Building A Greener LA

Examining Energy Efficiency Policies for Existing Buildings

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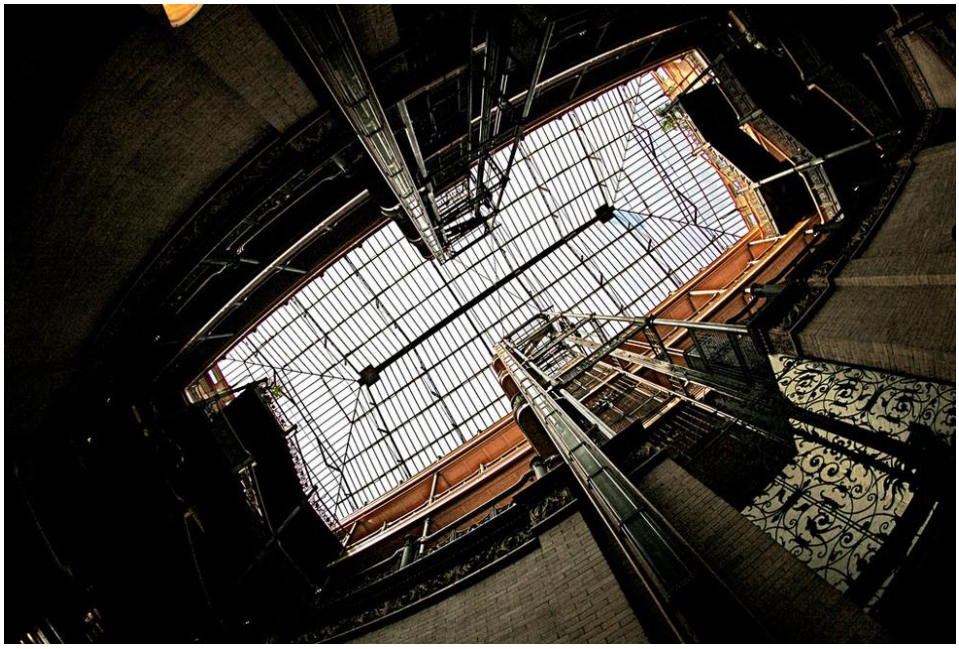

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The views expressed in this report are solely those of the policy analysts and do not necessarily represent the views of the UCLA Luskin School of Public Affairs or our client.

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Executive Summary

Los Angeles is considering a series of energy efficiency policies to introduce within the next year. This policy, modeled after ordinances passed in California, Washington, and nine other cities – Austin, Boston, Chicago, Minneapolis, New York City, Philadelphia, San Francisco, Seattle and Washington D.C., will center on benchmarking and disclosing of energy use within buildings. Energy use data are the initial pieces of information necessary to 1) understand how energy use affects climate change and greenhouse gas emissions, and 2) make wiser and more informed decisions about future energy use. Through benchmarking, building owners can compare their energy use to similar buildings to better understand their buildings' energy consumption and efficiency. Public disclosure of energy data can help increase transparency within the market about buildings' energy performance.

Los Angeles, as the second largest urban city in the United States, occupies a privileged status with a robust economy that houses many industries and employs millions of workers. Los Angeles and California as a whole are leaders in energy efficiency, the city itself topping the list

of the most Energy Star certified buildings.[1] Despite Los Angeles' leadership on issues of the environment and sustainability, huge opportunities remain to increase energy efficiency in existing buildings.

This Applied Policy Project examines energy efficiency policies including benchmarking and disclosure that are under the consideration of the Los Angeles Mayor's Office of Sustainability. The policies under study would impact existing privately-owned and municipal buildings throughout the city. By examining other cities' benchmarking and disclosure ordinances, our analysis offers policy recommendations that are site specific and can be successfully adopted by our client, the Los Angeles Mayor's Office of Sustainability. The following methods were used to determine our policy recommendation: 1) Analysis of existing building data, 2) Expert interviews, 3) Literature review, and 4) Estimations of projected energy savings, greenhouse gas emissions and costs.

Our findings led us to consider four policy option types:

- Benchmarking and Disclosure: Requires measuring, tracking, and public sharing of whole-building energy performance data.
- Audits: Allows for building owners to understand how they can improve their buildings through a professional inspection.
- Retro-Commissioning: Building owners enlist professionals to optimize their building settings to increase energy efficiency.
- Mandatory Upgrades: Requires building owners to implement recommendations from audits to reduce overall energy consumption.

After completing our first policy analysis, we further researched how to apply the selected policy options to different building types and building sizes in Los Angeles. This resulted in choosing building types (non-residential, residential, and municipal) that maximized the total floor area ft^2 covered while only requiring a small percentage of buildings to comply with the policy. Based on our analysis, we recommend the city adopts a policy that requires all non-residential and

[1] United States Environmental Protection Agency (EPA). "Top Cities with the Most ENERGY STAR Certified Buildings in 2012," *United States Environmental Protection Agency (EPA)*, December 31, 2012, http://www.energystar.gov/ia/business/downloads/2011_Top_Cities_chart.pdf.

multifamily residential buildings over 10,000 ft^2 annually disclose their energy use. In addition, we recommend that the city requires either an audit or retro-commissioning of buildings every 10 years. We do not recommend that the city pursues any mandatory upgrade or improvement to its building.

Cities that have passed energy efficiency policies utilized a phased-in policy implementation plan. For successful implementation, we recommend the following timeline:

Year Zero

- Before implementing a disclosure policy, the Mayor's Office will need to engage building stakeholders to secure feedback and support of the policy.

Year One

- Los Angeles will implement the policy recommendations for municipal buildings.

Year Two

- The city will implement the policy recommendations to impact commercial and multifamily residential buildings. As this is the first year that building owners will be required to participate, the city should spend a significant amount of time educating stakeholders and providing guidance concerning details of the policy.

Year Three

- Disclosure compliance becomes mandatory and enforced via deadlines and fines.

Year Four

- Audits and retro-commissioning compliance becomes mandatory and enforced via deadlines and fines.

In addition to phased implementation, we recommend the Mayor's Office create a plan for data management and educational outreach. The City of Los Angeles has the opportunity to develop new energy efficiency policies that will reduce energy use and greenhouse gas emissions, increase savings on utility bills, and create the infrastructure to store energy data that can later be effectively analyzed for further efficiency gains.

Introduction

Los Angeles and California possess an excellent reputation of environmental and energy efficiency leadership. Los Angeles has the most Energy Star buildings and California has the largest number of LEED certified buildings in the nation.[1] In 2008, Los Angeles passed an ordinance requiring that all new buildings constructed would need to meet green building standards.[2] California followed in 2010 passing the CalGreen Code – the first state green building code in the nation.[3] This policy set both mandatory and voluntary standards for green building and is a driver for energy efficiency investment in new buildings and major retrofits.

However, 84 % of buildings in Los Angeles were built prior to 1978 when the California passed its first energy building codes (Appendix J). These buildings (non-residential, commercial, and municipal) represent an opportunity for Los Angeles to expand energy efficiency investments.

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[1] Kriss, Jacob. "USGBC Releases the Top 10 States in the Nation for LEED Green Building." *US Green Building Council*. February 2014. http://www.usgbc.org/articles/usgbc-releases-top-10-states-nation-leed-green-building.

[2] Mitch Menzer and Elisa Paster. "Stay Current: Los Angeles Adopts Sustainable Building Ordinance," *Paul Hastings*, July 2008, http://www.paulhastings.com/Resources/Upload/Publications/946.pdf.

[3] Brown, Edward G. Jr., "State and Local Government Green Building Ordinances in California." State of California Department of Justice. http://ag.ca.gov/globalwarming/pdf/green_building.pdf

In Los Angeles, buildings are the second largest contributors to greenhouse gas emissions.[4] Creating an energy efficiency and disclosure policy will not only make tenants aware of their energy use, but reduce energy consumption which will decrease greenhouse gas emissions.

Currently, there is no transparency regarding buildings' energy usage in Los Angeles. Energy efficiency evokes the image of changing a light bulb or buying a new refrigerator—the bigger impact of building operations is often overlooked. Los Angeles can create a sustainable energy platform by passing a compliance measure that requires existing buildings to benchmark energy use. When aggregated, this could result in significant energy savings city-wide. By creating an awareness and dialogue about use, the market can move towards higher-level efficiency measures such as building materials and technologies.

Background: Disclosure and Energy Efficiency Policies across the Nation

In the last six years, nine cities and two states, including California, have implemented energy efficiency policies to mitigate the effects of greenhouse gas emissions across the country.[5] Some policies are as simple as disclosing energy usage to certain stakeholders while others require additional components such as audits, retro-commissioning, and mandatory upgrades.

