URBAN ENERGY INFRASTRUCTURE POLICY AND CLIMATE IMPACTS

REDUCING BUILDING ENERGY CONSUMPTION IN PITTSBURGH, PA

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PITTSBURGH, PA

DATE

28th February 2019

Contents

1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

Global climate change represents a significant threat to our well-being and to the well-being of future generations, across the world and in Pittsburgh. Climate change is driven by the emission of greenhouse gases, and urban areas are responsible for approximately 70% of global emissions. The state of Pennsylvania contributes significantly to global carbon emissions; if it were ranked as a country, it would be the 22nd largest carbon emitter in the world. Within Pennsylvania, Pittsburgh has a legacy of high per capita greenhouse gas (GHG) emissions, as a result of its heritage as a steel manufacturing city. Pittsburgh's emissions per capita have reduced dramatically since its heavy industrial days, but the city can do much to reduce its GHG emissions.

To this end, there are three broad strategies that can most effectively reduce Pittsburgh's urban emissions: shifting transportation modes, reducing residential building energy consumption, and reducing power sector emissions. Our research focuses on four policy types in the domain of building energy consumption, with interactions that span the three strategies. The four policy types that we choose to evaluate are: building quality, dense development, architectural form, and consumer habits.

At present, buildings are responsible for 81% of the Pittsburgh's carbon emissions, a far larger share than any other sector. To address the contribution of building energy consumption to GHG emissions, Pittsburgh has set ambitious goals within its Climate Action Plan. These goals include reducing energy use in existing buildings by 50%, and achieving carbon neutrality and location efficiency in all new construction.

1.2 KEY QUESTIONS AND ANSWERS

1.2.1 *What policy shortcomings are hindering Pittsburgh from achieving the broad strategy of building energy reduction?*

The policy shortcomings in Pittsburgh primarily come from years of inaction regarding building energy consumption in building codes, and gathering data. Though building codes have been updated very recently, Pittsburgh operated by outdated energy efficiency and quality standards for about a decade. Additionally, useful energy consumption data has not been consistently gathered for many years.

1.2.2 *How comprehensive is Pittsburgh's climate action plan for reducing building energy consumption?*

The comprehensiveness depends on which specific policy type you consider. While some areas in the plan are well detailed, others have room for expansion.

1.3 METHODS

Our methods included two primary strategies. First, we conducted a literature review for each of the four specific policy types. We used this review to assess each policy type's ability to reduce building energy consumption and determine (for each policy type) the most effective, state of the art policies. Following the literature reviews, we assessed Pittsburgh's current strengths and weaknesses for each policy type by searching government websites, local newspapers, and other sources. Finally, we evaluated Pittsburgh's Climate Action Plan (v3) to assess the city's plans for each of the four policy types.

1.4 MAIN FINDINGS AND CONCLUSIONS

Our main findings are that while Pittsburgh has set major goals and outlined comprehensive plans for some building energy reduction policies, there are numerous areas where Pittsburgh's strategy is underdeveloped. The main area where Pittsburgh should outline more detailed milestones is in building codes; for many years, building codes did not reflect up-to-date energy and emissions requirements, and many specific features, such as floor area ratios, were not discussed at all. Based on these findings, we conclude that Pittsburgh needs more comprehensive building requirements covering the entire city, not just those that are participating in optional initiatives. Policies for density, building quality, "green" architectural form, and data gathering will reduce many of Pittsburgh's current policy shortcomings.

1.5 SUMMARY OF RECOMMENDATIONS

Based on the findings of this report, we present five broad recommendations for the City of Pittsburgh to consider. First, the city should update local building codes to include green building measures. Second, the city should set minimum and maximum floor-to-area ratios (FARs). Third, the city should implement better incentives to encourage building retrofits. Fourth, the city should work with Duquesne Light to shift consumer habits. Fifth, the city should develop an energy efficiency education program. If Pittsburgh were to enact these policies, we argue that the city would take a strong step towards reducing building energy consumption, reducing its urban greenhouse gas emissions, and mitigating the threat of climate change.

