their rent, and thus do not even know what their energy costs are or have an incentive to try to reduce energy use.

Financing: The final barrier identified by most interviewees was the necessary up front capital to make changes in energy systems and energy equipment. Several businesses noted that banks are not likely to provide loans for energy system improvements, as they are seen to have lower rates of return than investments in business expansion and thus are more risky for the bank. Non-profit organizations noted that their constrained revenue streams limited their options, although one was able to make it work through a special request for donations. For non-profits, tax credits also don't usually apply, reducing the incentive to adopt low-carbon technologies. Many organizations noted that information about what kinds of grants, loans, or other financial options might be available to help support investments in energy efficiency or other sustainable energy investments would be helpful. One organization noted that they had purchased older, less efficient equipment precisely because it was less expensive.

Finding 4: Decarbonization will likely mean changes and challenges to small business operations

Because energy and energy costs are integral to the operations of small business and non-profit organizations, and intertwined with their operational performance in key ways, organizations are likely to face changes and challenges to decarbonization. In some and perhaps many cases, this may ultimately result in opportunities to improve organizational performance and/or reduce costs in ways that enhance the organization, but getting to that point will require significant working through of organizational change and even transformation. To the extent that changes occur outside their control, however, small organizations may have little choice but try to adapt, with real risks of failure or organizational closure. If electricity grid decarbonization raises costs, for example, or alters time-of-use or demand charges, both of which are likely, additional costs could be detrimental to many businesses. Similarly, if changes to natural gas utilities either close off the use of natural gas or impose significant new costs for carbon capture and sequestration, the result could seriously impact small organizations that depend on specific uses of gas for their functioning, like coffee roasters or specialized restaurants. Finally, changes from gasoline or diesel to electric or other low-carbon vehicles could impact a variety of businesses and supply chains. Hence, small organizations face potential changes and challenges both from internal choices to decarbonize operations and from external choices.

Conclusion

Our initial findings provide insights on clean energy awareness, energy use, energy challenges, and energy related goals and actions of small and minority owned businesses. The energy intensity and the energy burdens of small businesses vary greatly from one to another and so does the kind of challenges they might be facing in the process of decarbonization. Given the changes and challenges they are likely to face, many small business and non-profit organizations will need a variety of forms of support to navigate the complexities of the clean energy transition. This could potentially include new sources of information, support for planning and engineering, support from building owners, support for organizational change and transformation, and financial support. Community-centered organizations and programs appear to have had an impactful outcome with its cohorts. This was noted in the several references made by interviewees to a local program in the Phoenix area for providing support for sustainability knowledge and practices. The program served as a buffet of sustainability knowledge and experience for small business owners to access and interrogate, although it did not suffice to enable participants to get all the way to implementing significant carbon neutrality efforts.

The next step of this study is to complete 50 targeted interviews with the majority of the participants representing traditionally underrepresented groups in each state (Arizona and Georgia), which will allow for a comparison of energy equity and justice issues between affluent and underrepresented groups, as it relates to enabling a clean energy future.

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