Austin was the first city to pass and implement an energy efficiency policy, followed by New York City. Austin's policy requires that all commercial buildings benchmark energy use and that all multifamily buildings undergo an energy audit every 10 years.[6] Additionally, Austin requires that multifamily buildings that use over 150% of average energy use (of multifamily buildings) must decrease their energy consumption by 20%.[7] Austin's benchmarking policies are the most unique of the nine cities and offer an interesting comparison of policies. Concurrently, New York City created the PlaNYC Greener Greater Buildings Plan. This plan called for a set of energy

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[4] Los Angeles County Department of Regional Planning. "Community Climate Action Plan (CCAP) - Emissions Inventory," *Los Angeles County Department of Regional Planning*, 2014, http://planning.lacounty.gov/ccap/emissions.

[5] Northeast Energy Efficiency Partnerships (NEEP). "Building Energy Rating and Disclosure Policies Update and Lessons From the Field," *Northeast Energy Efficiency Partnerships (NEEP)*, February 2013, http://www.neep.org/Assets/uploads/files/public-policy/building-energy-rating/BER%20Supplement_FINAL%20DRAFT_2-25-13.pdf.

[6] Kimberly, Debbie and Tim Kisner. "Energy Conservation Audit and Disclosure (ECAD) Ordinance Overview and Status." Austin Energy. July 2013. http://www.austinenergy.com/wps/wcm/connect/6a9aadc7-404e-4689-b846-9d3fc31172d3/ECADOverviewStatusJuly2013.pdf?MOD=AJPERES.

[7] Austin Energy. "ECAD For Multifamily Properties." *Austin Energy ECAD Ordinance.* 2014. http://www.austinenergy.com/wps/portal/ae/Programs/ECAD-Ordinance/for-multifamily-properties/.

efficiency policies that have become a new standard. In particular, the Greener Greater Buildings Plan resulted in Local Law 84, which requires the benchmarking and public disclosure of commercial and multifamily buildings over 50,000 ft^2 and Local Law 87 that requires all buildings over 50,000 ft^2 to audit and retro-commission once every 10 years.[8]

Seattle, Washington D.C., and San Francisco also have passed and implemented similar policies with slight variations. Seattle does not require public disclosure of the data. Washington D.C. does not have any audit or retro-commission requirement. San Francisco's policy is the most similar to New York City's, but allows building owners to choose between audits and retro-commissioning instead of mandating both actions. Boston, Philadelphia, Minneapolis, and Chicago have also passed policies in the past two years but have not yet implemented their policies. Most of these cities will require compliance within the next year. (Refer to Appendices C and D for a more detailed comparison of these policies.)

Though these energy efficiency policies hold promise, there have been significant delays between their enactment and implementation. Most cities have two or fewer staff members working on policy implementation and compliance and often require additional assistance and resources.[9] At the same time, building owners require time to learn and comply with the policy. Most cities have provided free training and educational materials to building owners and these actions have resulted in high compliance rates[10].

To encourage compliance with new regulations, many cities are working closely with the Environmental Protection Agency (EPA) to report their energy data through the agency's Energy Star Portfolio Manager.[11] This is a free tool that allows building owners to upload their buildings' energy and water data with other building characteristics. Many cities are also working with utilities to facilitate disclosure by allowing them to directly update energy and water data to

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[8] PlanNYC. "New York City Local Law 84 Benchmarking Report August 2012." *The City of New York*. 2012. http://www.nyc.gov/html/gbee/downloads/pdf/nyc_ll84_benchmarking_report_2012.pdf.

[9] Institute for Market Transformation. "Jurisdiction Briefs" (unpublished collection, accessed February 2014). Institute for Market Transformation, Washington D.C.

[10] See Appendix G

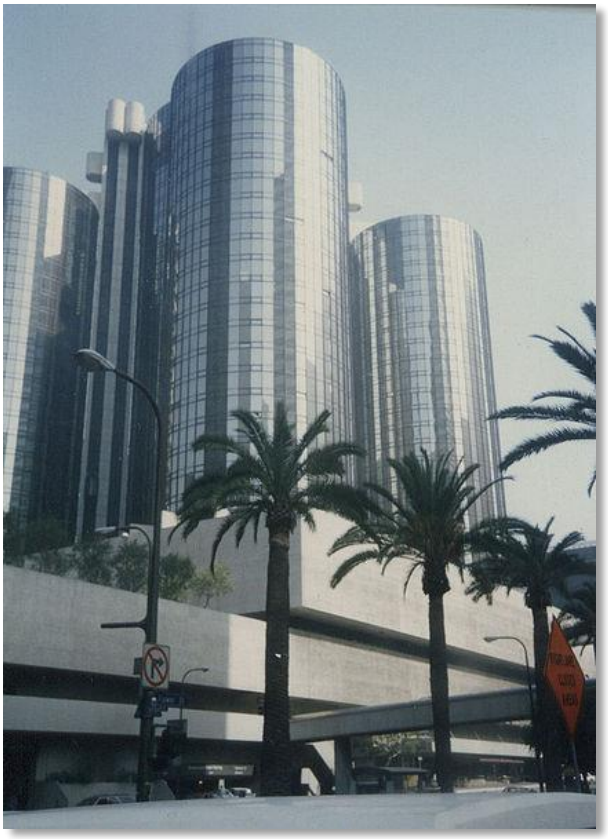
[11] Northeast Energy Efficiency Partnerships (NEEP). "Building Energy Rating and Disclosure Policies Update and Lessons From the Field," *Northeast Energy Efficiency Partnerships (NEEP)*, February 2013, http://www.neep.org/Assets/uploads/files/public-policy/building-energy-rating/BER%20Supplement_FINAL%20DRAFT_2-25-13.pdf.

Portfolio Manager.[12] As a benchmarking tool, Portfolio Manager allows for the ranking of a building's efficiency relative to similar buildings of the same use.

California, as early as October of 2007, passed AB1103 which mandates building owners to disclose energy data through Energy Star Portfolio Manager.[13] This policy is significant as it sets a precedent for California utilities to provide whole building data using Portfolio Manager. AB1103 only requires disclosure at point of sale for commercial buildings and applies only to prospective buyers, lessees and lenders as opposed to the public.

[12] Danny Orlando (Energy Star Program Manager, US Environmental Protection Agency), interview by Amanda Morrall, January 23, 2014.

[13] State of California. "Assembly Bill No. 1103," *California Energy Commission*, October 12, 2007, http://www.energy.ca.gov/ab1103/documents/ab_1103_bill_20071012_chaptered.pdf.



The Client & Policy Problem

The Client

Our client is the Los Angeles Mayor's Office of Sustainability. During his campaign in 2013, Mayor Eric Garcetti vowed to "create 20,000 local clean energy, energy efficiency and clean water jobs during his first term in office, with a focus on building retrofit, solar installation and design, component manufacturing, and maintenance jobs."[14] With this mandate in mind, energy efficiency has become a key policy area for our client. In September 2013, the Mayor's Office was awarded a grant from the Institute for Market Transformation (IMT) and the National Resource Defense Council (NRDC) to support the development and implementation of an integrated policy and program package that would target the energy efficiency of existing buildings. Working with Ted Bardacke, the Deputy Director of Sustainability, and Hilary Firestone, a consultant for the Office of Sustainability, our team was asked to investigate these

[14] Office of Los Angeles Mayor Eric Garcetti. "20,000 Good, Local Jobs: A $2 Billion Investment in Clean Energy, Clean Water and Energy Efficiency," *Eric Garcetti*, 2013, http://www.ericgarcetti.com/issue_jobs.

policies for the city of Los Angeles. In this paper, we will refer to the Mayor's Office, Ted Bardacke, and Hilary Firestone as our client.

Policy Problem

The Los Angeles Mayor's Office intends to implement an energy disclosure benchmarking policy that would mandate disclosure of annual energy use of large existing buildings in Los Angeles. This policy is modeled after a series of energy disclosure policies that have passed in nine other U.S. cities--including New York, Austin, Seattle, and San Francisco. In tandem, the Mayor's office hopes to pass complementary energy and water efficiency policies to drive further efficiency gains. Given the dual goals of benchmarking and improved efficiency, our analysis aims to address the following two questions:

Will benchmarking and disclosure, as a standalone policy, drive energy and water efficiency investment and if not, which set of additional policies are most cost effective at driving energy and water savings in existing buildings?

What criteria should be used to determine if a building owner should be mandated to disclose energy use?

Significance: Climate Change and Buildings

Due to increased greenhouse gas (GHG) emissions, Los Angeles is facing a shifting climate that includes projections of more wildfires, sea level rise, and the increase of extreme heat days.[15] Given these threats, it is imperative that Los Angeles takes action to reduce its carbon emissions. Buildings are the second largest contributor to GHG emissions in Los Angeles after transportation.[16] Most GHG emissions attributed to buildings are from the energy used to construct, operate, heat, cool, and light buildings. By making building operations more efficient, a reduction in energy consumption and decrease GHG emissions can be achieved. In the past, most mandatory efficiency policies have targeted construction of new buildings or large renovations through building codes. These policies usually use the permitting process for new building construction and retrofits to enforce higher energy and water efficiency standards.

Eighty four percent of buildings in Los Angeles were built prior to 1978 when California legislature passed its first energy building codes and most energy efficiency programs do not target older buildings.[17] Accordingly, it is imperative for Los Angeles to consider how improved information availability, incentives, and regulation can promote existing buildings to become more water and energy efficient.