2

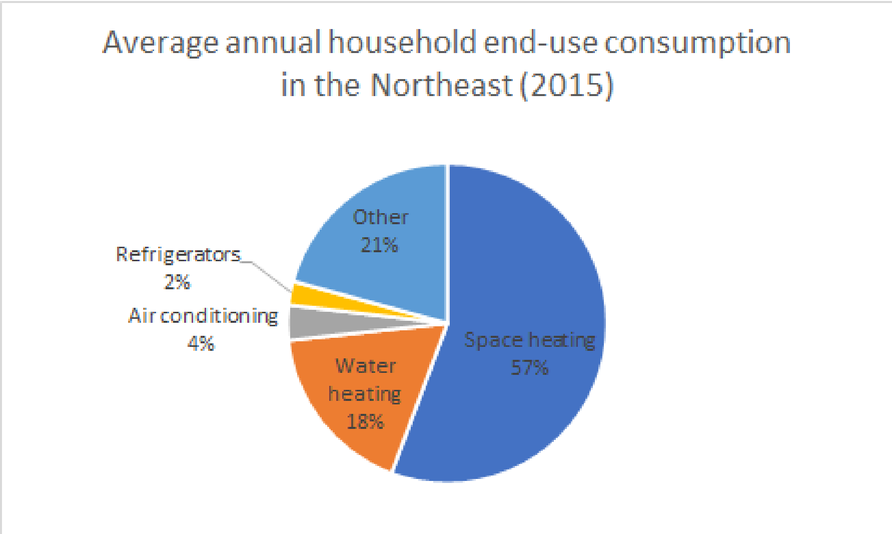
BUILDING QUALITY

2.1 INTRODUCTION TO BUILDING QUALITY

There are many aspects to the broad concept of building quality. However, for our concerns, we will define a high-quality building to be one that is able to regulate itself in an energy efficient manner. This efficiency is based on the consideration of two main features: the insulation quality, as well as the HVAC system quality. In other words, a quality building is one that requires less cooling and heating.

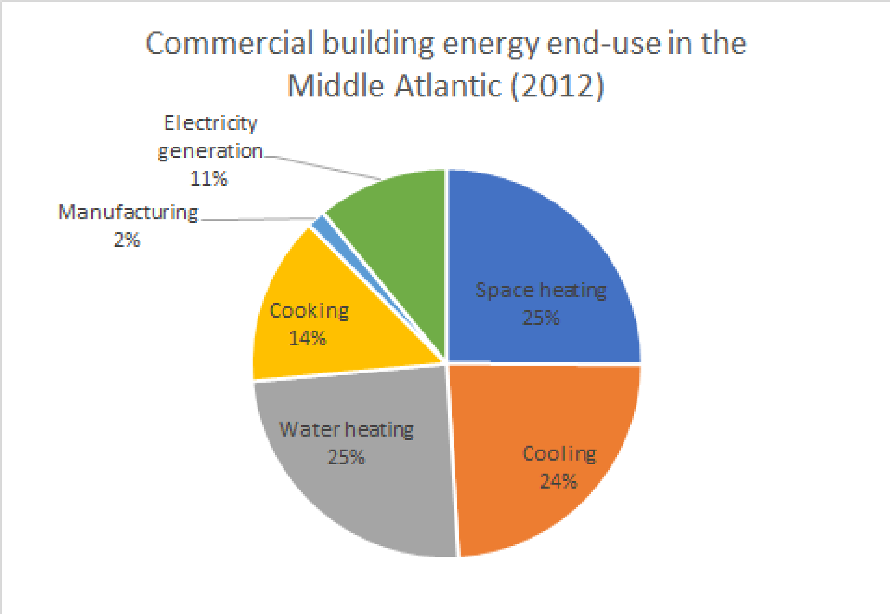
It is important to consider how building quality can be improved. The most recent EIA data show that 61% of household and 49% of commercial building energy consumption come from heating and cooling (Figures 1 and 2).

Figure 1: Average annual household end-use consumption in the Northeast (2015) (RECS, 2015)



In order to reduce these numbers, there are two main strategies that can be employed. The first is to follow stricter building codes that enforce more efficiency in buildings. The second is to create a system that incentivizes the retrofitting of old, lower quality buildings.