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[15] Hall, Alex, Fengpeng Sun, and Daniel Walton. "Climate Change in Los Angeles." C-Change LA. University of California, Los Angeles. 2014. http://c-change.la/la-climate-studies/

[16] Los Angeles County Department of Regional Planning. "Community Climate Action Plan (CCAP) - Emissions Inventory," *Los Angeles County Department of Regional Planning*, 2014, http://planning.lacounty.gov/ccap/emissions.

[17] See Appendix K

What is the Energy Efficiency Gap? Why Energy Efficiency?

Although California and Los Angeles are leaders in energy efficiency, an efficiency gap continues to exist. An energy efficiency gap is defined as the difference between actual use and optimal use—both currently and in the future.[18] The importance in considering this gap centers on the optimality of resource allocation from an economic perspective.[19] Cost efficient technologies are available on the market and provide for energy and water improvements. However there appears to be a paradox where households and firms under-invest in efficiency technologies despite projected cost savings and rebate incentives. The market conditions and market failures that contribute to the energy efficiency gap are numerous—lack of information, informational asymmetries, and split incentives are a few examples. An energy efficiency and disclosure policy, with the purpose of creating transparency around energy use, has the ability to ameliorate some of these market concerns.

Lack of information

At the core of the energy efficiency debate is the availability of information.[20] Consumers of energy cannot be expected to conserve energy or be more efficient without knowledge of their

[18] Adam Jaffe and Robert Stavins. "The energy-efficiency gap What does it mean?" *Energy Policy* 22, no. 10 (1994): 804.
[19] Ibid.
[20] Ibid, 805.

baseline energy use. Information about energy use can be viewed as a public good available for public consumption—to tenants, building owners, and efficiency consultants. A public good of this type is typically underprovided in a market economy[21] since no incentive exists to provide or produce such a good. By mandating that energy information is made available, corrections towards the energy efficiency gap can be made. In particular, the benchmarking and disclosure policy aims to provide whole building energy consumption data and allows for comparison of energy consumption across buildings.

Information asymmetry and the split incentive

The lack of awareness of energy usage, along with the uncertainty surrounding savings from efficiency technologies, high levels of uncertainty of future energy prices, and the high upfront costs of energy-saving technology create a barrier for investments in energy and water efficiency. Information asymmetry is the general problem whereby one party possesses more information than the other. These information gaps can be exacerbated at the building level. Building owners, with one or multiple tenants, may have no information about their buildings' energy and water performance if they do not pay the utility bill.

This information asymmetry between the landlord and tenant leads to a split incentive. Building owners and tenants operate with conflicting motivations in mind. Building owners have little incentive to make investments towards energy efficiency improvements when they lease their properties to tenants, who resultantly pay energy bills.[22] In the case where improvements are made, tenants would reap the benefits of saved costs, however, tenants themselves have little incentive to make the energy efficiency investments themselves since they will "lose out on future energy savings"[23] once they move from a rental.

Energy disclosure's promise rests upon the assumption that behavioral changes will occur once consumers have an understanding of energy use. By increasing attention to energy use and performance, property owners can "act on opportunities to invest in cost-effective energy

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[21] Ibid, 805.

[22] Robert Stavins, Todd Schatzki, and Jonathan Brock. "An Economic Perspective on Building Labeling Policies," Analysis Group, March 28, 2013, http://www.boma.org/research/newsroom/press-room/Documents/An%20Economic%20Perspective%20on%20Building%20Labeling%20Policies.pdf.ES-2.

[23] Adam Jaffe and Robert Stavins. "The energy-efficiency gap What does it mean?" Energy Policy 22, no. 10 (1994): 804-805.

efficiency," that is, make energy efficiency investments that will save enough energy in the long run to offset the costs of the initial purchase.[24] Disclosure also has the ability to give owners of buildings a way to share information about the energy performance of their buildings. If indeed their buildings are more efficient relative to other buildings, this translates to higher rents and sale prices of their properties.[25] Future renters and buyers can also consider energy efficiency as part of the transaction. Without this transparency, building owners may forego energy efficiency investments when considering renovations and focus on comfort, amenities and costs.

Market Barriers

Market barriers present another challenge in the face of energy efficiency inducements. Time spent on energy efficiency ventures such as an audit or retro-commissioning is burdensome. Even if the owner of a building is willing to make the investment towards an audit or retro-commissioning, the technical knowledge required to successfully implement the venture is complex. Hiring an experienced professional to perform the necessary audit or retro-commission to ensure that a building is energy efficient incurs substantial cost. Finally, once the audit or retro-commissioning is performed and changes implemented, one must consider the time horizon to recoup the costs of the updated energy technologies and fees to consultants. Typically referred to as the payback period, commercial real estate firms have indicated that the ideal time horizon is roughly 2-3 years,[26] although it can be any length of years. This requires a risk calculation that not every layman can assess. The average building owner is not adept at making such risk calculations in order to save a few dollars from energy costs or to decrease greenhouse gas emissions. Requiring a building to undergo an audit or a retro-commissioning may help overcome this inertia and status quo bias that prevents energy efficiency investment.

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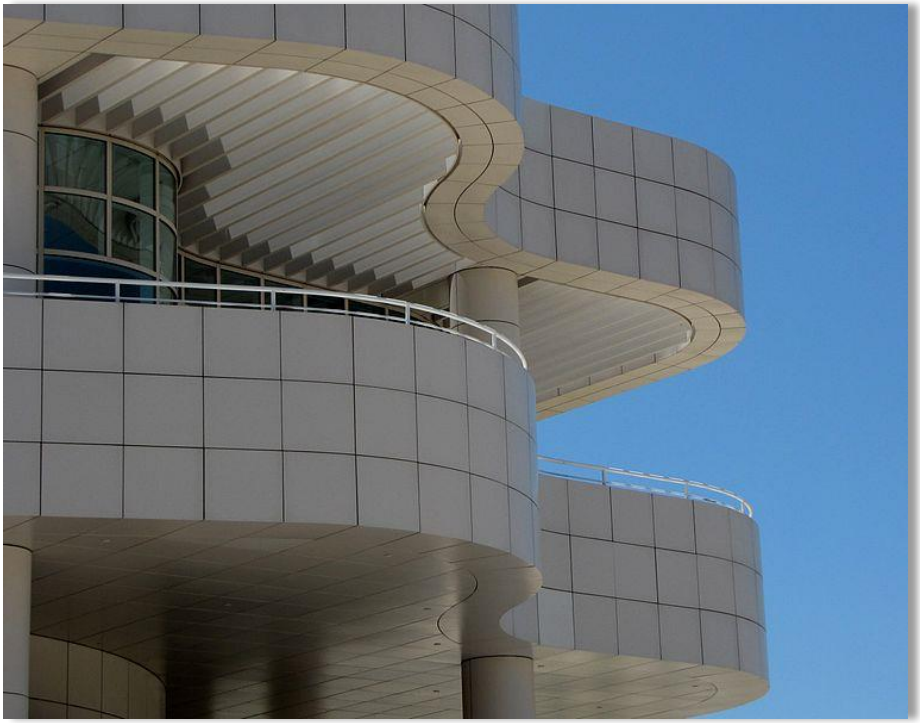
[24] Robert Stavins, Todd Schatzki, and Jonathan Brock. "An Economic Perspective on Building Labeling Policies," Analysis Group, March 28, 2013, http://www.boma.org/research/newsroom/press-room/Documents/An%20Economic%20Perspective%20on%20Building%20Labeling%20Policies.pdf.ES-2.

[25] Ibid.

[26] Interview with New York City real estate expert, February 19, 2014



Policy Barrier: Data Privacy

For building owners with one or more tenants, data privacy rules create a tremendous barrier for benchmarking. The California Public Utility Commission's (CPUC) rule 8380 and 8381 safeguards that energy use and personally identifiable information about its customers will not be shared or sold to third parties *unless* the customer consents to sharing such data.[27] If the customer chooses to share such information with a third party, the utility is not responsible for the security or misuse of such data.[28] It is important to differentiate between two types of data that the public utility possesses on its customers.

1) "Personally identifiable information which consists of customer names, addresses, social security numbers, and other information that specifically identifies a person."[29]

[27] State of California. "PUBLIC UTILITIES CODE – PUC DIVISION 4.1. CHAPTER 5," *State of California*, 2011, http://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=PUC&division=4.1.&title=&part=&chapter=5.&article=.

[28] Ibid.

[29] State and Local Energy Efficiency Action Network. "*A Regulator's Privacy Guide to Third-Party Data Access for Energy Efficiency*." Prepared by M. Dworkin, et al. 2012. http://www1.eere.energy.gov/seeaction/pdfs/cib_regulator_privacy_guide.pdf

2) "Customer specific energy usage data which does not identify an individual customer but includes detailed information about the utility service provided to the customer."[30]

The utility can release energy use data as long as personally identifiable information is stripped and kept private. Consequently, LADWP will only release aggregate data to the public using the 15/15 rule. The 15/15 rule specifies that aggregated energy data must include usage by fifteen customers and that no single customer comprises 15% of the composite energy use.[31]

The current practice of using the 15/15 rule for data aggregation is from a ruling by the CPUC in 1997 and is informed by precedent. [32] According to the CPUC, this ruling was designed to protect utility customers from a deregulated energy market; the outstanding concern was the individual's utility bills and was not meant to apply to benchmarking. In order to secure energy contracts from private-sector utilities, this method of data aggregation was used mainly to aggregate the buying power of individual customers and less for anonymity. In the context of energy benchmarking, the use of the 15/15 rule has no logical reasoning and serves as severe impasse for building owners who would like to benchmark their buildings' energy use but have no formal venue to access their data. If LADWP decides to keep data aggregated by the 15/15 rule, it should at least give building owners a venue to access such data.

At the same time, no national standard for data privacy and data aggregation exists.[33] In some cities with benchmarking and disclosure ordinances, utilities have released whole-building aggregated data to owners as long as there are more than 3-5 accounts.[34] Other utilities, including ConEd in New York City and Seattle's utility, City Light, will release whole building data when

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[30] David Baker. "Energy Upgrade falls far short of goal," *SFGate*, September 22, 2012, http://www.sfgate.com/news/article/Energy-Upgrade-falls-far-short-of-goal-3886924.php.

[31] State and Local Energy Efficiency Action Network. "*A Regulator's Privacy Guide to Third-Party Data Access for Energy Efficiency*." Prepared by M. Dworkin, et al. 2012. http://www1.eere.energy.gov/seeaction/pdfs/cib_regulator_privacy_guide.pdf

[32] Audrey Lee and Marzia Zafar. "Energy Data Center: Briefing Paper," *California Public Utilities Commission*, September 2012, http://www.cpuc.ca.gov/NR/rdonlyres/8B005D2C-9698-4F16-BB2B-D07E707DA676/0/EnergyDataCenterFinal.pdf.

[33] Krukowski, Andrea and Cliff Majersik. "Utilities' Guide to Data Access for Building Benchmarking."Energy Efficient Buildings Hub. March 2013. Institute for Market Transformation. http://s146206.gridserver.com/media/files/IMT_Report_-_Utilities_Guide_-_March_2013.pdf

[34] Ibid.

there are as few as two accounts in the building.[35] In 2013, the National Association of State Utility Consumer Advocates also released a resolution stating the need for providing owners whole-building aggregated data in order to support benchmarking and disclosure. [36]

In order to benchmark and obtain their own buildings' energy use data from the utility, the owner must request permission from each tenant. In San Francisco, this has resulted in incomplete data sets where owners have been unable to receive tenant permission as tenants move out or go out of business prior to the owner obtaining consent.[37]

The Mayor's Office has two options to ameliorate the data disclosure concerns. There are three parties involved in this process: LADWP, a building owner, and tenant. LAWDP provides energy and tracks energy use. A bill is sent to the tenant and consequently, the tenant is aware of his or her energy use. As it stands, the building owner must approach two parties—the tenant and the utility in order to get energy use for his or her building. If, in fact, building owners had the ability to get automatic consent to receive the data from the tenant within their lease agreement, the process for the building owner would be simplified.

The other, and more pervasive, option is to change LADWP's current privacy policy to allow the release of aggregated energy data directly to building owners. To change this policy, Los Angeles must address privacy concerns and make a case for providing building owners aggregated building data. Since the proposed policy only applies to large buildings, individual tenant data would be protected. Additionally, special consideration for buildings with individual privacy concerns may be addressed within the policy. The Mayor's Office needs to ensure that it works with stakeholders to comprehensively address this issue. To date, however, there has been no evidence that whole building aggregated data has infringed upon individual privacy in cities that have passed public energy disclosure policies. Since the potential risks for aggregated data are low, the Mayor should be able to address concerns and change this policy.

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[35] Andrea Krukowski (Institute for Market Transformation), email correspondence to authors, March 17, 2014.

[36] National Association of State Utility Consumer Advocates (NASUCA). "2013-05 Supporting Automated Benchmarking of MultiFamily Buildings for Energy Efficiency Purposes." Resolution 2013-05. November 2013. http://nasuca.org/2013-05-supporting-automated-benchmarking-of-multifamily-buildings-for-energy-efficiency-purposes/

[37] Barry Hooper (San Francisco Department of the Environment), interview by Saira Gandhi, February 3 2014.

Methodology

To inform our analysis of energy efficiency policies, energy and water disclosure and benchmarking policies, and understand the feasibility of these policies in Los Angeles, our team used the following research methods:

Literature Review

Our team analyzed existing energy efficiency policies, economic theory behind energy inefficiency and existing research on our policy options.

Expert Interviews

To understand the impact of existing policies, our team interviewed officials from San Francisco, Austin, New York City, Seattle and the California Energy Commission. These officials shared the rationale behind the policies as well as the challenges and successes.

We interviewed two commercial real estate firms who own buildings in New York City, San Francisco, Los Angeles, and Washington DC. Focusing on New York City's Green Greater Building Plans, these experts shared their perspectives on disclosure, benchmarking, and other policies impacting the real estate market.

To better understand the technicalities of the benchmarking process, we also interviewed Pacific Gas and Electric (PG&E), the utility in the San Francisco region that provides building data for benchmarking, and staff from the Environmental Protection Agency who administer the Energy Star Portfolio Manager tool used for benchmarking.

Additionally, we interviewed key Los Angeles City Officials, experts in Los Angeles energy use and policies to understand the feasibility of implementing energy efficiency policies locally.

Analysis of Los Angeles' County Assessor's Database

In order to understand the distribution and variance of buildings in Los Angeles, our team performed a descriptive analysis of the Los Angeles building stock using the County Assessor's database from 2008. This allowed us to determine how many buildings, how many parcels, and

the percentage of the city's total building square footage would be impacted by our policy options.

Estimation of Energy Savings, Greenhouse Gas Reductions, Compliance Rates, and Costs

Our team modeled projected energy savings for each policy alternative based on a set of assumptions used in IMT's City Energy Project calculator and other sources. These assumptions and calculations are outlined in Appendix E.

Energy production creates greenhouse gas emissions through the process of burning fossil fuels. Based upon our estimated energy savings, we used LADWP's electricity carbon intensity and PG&E's natural gas carbon intensity figures to calculate the estimated green house gas reductions. (Appendix F)

Cost estimates include both the administrative cost to the City and the cost to the building owner. Administrative costs are based on the number of full time employees to implement energy disclosure and efficiency policies. Costs to building owners are based on literature on existing building policies and expert interviews. (Appendix H and I)

Evaluative Criteria

1) *Impacts on Energy Use and Greenhouse Gas Emissions*

The primary goal of our client is to increase energy efficiency in existing buildings, decrease the energy use intensity (energy use/square feet) of existing buildings, and thereby decrease total greenhouse gas emissions. We will compare the relative energy savings and greenhouse gas reductions of each proposal.

2) *Projected Compliance Rates*

When interviewing cities with disclosure and energy efficiency policies for existing buildings, compliance was often touted as a sign of success. If the policy has low compliance rates, then the availability of energy use data will be greatly diminished. Low compliance rates are also a signal that the policy will not work. Finally, cities may not have the capacity to enforce compliance even when the statute allows for fees or other penalties. Voluntary compliance is necessary for both administrative success and as a signal of policy acceptance. As such, we will look at the projected compliance rates for each policy based on the compliance rates in other cities that have passed similar ordinances.

3) *Costs of Implementation*

Costs for the four policy options will be incurred by the following actors:

City of Los Angeles: Administrative costs of this policy include staff members for implementation and data analysis, the creation a master database, and the collection and uploading of energy use data.

Individuals and/or Owners: In order to comply with the law, building owners will incur costs. We will attempt to estimate these costs for each policy option based on current literature. However, as buildings are diverse, costs may vary.

4) *Political Feasibility*

In order to pass any policy, it is important that the mayor's office has support from the City, local building owners, real estate and building associations, and the business community. We will discuss qualitatively what political barriers may exist.

Policy Options

The Los Angeles Mayor's Office is planning to implement a suite of energy efficiency policies, including annual mandatory benchmarking, audits, retro-commissioning and mandatory upgrades. Below is a description of each of these options. In order to evaluate the options, we made a set of assumptions and recommendations for each policy based upon the adopted policies set by the nine cities that have already adopted similar policies.