Figure 2: Commercial building energy end-use in the Middle Atlantic (2012) (CBECS, 2012)



2.2 BUILDING QUALITY AND PITTSBURGH

2.2.1 *Stricter codes*

Up until October 2018, Pittsburgh was only following the 2009 International Building Codes (IBC), which were initially drafted in 2006. Therefore, for nearly 10 years, Pittsburgh was following outdated codes. The main goal of these building codes is to enforce energy efficiency. They regulate insulation thickness, window and glazing quality, attic ceiling finishes (radiant barriers), as well as air infiltration systems (Cohan, 2016). As a result of the delay in code adoption, the buildings built in the past ten years follow codes for technology that is over ten years old. Especially as efficiency gains have increased within the past decade, this means that Pittsburgh has largely missed out on the construction of increasingly energy efficient buildings.

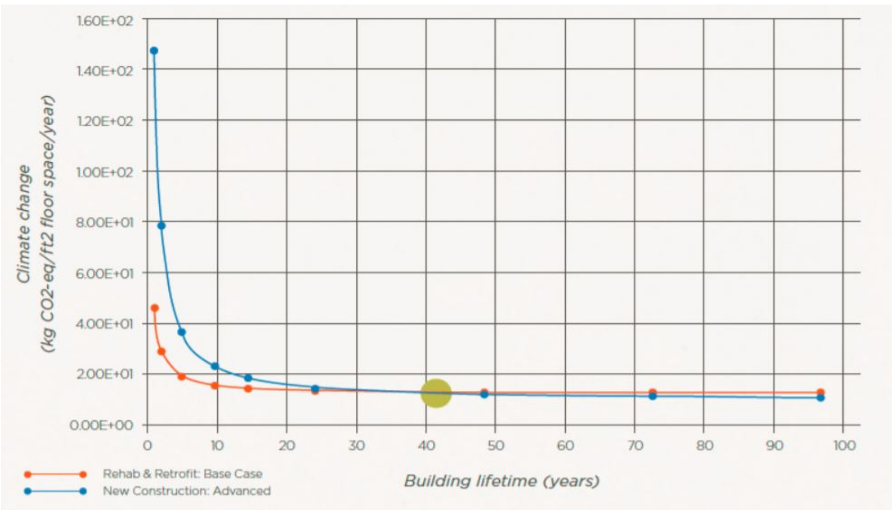
In the 2017 Climate Action Plan, Pittsburgh stated that they were working with Philadelphia to influence the state of Pennsylvania to adopt the most recent IBC. This was in response to a state-passed legislation that made it more difficult to follow the most up to date IBC. They were successful in accomplishing this, and were able to push the state to be on board with the 2015 IBC. This will result in new buildings being 25% more energy efficient than the buildings constructed to comply with the 2009 IBC. Additionally, the net cost savings for the average Pennsylvanian house built in the past 30 years, if built to the most recent IBC, would be $8,000 (Legere, 2018).

2.2.2 *Retrofitting*

Although policy adoption has stunted the development of the newest line of efficient buildings, another problem that must be solved is the massive inefficiencies of existing buildings. Older homes were built with much less stringent standards, and with the addition of decades of aging, have become very inefficient when it comes to heating and cooling. These older homes tend to have insulation that is at least 3 times thinner than the recommended thickness for homes in northern climates (Deetjen, 2019). This is a considerable problem, as over 70% of Pittsburgh homes were built before the 1960s, when energy efficiency guidelines had yet to be included in building codes (PCAP). This reveals that Pittsburgh's current building stock shows incredible potential for renovation and reuse, but is currently the root of a large portion of the energy waste in the system.

This problem can be solved through renovation of old buildings. The renovation could include retrofitting of old homes by residents, and urban regeneration, through which old buildings can be retrofitted and repurposed. This is an advantage for more reasons than just improving energy waste, as renovation produces a lower climate change impact than new construction. This is because it bypasses construction, which accounts for a large portion of the life cycle emissions of a building. Additionally, retrofitting an already existing building reduces demolition waste and yields more immediate carbon savings than new construction does (Figure 3).

Figure 3: Commercial building energy end-use in the Middle Atlantic (2012) (CBECS, 2012)



The primary issue with retrofitting is that it needs to be incentivized. Most consumers are unwilling to renovate existing structures, as it requires a large upfront cost that they are unable to justify. There is also limited guidance for residents or developers who wish to renovate, and no overarching plan provided by the city of Pittsburgh.