Policy Option 1: Annual Energy Benchmarking & Public Disclosure

This policy option would mandate that building owners annually benchmark their energy use using EPA's Energy Star Portfolio Manager. Owners would upload data on a buildings' total area in square feet, building use and aggregated energy and into the Energy Star Portfolio Manager tool. The Portfolio Manager would return the buildings' site and source energy use intensity, greenhouse gas emissions, and if available for their building classification, an Energy Star score. This information would inform building owners of how much energy their building use on average and would provide comparison to buildings of similar capacity and usage. If a building owner receives a low energy star score, this is a signal that the building is operating inefficiently. After a building owner benchmarks energy use on Portfolio Manager, the EPA would transfer the data to the city. The city would then be responsible for publishing the data to a public website. Currently, only New York City and Washington D.C. have publicly published raw data which is

available for download into an Excel spreadsheet. In this format, it is difficult to see how much energy a specific building uses. Further, many New Yorkers will not realize that this information is available for download on the city's website. Ideally, New York City hopes that an enterprising individual or firm will use the data to create a more user-friendly format to navigate building data.[38] The trends towards open data—"big data" sets released to the public-- allow for private individuals and firms to perform analysis and elucidate complex social and spatial relationships within urban cities.[39] We assume that Los Angeles will also use an open data model.

Policy Option 2: Audits

Audits augment energy use data and allow a building owner to 1) see where building inefficiencies occur and 2) understand which investments would create the largest savings. An audit is the "inspection, survey, and analysis of energy flows for energy conservation in a building."[40] Typical is a 2-3 hour building inspection that looks at specific parameters of a building, such as insulation and heating systems. Audits have been standardized nationwide and are categorized on three levels—ASHRAE Level 1, 2, and 3.[41]

ASHRAE Audit Comparison	
Level 1: Walk Through	• "Rough costs and savings for energy efficiency measures (EEMs)"
	• "Identify capital Projects"
Level 2: Energy Survey & Analysis	• "Detailed building survey of systems and operations"
	• "Breakdown of energy source and end use"
	• "Range of savings and costs for the EEMs"
	• "Operation & Management changes"
Level 3: Detailed Service and Analysis	• "Refined analysis and additional measurement"
	• "Whole-building computer simulation calibrated with field data"
Table adapted from Microgrid Solar42	

[38] Interview with New York City real estate expert 2, February 25, 2014

[39] Duncan Smith. "The availability of open data and new trends in data visualization will transform how we understand our cities," *The London School of Economics and Political Science*, 2011, http://blogs.lse.ac.uk/impactofsocialsciences/2013/11/15/luminocity-project-urban-cartography/.

[40] "Energy Audit." Wikipedia. March 2014. http://en.wikipedia.org/wiki/Energy_audit

[41] Microgrid Solar Admin. "The Difference Between ASHRAE Level 1, 2 & 3 Energy Audits," *Microgrid Solar*, November 10, 2010, http://www.microgrid-solar.com/2010/11/the-difference-between-ashrae-level-1-2-3-energy-audits/.

[42] Ibid.

The ASHRAE model is useful for municipalities that mandate audits. New York City and San Francisco use these standardized levels to legally define audits while Austin created its own standard for its audit policy. Without standardization, it is difficult for the city to regulate and ensure that all building owners are complying with the audit policy. However, there is no reason for the city to create its own individual standard. Since the ASHRAE model is already widely accepted throughout the country, our team recommends that Los Angeles use the ASHRAE national standards in defining their audit policy.

Policy Option 3: Retro-commissioning

Retro-commissioning differs from an audit as it requires building owners to hire professionals to make specific operational improvements to the infrastructure of already existing buildings. While an audit provides information to the owner, retro-commissioning can be thought of as a tune-up of existing buildings and a good alternative to investing in new, expensive technologies.[43] Retro-commissioning usually does not include changing the buildings systems but "can often resolve problems that occurred during design or construction, or address problems that have developed throughout the building's life."[44]

As of 2013, New York City requires commercial buildings 50,000 ft^2 and over to audit and retro-commissioning every ten years and submit an energy efficiency report based on these findings.[45] San Francisco, following New York City's model in the *Greener Greater Buildings Plan*, passed the *Existing Commercial Buildings Energy Performance Ordinance,* requires buildings 10,000 ft^2 and over to perform an audit or retro-commissioning every 5 years. This allows building owners in San Francisco to choose whether or not to retro-commission their building.

Retro-commissioning depend largely on existing infrastructure and result in more variability in energy savings. Outside consultants, hired to manage these tasks, lack uniformity in the way they

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[43] Abraxas Energy Consulting. "What is Retro-Commissioning?" *Abraxas Energy Consulting*, 2013, http://www.abraxasenergy.com/energy-management-services/energy-audits/what-is-retro-commissioning/.

[44] Mills, Evan. "Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions)" *Lawrence Berkeley National Lab*. July 2009. http://cx.lbl.gov/documents/2009-assessment/lbnl-cx-cost-benefit.pdf

[45] PlanNYC Green Buildings & Energy Efficiency. "LL87: Energy Audits & Retro-commissioning," *The City of New York*, 2014, http://www.nyc.gov/html/gbee/html/plan/ll87.shtml.

conduct retro-commissioning. There is a non-standardization inherent in retro-commissioning as a result of existing buildings that were built in different years, styles, materials, and equipment. Since retro-commissioning includes actual improvements in building operations, this can result in much larger variable costs. Without official certifications that designate how or what to perform during a retro-commission, the ability to measure success is unclear. While both New York and San Francisco include clear guidelines on what should be included during building retro-commissioning, the variability of buildings inevitably will result in highly variable costs. As such, retro-commissioning is viewed as a more intrusive policy by building owners.

Policy Option 4: Mandatory Upgrades

This policy would require the city to enforce mandatory upgrades for large properties with high energy use based on established minimum levels of energy efficiency. In general, there is a large gap between buildings with high EUI and buildings with low EUI in each building type.[46] For example, New York City compared EUI, within building type, between low performing buildings at the 5th percentile and high performing buildings at the 95th percentile.[47] Inefficient buildings across all building types generally "use three to five times the energy" as efficient buildings.[48] These findings indicate that mandatory upgrades will reduce overall energy use in poor performing buildings.

The goal of a mandatory upgrade policy is to prescribe specific capital upgrades that can improve a building's energy performance. This can include improvements to lighting, ventilation, and heating and cooling (HVAC) systems.[49] However, since both buildings and recommended capital improvements are highly variable, the resulting energy savings are also variable. A one-size-fits-all solution for mandatory upgrades will be ineffective; this uncertainty poses a challenge for policy makers.

Due to these challenges, only Austin has implemented a mandatory upgrade policy. In 2008, Austin passed an ordinance mandating "high energy use" multifamily building owners to

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[46] PlanNYC. "New York City Local Law 84 Benchmarking Report August 2012," *The City of New York*, 2012, http://www.nyc.gov/html/gbee/downloads/pdf/nyc_ll84_benchmarking_report_2012.pdf.

[47] Ibid.

[48] Ibid.

[49] City of Berkeley. "Performing a Self-Audit for CECO," *City of Berkeley*, January 2011, http://www.ci.berkeley.ca.us/uploadedFiles/Online_Service_Center/Planning/CECO%20self%20audit_current.pdf.

implement upgrades that reduce their energy use by 20%.[50] High energy usage multifamily buildings are defined by Austin as multifamily buildings with "more than 150% of average energy use per sq ft."[51] Building owners are not explicitly told how they must reduce their energy, which allows them to choose packages that are the most cost-effective. Additionally, Austin Energy provides rebates to significantly reduce the costs to owners.[52] The autonomy that Austin's mandatory upgrade policy gives to building owners provides a model for Los Angeles. For our policy analysis, we considered a mandatory upgrade policy that states that buildings within the highest quintile of energy use must reduce their energy consumption by 20%. This policy would not mandate what upgrades a building chooses to pursue or mandate a certain dollar amount be spent. If the city adopts this policy, it should consider the exemption of buildings that are unable to reduce their EUI scores due to the building's functional use (i.e. buildings with server farms).

[50] Scott Jarman, Minh Bruce, and Jessica Galloway (Austin Energy), interview by Saira Gandhi. February 18, 2014.

[51] John Mitchell and Will Nissen. "Enabling Energy Efficiency in Rental Housing Overcoming the Split Incentives Barrier," *University of Minnesota Humphrey School of Public Affairs*, May 2011, http://conservancy.umn.edu/bitstream/11299/107532/1/Mitchell_Enabling%20Energy%20Efficiency%20in%20Rental%20Housing.pdf.

[52] Ibid.

Analysis of Los Angeles' Building Stock

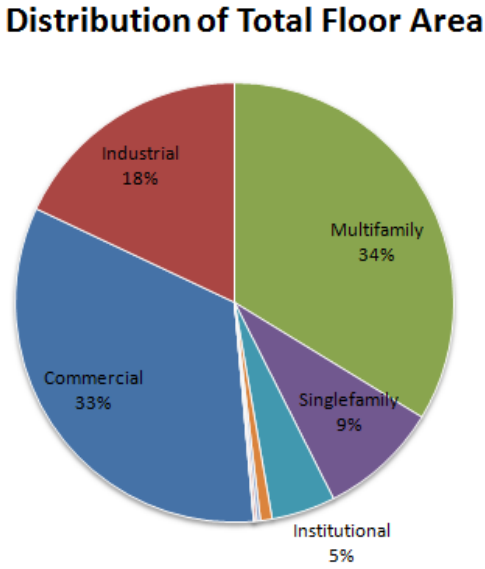
None of our model cities universally mandated energy disclosure or efficiency projects for all building types and all building sizes. In general, cities tried to maximize the total floor area and minimize the total number of buildings impacted by the policy. Single-family residences and small buildings are exempt from these policies. The smallest private buildings that must comply with an annual benchmarking and disclosure policy in the country are 10,000 ft^2 non-residential buildings in San Francisco and Austin. Additionally, California requires at-point-of-sale disclosure for non-residential commercial buildings larger than 5,000 ft^2 starting in July 2014.

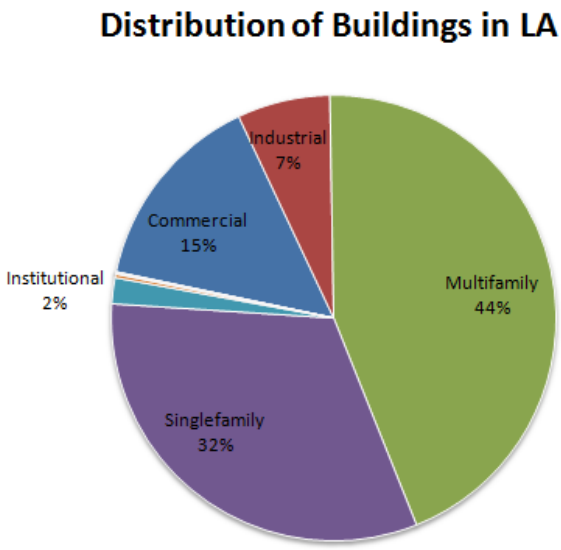
For multifamily buildings, the smallest private building that must comply with an annual benchmarking and public disclosure policy is 35,000 ft^2 or 35 units in Boston. Seattle requires benchmarking for multifamily buildings over 20,000 ft^2 but not public disclosure. Austin requires that all multifamily buildings undergo an audit and provides each multifamily building with a notification of average energy use. (See Appendix C and D). Most cities underwent a dual process of analyzing their building stock and meeting with local stakeholders to determine who must comply with any proposed ordinance.

In order to recommend which buildings and at what threshold the policy should impact, we analyzed the size and distribution of multifamily, commercial, and industrial buildings in Los Angeles. An ideal analysis would combine building data with current energy usage data to see where the marginal energy savings would be the greatest. Unfortunately, our team was unable to gain access to current energy data due to the restrictive privacy rules. It is possible that the Mayor's office will gain access to energy data in the next few months and they can combine new information with our analysis to make a final decision.

To proxy the marginal energy savings, we looked at the marginal gains in floor area impacted by our policy options compared to the total number of buildings. We analyzed the Los Angeles County Assessors' 2008 Database for tax collection. This data set contains parcel level information. Each parcel may have up to five buildings recorded. If a parcel has more than five

buildings, it is not included within the data. As such, some buildings may be lost in our analysis. In order to implement a final policy, the City will need to undergo a much more vigorous data analysis and data cleaning process to identify every building in the City that must comply with the law. However, the County Assessors' data provides adequate accuracy to determine trends in the building stock and determine a threshold for our final policy recommendation.



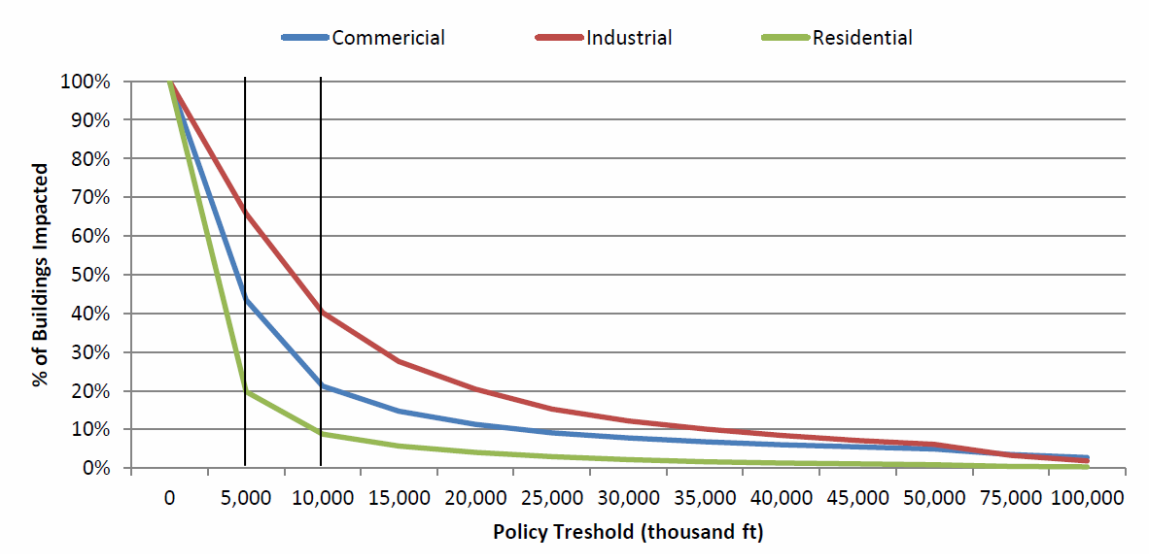


We split the data into four major categories: municipal (government owned), non-residential (commercial and industrial), multifamily residential and single family residential. In addition to these categories, the Assessors' database includes institutional, recreational, farms, dump sites, and miscellaneous parcels. These additional categories represent a small total percentage of both buildings and total floor area. As such, the Mayor's office should investigate how these buildings relate to the larger categories and how they should be legally classified under the law.

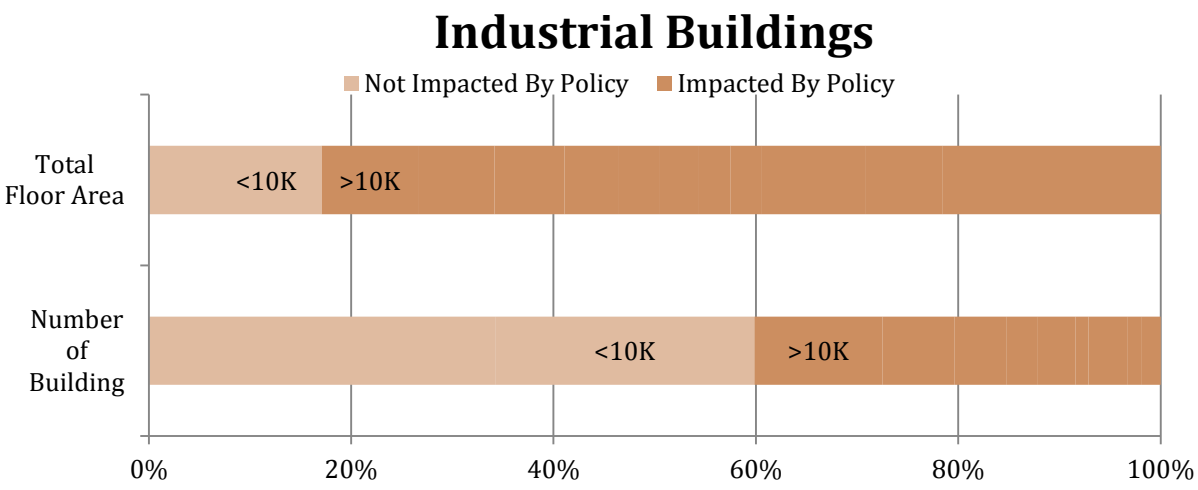
Our analysis focuses on commercial, industrial, and multifamily residential buildings. These buildings usually have one or more tenants and are more likely to face a split incentive. Further, the building owner is more likely to view these buildings as a business or an asset compared to a private home. When analyzing the distribution of these buildings by the total floor area, we found that Los Angeles has many small buildings. In fact, 90% of buildings were below 10,000 ft^2. When looking at the distribution of buildings, setting the policy below 10,000 ft^2 has small marginal gains in total square feet and large gains in the number of buildings impacted. Based on this we recommend a 10,000 ft^2 policy across building types.

As mentioned previously, our analysis was limited by the inability to access actual energy use data of buildings in Los Angeles due to existing privacy laws. The 10,000 ft^2 threshold recommended is optimal in the sense that setting the policy at this threshold is the "most bang for your buck" approach—capturing the most square footage of buildings while affecting the least number of buildings. This is essential when considering any policy; administrative burdens, to both building owners and to the City, are contained while the policy is introduced and constituents inculcate to the policy. Given the constraints of data, we recommend that further study using energy use data of buildings in Los Angeles be performed as soon as the data becomes available.