Despite its shortcomings, Pittsburgh has shown some progress in the category of renovation. Through executive order, the city will begin focusing on upgrading all of its public facilities. The city has also begun benchmarking its municipal buildings with the intent of improving their energy efficiency. They have gone as far as investing in new asset management software to track the progress of the physical condition of their buildings (ACEEE, 2017).

3 DENSE DEVELOPMENT

3.1 INTRODUCTION TO DENSE DEVELOPMENT

Dense development has numerous definitions and methods of measurement, but here it is discussed in the context of buildings. In a city, dense development is an important characteristic in determining the relationship between land use, successful transportation services, and reducing greenhouse gas emissions. The higher the number of housing units, the more dense the city or region is. According to studies, cities have been found to operate more efficiently when residents live in dense urban surroundings. This is because dense cities tend to be more walkable and have diverse transportation options.

Dense development can help cities to reduce greenhouse gas emissions, as denser cities tend to avoid problems associated with urban sprawl. One benefit to city density is that residents of dense cities live in relatively small apartments rather than larger houses, and thereby consume less energy to heat and cool their homes. A drawback of less-dense cities is that their sprawl will mean the average distance between destinations is higher, driving residents to use their private vehicles rather than relying on mass transit. This is one of the biggest reasons for the increase in greenhouse gas emissions with urban sprawl.

3.1.1 *How can cities advance dense development?*

Cities can pursue different strategies to minimize ecological impact and maximize economic effects of dense development. Some of these strategies are planned development, incorporating multiple price points to attract a wider audience, and establishing long term development goals for city. Specifically, cities can consider planning dense development in strategic locations which have amenities such as effective mass transit. In order to build smaller living spaces,it is important to decide a minimum floor area ratio (FAR).

Cities like New York have accommodated high population density in a relatively smaller land area by constructing taller buildings which have a higher number of apartments than buildings with fewer floors. Open spaces need to be strategically located, especially since these

Figure 4: FAR as set by the Seattle Department of Planning and Development (DPD)

Minimum Floor Area						
Height Limit	30'	40'	65'	85'	125'	160'
Minimum FAR	1.5	1.5	2	2	2.5	2.5

decrease accessibility between parts of cities despite functioning as carbon sinks.

Figure 5: Difference in existing height of the building and the suggested height. Taller buildings can accommodate a greater number of living spaces.

3.2 Dense development and Pittsburgh

While it is hard to state how Pittsburgh is looking specifically at dense development, the Climate Action Plan 3.0 does mention goals of new building development and reducing energy/water usage by 30% by 2030.

The population density in Pittsburgh is 2,140 persons per square kilometer, which is less than half of the often-cited threshold (5000 persons per square kilometer) for cities to have successful mass transit as a function of density. This implies that since the density of Pittsburgh is lower the average, living spaces are larger and the same can be observed in the city. Larger living spaces contribute more towards carbon emissions, as the residents tend to use more resources per person as compared to those living in smaller spaces. With this in mind, it would be easy to assume that the average emission per person in Pittsburgh should be higher. It is important to note that the city has actually taken measures to reduce the emissions by restricting increase in use of private vehicles by increasing other modes of transport such as cycling, walking. Additionally, design and implementation of transit-oriented streets has increased walkability between buildings and is solving the last mile problem.

This change in modes of transport should incentivize closer construction of buildings in the city. A tool created to this effect is the LERTA - Local Economic Revitalization Tax Assistance - which aims to "improve economic and business climate of certain residential/-commercial districts with declining population and vacant properties."

Pittsburgh has adopted another measure to ensure more spaces for building construction by eliminating the minimum on parking spaces, and enforcing a maximum on parking spaces that can be allotted/occupied at a time.

However, the city is not actively looking at enforcing a minimum floor area ratio. This may have been a result of the building codes not being updated in nearly a decade. Another area Pittsburgh is found to be lagging is strategic location of recreational and green spaces, which increases the distance between buildings, reducing accessibility on foot. This results in increasing use of private vehicles to accomplish tasks otherwise possible by walking.

4 ARCHITECTURAL FORM

4.1 INTRODUCTION TO ARCHITECTURAL FORM

Architectural form is defined as referring to the "shape or configuration" of a building, according to the National Institute of Building Sciences. Related attributes include the shape, size, and scale of building features, along with lighting conditions and configuration of space within the building (Crisman). Architectural form can have a significant impact on the energy demand and emissions of a building. According to the US Department of Energy, buildings following LEED standards (which promote green building design features) require 24% less energy and produce 34% less carbon (Fowler, et. al).

Figure 6: Green Roof

There are multiple strategies that can reduce buildings' energy and emissions impacts, one of which is reducing outer walls and per-capita space through denser building forms. For example, apartment buildings have lower heating, cooling, and electricity needs per person than single family homes, as they house more people in a smaller space and have less exterior wall surface area per residential unit. Other effective design features include cool or green roofs and daylighting. Cool or green roofs can decrease the cooling and heating load of a building by preventing excess solar radiation from warming the building, and preventing excess heat from being lost through the roof ("Cool Roofs", "Green Roofs"). Daylighting can reduce electricity demand for daytime lighting in a building, thereby reducing energy consumption and emissions ("Daylighting").

Figure 7: Daylighting

4.2 ARCHITECTURAL FORM AND PITTSBURGH

Pittsburgh has developed some ambitious initiatives and goals for architectural form in recent years. The most prominent initiative is the Pittsburgh 2030 District, which includes over 435 buildings in the Downtown and Oakland neighborhoods. According to the Pittsburgh Green Building Alliance, new buildings in the 2030 District aim to reduce fossil fuel demand, energy use, and greenhouse gas emissions to 70% below the national average for their building type, with an equal area of existing buildings renovated to meet the same standard for their building type. Overall, fossil fuel reductions for all buildings should reach 80% by 2020, 90% by 2025, and 100% in 2030 (or carbon neutrality) ("Meeting the 2030 Challenge"). Beyond the 2030 District Challenge, Pittsburgh has set a goal in its Climate Action plan to adopt building codes for passive house and âclimate smartâ building (âCity of Pittsburgh Climate Action Planâ). Additionally, the city has implemented a density bonus for LEED certified buildings, which are allowed to rise 20% higher and contain 20% more floor space than non-LEED certified buildings ("Pittsburgh").

The existence of ambitious initiatives such as the 2030 District Challenge, along with the acknowledgement of opportunities in green building within the Climate Action Plan and standard city building policy, can be considered a strength. Pittsburgh has been making progress, as measured in the 2030 District: since 2012, participating buildings have reduced energy consumption by 10.7% on average below baseline levels ("City of Pittsburgh Climate Action Plan"). However, the weaknesses in Pittsburgh's policy options regarding architectural form lie in its omissions. While the 2030 District is driving measurable change in its two participating neighborhoods, it does not include the vast majority of Pittsburgh's neighborhoods. Moreover, while these remaining neighborhoods may be impacted by passive house and climate-smart building codes as called for in the Climate Action Plan, no concrete goals toward that have been set yet. In general, there is no overarching requirement for residential or private commercial buildings in Pittsburgh to incorporate green architectural forms, reducing the impetus for individual buildings to improve. At present, neither building codes nor the Pittsburgh climate action plan specifically call for buildings to incorporate energy- or emissions-saving architectural forms.

5

CONSUMER HABITS

5.1 INTRODUCTION TO CONSUMER HABITS

Influencing consumer habits is an essential component of policy adoption, and it therefore has significant potential to improve the success of the two broad strategies within which it operates. Specifically, consumer habits contributes to reducing power sector emissions and reducing building energy consumption.

With regard to reducing power sector emissions, influencing consumer habits is a key supporting component of the broad strategy's cornerstone policy: the smart grid. The smart grid is a system of smart technologies, markets, and policies that interact with one another to create flexible energy demand. Implementation of smart grids is often difficult because it requires buy-in from consumers in order to succeed. Even when utilities offer smart meters and smart electricity pricing, consumers still usually need to opt in to those programs. Consumer habits policies are designed to facilitate adoption of energy and emissions reduction technologies.