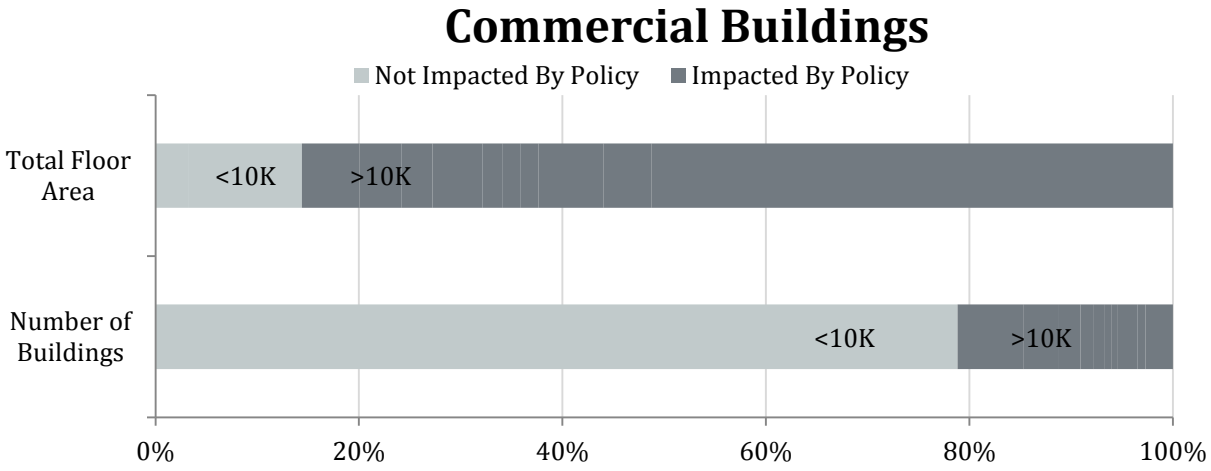
% of Buildings in Los Angeles Impacted by Policy based on Square Foot Thresholds



Non-residential Buildings refer to both commercial and industrial properties. In Los Angeles, the Industrial and Commercial building stock are approximately 44% of the total floor area in the city while they are only 20% of the total number of buildings. Looking more closely at the data, we can see that buildings 10,000 ft^2 or larger represent a large percentage of the floor area and small percentage of industrial and commercial buildings. For industrial buildings, a policy that included all buildings 10,000 $ft^2$and larger would affect 80% of all floor area but only 40% of all industrial buildings.



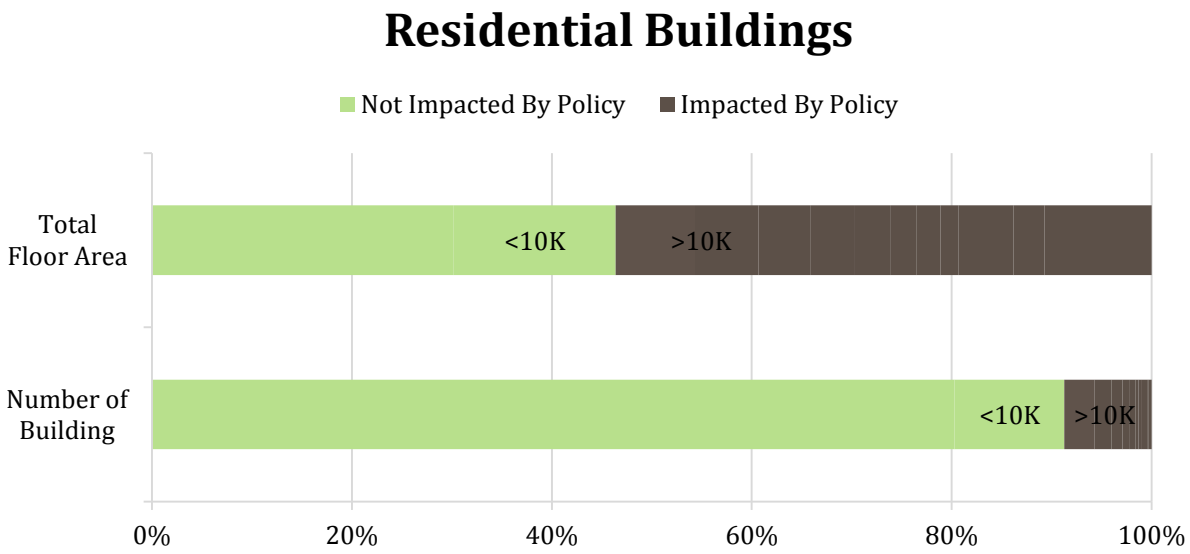
At 10, 000 ft^2, the policy would impact 70% of the total floor area and only 17% of all commercial buildings. This difference in the number of buildings is due to the fact that there are many small commercial buildings throughout the city. In fact, 59% of all commercial buildings are smaller than 5,000 ft^2.



Given the strong trend towards benchmarking commercial buildings nationally and in the state, we highly recommend that any energy efficiency policies for existing buildings include industrial and commercial buildings. We suggest that the policy would include all buildings over 10,000 ft^2. If the policy is set at a higher threshold (25,000 ft^2 or 50,000 ft^2), a substantial percentage of the total floor area and only a small number of buildings would not be subject to the policy and limits the overall policy impact. The marginal loss of raising the threshold would be high. While a policy at 10,000 ft^2 may seem aggressive in comparison to other cities, San Francisco's policy at 10,000 ft^2 and AB 1103 at the state level create precedent for this threshold.

The city may even consider a smaller threshold of 5,000 ft^2 as all commercial buildings under AB 1103 will be mandated to benchmark at the point of sale starting in July 2014. However, this would greatly increase the number of buildings that must comply. The City should consider their capacity to enforce a wider reaching policy if they decide to lower the threshold for compliance to 5,000 ft^2.

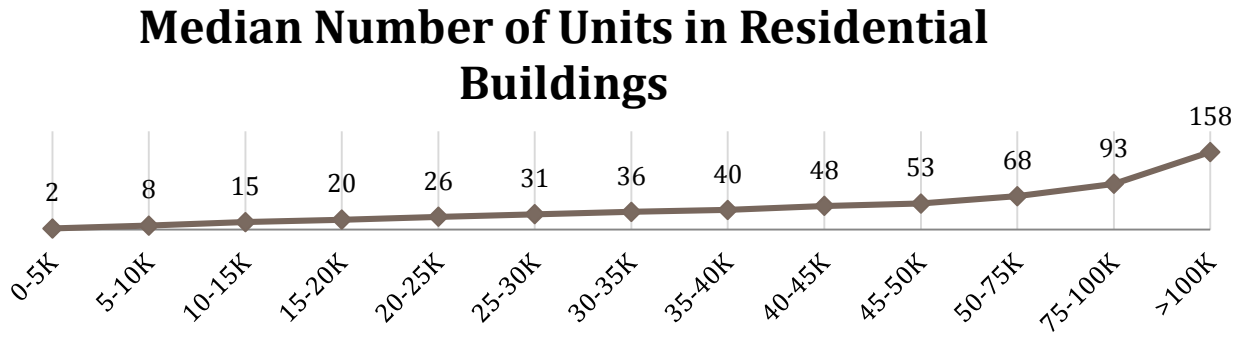
Multifamily Buildings refer to residential buildings with 2 or more units. Multifamily buildings have the largest share of total buildings and the largest share of total floor area. A policy impacting multifamily buildings has the largest potential to improve energy efficiency across the city. We recommend that multifamily buildings follow the same threshold for compliance as commercial and industrial buildings based on the distribution of the building stock. At a 10,000 ft^2, this policy would impact 52% of the total floor area but only 9% of multifamily buildings. Setting the policy at a higher threshold would dramatically reduce the impact floor area and have a limited impact on the number of buildings.



However, a 10,000 ft^2 policy would be the most wide reaching energy disclosure and benchmarking policy in the nation and there is a chance it will not be as politically feasible to set the threshold so low. Unlike commercial and industrial buildings, there is no precedent for requiring disclosure of multifamily buildings in California. The largest concern for multifamily buildings is data privacy. Under current state policy, the building owner would need to request permission from tenants to access energy consumption data and the process of obtaining consent creates large transactional costs. In San Francisco, the process of obtaining consent has led to

gaps in data.[53] For multifamily buildings to be included in the ordinance, the utility will need to be able to provide whole-building aggregated data that protects the privacy of individual tenants. If current privacy policies do not change and the 15/15 rule remains a standard, we assume that a building owner will be able to obtain whole building aggregated data if the building has more than 15 units.

As such, we compared the median number of units in multifamily buildings at different sizes to see how this data privacy would impact our 10,000 ft^2 threshold.



In a building between 10,000 ft^2 and 15,000 ft^2,the median number of units is 15. The city could decide to set the threshold at 15 units instead of 10,000 ft^2 if they are unable to set a more specific data aggregation policy. This change would impact 1% of all multifamily buildings in the City. However, using the number of units instead of the floor area of the building will be more difficult to enforce as the total number of units in a building are often misreported.[54] Since 15 units and 10,000 ft^2 threshold would impact a similar percentage of buildings and floor area, we will assume that the city adopts a 10,000 ft^2 policy to align with the commercial and industrial building recommendation.