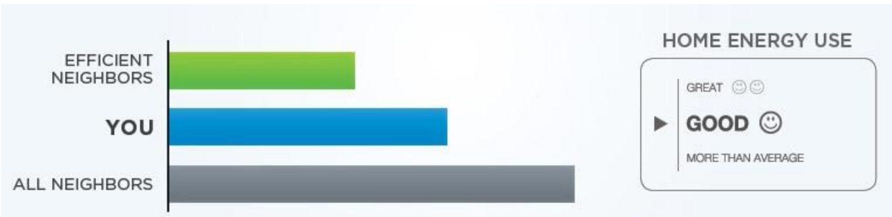
While consumer habits have potential to greatly impact the broad strategy of reducing power sector emissions, this section will focus on how consumer habits can contribute to reducing building energy consumption. Some sources of building energy consumption are highly sensitive to small shifts in consumer behavior. There is no better evidence for this concept than thermostat set points. For example, assuming a baseline summer thermostat set point of 78°F, a consumer could reduce the energy used to cool their home by 19% if they raised their thermostat set point to 80°F. Not only would this behavioral change improve the energy efficiency of the consumer's home, it would also save them money. Consumer habits policies serve to nudge consumers towards behavior that would reduce their energy consumption and electricity bills.

Consumer habits as a policy type can be divided into three primary piecemeal policies: educating consumers, eco-feedback, and social interaction (Paone, 2018). Educating consumers about energy efficiency is arguably the more important piecemeal policy, and it ties into the other two. When consumers purchase their homes and appliances, they often don't consider how energy efficiency can lead to cost savings. Cities such as Pittsburgh can drive consumers towards purchasing smart, energy efficient homes and appliances by educating them about the potential monetary and energy savings of choosing those options.

Educating consumers about their own energy consumption habits – known as eco-feedback – can also lead to reductions in building energy consumption. As we previously discussed, consumers frequently make decisions without considering the energy consumption implications of their actions. One technique for calibrating consumers' energy consumption habits with their desired energy consumption level is by providing consumers with data on their current and historical energy consumption habits. This policy is powerful because it provides tailored recommendations to individual consumers; tailored recommendations can help consumers optimize their individual energy consumption habits. Eco-feedback policies help consumers identify specific behavior changes that enable them to reduce energy consumption and save money.

Finally, social interaction policies utilize relative performance norms to help consumers reduce their building energy consumption; comparing consumers' energy consumption to that of their low-consuming neighbors can inspire them to reduce their own consumption. Often, public utilities with social interaction programs will display a metric for the consumer's energy consumption directly adjacent to that of their neighbors (Figure 1). Social interaction policies help consumers reduce their building energy consumption by playing on the desire to outperform one's neighbors.

Figure 8: Example of Social Interaction



5.2 consumer habits and pittsburgh

Pittsburgh is currently doing little to change consumer habits with regard to reducing building energy consumption. The city advertises no ongoing consumer habit initiatives on their website, nor could any programs be found after an extensive internet search. The one minor exception is the Community Education Energy Efficiency Program offered by Duquesne Light – one of Pittsburgh's electricity utilities. The program is an educational competition where high school students theoretically gain the skills necessary to become successful energy efficiency auditors. The City of Pittsburgh itself offers no energy efficiency education programs.

Not only is Pittsburgh currently failing to enact consumer habits policies, but the city also does not include any substantial consumer habits policies in their Climate Action Plan (v3). The Climate Action Plan's only proposed consumer habits policies are a marketing campaign and online resources for Pittsburgh's forthcoming "Zero Waste Strategic Plan." Notably, this singular proposed consumer habit plan relates to waste reduction, not to building energy consumption reductions.

Based on this analysis, it is clear that consumer habits policies are a serious weakness in Pittsburgh's current and proposed building energy reduction strategies. The city has no strengths that are worth mentioning with regard to this particular policy type.

6 SYNTHESIS AND CONCLUSION

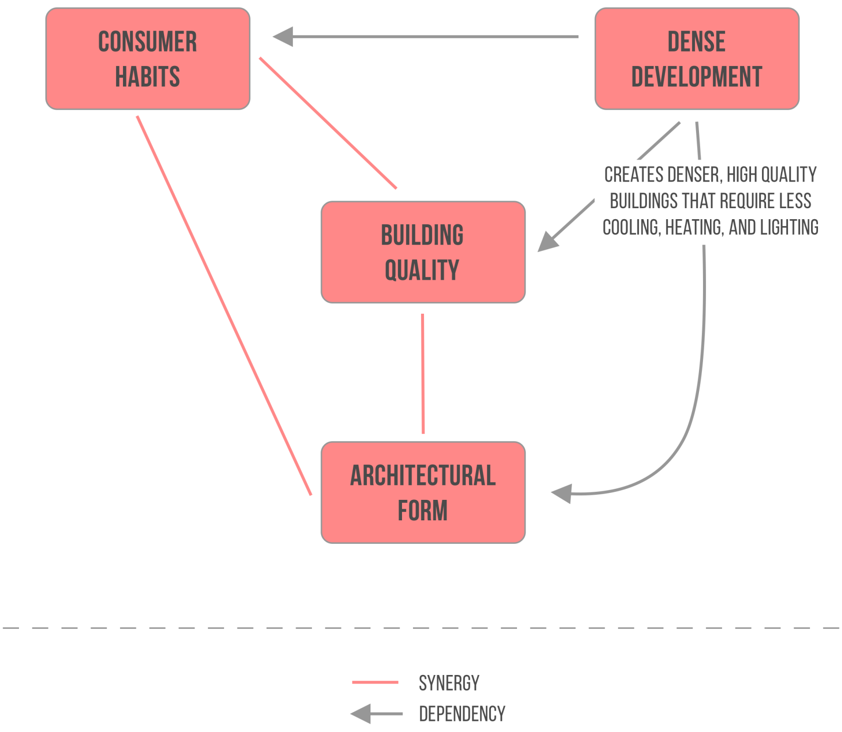
6.1 Synergies and dependencies

Beyond individual positive impacts, the four building policies discussed in this report interact with each other to contribute to energy and emissions reductions, through dependencies and synergies (Figure 9). Dense development relies on dense architectural forms, from multi-family apartment buildings to skyscrapers, which cluster people together in small geographical footprints. It is important to note that dense buildings with compact form and conscious consumers might still consume large amounts of energy without quality construction. To that end, building quality and architectural form work together to minimize energy waste and direct emissions from buildings of all types. Well-designed architectural form can help occupants of buildings develop energy- and emissions-saving consumer habits, for instance, keeping lights off during the day due to sufficient daylighting. Dense development is another driver of good consumer habits, creating the necessary conditions for mass transit and zero-carbon transport modes such as walking and biking, and smaller living spaces which foster lower levels of energy consumption per person. Finally, good consumer habits toward saving energy and emissions can enabled improved building quality, through building owners regularly updating their buildings for energy efficiency and low emissions.

6.2 Pittsburgh's strengths and weaknesses

With regard to Pittsburgh's existing policy landscape, there are several strengths and weaknesses that affect its ability to achieve building energy reductions. Beginning with strengths, Pittsburgh has implemented numerous policies to promote building energy reduction across the four policies. The city has set maximum parking spaces per building, and has now updated its building codes for current energy efficiency and building quality standards. Additionally, Pittsburgh has made progress on 2030 District Challenge for building efficiency and green building. Finally, while they have been included to different extents, all four building policies are addressed in the Buildings section of the Pittsburgh Climate Action Plan. Despite these policy strengths, Pittsburgh's building energy policies exhibit

Figure 9: Policy synergies and dependencies



numerous areas for improvement, largely due to insufficient prior action. Until recently, Pittsburgh has been inactive in requiring improvements to building energy consumption and emissions; building codes had been outdated for ten years. While incentives could be a useful alternative, the city's existing incentives are insufficient to truly drive better practices. Building retrofit incentives, such as the zero-interest home improvement loan and the $2500 energy efficiency grant, are still relatively small compared to the typical costs of retrofitting, which can amount to tens of thousands of dollars for a small, 1,000-square-foot home ("What It Costs to Green an Existing House.") More broadly, while the Pittsburgh Climate Action Plan mentions many building policy goals, it does not successfully lay the groundwork for most of them. It states the motivation for many policies, but does not establish time-based deadlines for concrete, actionable steps. Finally, there are still many lacking areas in Pittsburgh's general suite of building policies. At present, there is still no discussion of floor area ratios (FAR), or specific requirements for green architectural forms, in building codes There are few to no policies addressing consumer habits. And finally, building benchmarking ordinances cannot be developed without sufficient data on energy consumption, which Pittsburgh currently lacks.

6.3 recommendations for pittsburgh

6.3.1 *Building Quality*

Pittsburgh is lacking when it comes to focusing on building quality. In order to remedy this, it needs to enforce stricter building regulations on new buildings to ensure their energy efficiency, as well as create programs to incentivize the reuse and renovation of older buildings.

In the future, Pittsburgh must continue influencing the state to follow the most recent IBC every time it is updated. If the state were to continue to lag behind in the adoption of updated codes, it will continue to lose out on the production of the most energy efficient buildings available.

Pittsburgh can take advantage of the large renovation potential of its current building stock in various ways. For example, the city can give tax breaks to building and home owners who invest in renovation projects. They should also provide and promote grant and low interest loan programs for home renovations. Pittsburgh can help out consumers even more by streamlining the approval of energy efficient renovation projects and facilitate connections with energy efficient contractors (Deetjen, 2019). By making the process of renovation as easy and accessible as possible, it will encourage the reuse and retrofitting of older buildings, which will in turn improve the overall quality of buildings in Pittsburgh.

The recent adoption of the 2015 IBC is a good step in this direction, however, with the abundance of older buildings in the city, more steps need to be made towards the retrofitting of the city. If done properly, these policies will lead to improved insulation and HVAC systems in buildings throughout Pittsburgh, and will cause a major improvement in building quality, and therefore building energy consumption within the city.

6.3.2 *Dense Development*

To start with, the city needs to actively look at data management of open, green and recreational spaces by use of tools such as Geographic Information Systems (GIS). At the same time, the open spaces need to be diversified in terms of usage and scale. That is, an open space can be turned into a green and recreational space. This should be scaled down as per the locality and number of buildings per unit area around.

It is imperative that a minimum floor to area ratio be established, especially since there is a lot of scope for new buildings to be constructed. In the context of construction, the impact of LERTA has to be assessed, and iterations should be made just as for building codes. Redevelopment is an aspect that should be considered seriously for the poorly designed parts of the city.

Pittsburgh's multimodal network should be leveraged to increase accessibility between new building development. The transport infrastructure will in turn improve if the city positions itself as a commercial hub which will bring in more investment. Hence, there is a symbiotic relationship between dense development of buildings and transportation.

6.3.3 *Architectural Form*

To promote the use of energy- and emissions-efficient architectural form, the city of Pittsburgh should consider incorporating specific requirements for design features such as daylighting and minimizing exterior walls into the city-wide building codes, whether for new construction, retrofits of existing buildings, or both. An example of building codes including these measures, which Pittsburgh could either adopt or use as a model, is the International Green Building Code. Beyond building code, Pittsburgh can also encourage the use of denser architectural forms, such as multi-story apartment buildings, through updates to zoning. Much of Pittsburgh's land area is currently zoned for single- to three-family housing, which could be zoned for multi-unit residential buildings, creating increased density and reducing energy demand per person.

6.3.4 *Consumer Habits*

In order to utilize consumer habits policies to reduce building energy consumption, Pittsburgh should more closely collaborate with one of the city's public utilities (Duquesne Light) and initiate a city-run energy efficiency education program. The city should work with Duquesne Light in two ways. First, the two parties should establish a system for estimating or collecting energy consumption data for all buildings in Pittsburgh; this data will provide a framework for future eco-feedback and social interaction programs. Second, the two parties should develop and communicate eco-feedback programs that utilize social interaction to consumers. Implementing these policies would directly address Pittsburgh's deficiency in consumer habits policies.

6.4 CONCLUSION

We present five broad recommendations for the City of Pittsburgh to consider. First, the city should update local building codes to include green building measures. Second, the city should set minimum and maximum floor-to-area ratios (FARs). Third, the city should implement better incentives to encourage building retrofits. Fourth, the city should work with Duquesne Light to shift consumer habits. Fifth, the city should develop an energy efficiency education program. If Pittsburgh were to enact these policies, the city would take a strong step towards reducing building energy consumption, reducing its urban greenhouse gas emissions, and mitigating the threat of climate change.

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