Single Family houses are stand-alone homes or single condos. Single family homes include over a third of buildings in Los Angeles but only 11% of the total floor area. In general, single family homes are treated differently than multifamily, commercial, and industrial buildings in energy efficiency policies. The EPA has a separate program for single family homes and does not allow for single family homes to benchmark using the Portfolio Manager tool. We recommend that a

[53] Barry Hooper (San Francisco Department of the Environment), interview by Saira Gandhi, February 3 2014.
[54] Hilary Firestone (former staff, New York City Office of Mayor Bloomberg), interview by Amanda Morrall, January 17, 2014.

separate analysis be undertaken to address energy and water efficiency in single family homes. For our analysis we will not include the single family building sector.

Municipal Buildings refer to buildings owned by the Los Angeles City Government. The Mayor can mandate disclosure for municipal buildings through an Executive Order without seeking a vote from City Counsel. The General Services Department manages all City properties not owned by the Port of LA, LADWP, LA Airports, and the Department of Recreation and Parks. The Mayor's staff can work with the Port of LA, LADWP, LA Airports, Department of Recreation and Parks, and General Services to disclose energy.

The dominant goal for disclosing energy data of municipal buildings would not be to increase energy efficiency. The city could choose to improve efficiency without public disclosure. Further, energy efficiency improvements on only city owned buildings would have limited impact since government buildings account for fewer than 1% of the total area of buildings in Los Angeles and fewer than 1% of all buildings in Los Angeles.

Instead, the Mayor can publicly mandate the proposed energy efficiency policies as a political act to help with passing a broader policy aimed at private buildings. Additionally, the city can ensure that any necessary support systems are in place for data collection prior to implementing the policy for private buildings.

Policy Analysis

Impacts on Energy Use and Greenhouse Gas Emissions

The table below provides a summary of the input assumptions used in order to determine energy savings estimates. The estimations are the "independent savings rate" for each policy option, meaning that only one policy is enacted and potential savings are attributable to only that specific policy choice. In contrast, if the city implements two or more policies, the total energy savings would not be the sum of the independent savings. Instead, adjustment for policy overlap is required to ensure that these savings are not double counted. Additionally, the energy savings can be attributed to capital improvements and operations improvements. Capital improvements are making improvements to actual buildings, for example, replacing a HVAC system while operational improvements are changing settings within a buildings, such as resetting the thermostat. Capital and operational improvements in the context of energy savings analysis need to be accounted for individually. We will adjust for policy overlap below.

This savings rate is the estimated percentage reduction (relative to a constant baseline) in a sector's EUI for one year after each policy has been adopted and reached an equilibrium level. For our analysis and results presented below, we assume 100% compliance with each policy.

Policy	Description	Input Assumptions	Estimates
Benchmarking	(a) Mandatory annual reporting of energy use by large commercial & multifamily buildings using EPA ENERGY STAR Portfolio Manager (b) A summary of results gets publicly disclosed.	Average savings in compliant buildings	5%
		Share of floor space that would have benchmarked without the policy	9%
		Independent energy savings rate	4.5%
Energy Audits	(a) ASHRAE Level II audit mandatory for commercial and multifamily properties by a licensed professional once every 10 years. (b) Audit results would provide actionable information about the potential energy savings and cost-effectiveness of recommended performance improvements.	Share of audited space that improves operations due to policy	40%
		Savings rate for operations improvement	10%
		Share of audited floor space that upgrades equipment/capital due to policy	5%
		Savings rate for equipment/capital upgrades	20%
		Degradation rate	20%
		Exemption rate (policy may exempt ENERGY STAR and LEED properties)	9%
		Independent energy savings rate	3.6%
Retro-commissioning	For large buildings, retro-commissioning would be required once every 10 years, thereby optimizing the existing base building systems (including the HVAC system, electrical and lighting systems, building envelope).	Estimated savings rate for retro-commissioning	16%
		Degradation rate (Assume 40% degradation over 15 years, implying a 20% average degradation in any given year)	20%
		Share of floor space that would have retro-commissioned without the policy	5%
		Independent energy savings rate	12.16%
Energy Efficiency Improvements	For large properties, establish minimum levels of energy efficiency and/or require energy improvement measures based on cost-effectiveness.	Share of buildings (floor space) that must comply with policy (highest energy users)	20%
		Average savings rate of affected floor space (Based on NYC modeling, 36% average savings potential in below-average buildings. Assume that 75% of those savings are cost-effective.)	27%
	MODELED POLICY: A property in lowest quintile performance must improve by 20%.	Independent energy savings rate	5.4%

Source: These energy savings rates are based on assumptions and estimates made in IMT's City Energy Project Calculator and other sources. The IMT assumptions were modified and simplified for our analysis. See Appendix E for more details.

Benchmarking energy savings are based on the EPA's Energy Star Portfolio Manager's Data Trends. In 2012, the EPA released a report based on EUI data from benchmarking on 35,000 buildings between years 2008 and 2011. During this time, there was an average energy reduction of 7%.[55] However, this 7% savings resulted from buildings that voluntarily benchmarked, not those mandated to benchmark. To correct for self-selection bias, a 5% savings rate was used, since a slightly lower savings is expected when accounting for a mandatory policy. The energy savings would be a result of changed behavior or a decision to voluntarily invest in efficient technologies upon understanding the level of energy use. A person who voluntarily benchmarks is more invested in energy efficiency relative to someone who is mandated to do so. However, some buildings would benchmark in the absence of any policy. To reflect this, we multiply the 5% energy savings by 91% of all buildings that are benchmarking, due to the policy. Buildings that already are Energy Star or LEED certified comprise the remaining 9%. This results at an independent savings of 4.5%, which is the average estimated savings across all buildings impacted by the policy, assuming 100% compliance.

Mandatory benchmarking is a relatively new policy. New York City was the first city to implement benchmarking and only has two years of post-benchmarking data. Because the city does not have access to pre-benchmarking energy data nor to non-benchmarked buildings, the ability to statistically analyze the current impact of benchmarking is fairly limited. Thus, our estimate energy savings relies only upon the EPA's assessment of voluntary benchmarking and does not take into account existing mandatory benchmarking policies.

Audits, like benchmarking, provide information to building owners. An audit provides specific and actionable information to save energy through operations and through capital improvements. If a building owner decides to implement audit recommendations, he can realize substantial energy savings. However, there have been no studies that examine specifically how audits impact energy savings nor is there knowledge regarding the percentage of audits that result in the adoption of recommendations. Additionally, information on how an audit impacts energy savings is usually not tracked.

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[55] United States Environmental Protection Agency (EPA). "Data Trends: Benchmarking and Energy Savings." *United States Environmental Protection Agency (EPA)*. October 2012. http://www.energystar.gov/buildings/sites/default/uploads/tools/DataTrends_Savings_20121002.pdf

So far, there is little research that is available regarding typical energy savings from audits. In Austin, its single family audit program showed that 98% of homes took an action based on the audit recommendations.[56] However, it is unclear what type of action these homes took.

Additionally, homeowners may have more incentive than large building owners as there is no split incentive between an owner making upgrades and tenants who pay utility bills. As such, we will assume that there is a lower uptake of audit recommendations for large multifamily, commercial and industrial buildings.

Based upon input from industry experts, we assume that 40% of owners will make an operational improvement that results in an average 10% savings. Additionally, 5% of owners will make a capital improvement that results in a 20% savings. Generally, energy savings experienced immediately after an improvement will not persist over time. Since we are estimating the energy savings in the future, our model includes a 20% degradation rate that shows the diminishing of energy savings over time due to the aging of equipment and infrastructure. Exempting LEED and Energy Star buildings results in a 3.6% independent savings rate for audits. Again, we assumed 100% compliance.

Retro-commissioning is often viewed as a highly cost effective energy efficiency solution. The Lawrence Berkeley National Laboratory, a national laboratory that performs empirical research on science and energy, surveyed commissioning projects at over 643 buildings or 99 million ft^2 of floor space and found a median savings rate of 16%.[57] As such, we estimate that there will be a 16% average savings across the impacted building stock. However, commissioning is an operational improvement and these savings will not be constant and also must be discounted with a 20% degradation rate. Assuming 5% of buildings would retro-commission in absence of this policy, this individual policy generates the largest independent energy savings of 12.16% across each building sector assuming that all required buildings complied with the policy.

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[56] Austin Energy. "Energy Conservation Audit and Disclosure Ordiance Data." *Austin Energy ECAD Ordinance.* 2014. http://www.austinenergy.com/wps/wcm/connect/125237ef-4cc7-4c9a-8014-d1afa8984175/EES-conservAuditDisclosureOrdinance.xls?MOD=AJPERES

[57] Mills, Evan. "Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions)" *Lawrence Berkeley National Lab*. July 2009. http://cx.lbl.gov/documents/2009-assessment/lbnl-cx-cost-benefit.pdf

Mandatory Upgrades require that the top quintile of energy users reduce their energy savings by 20%. Thus, this policy would only apply to 20% of buildings impacted by any energy efficiency policy. Enforcement of this policy would also require that buildings benchmark their energy use so that the city can isolate the buildings with the highest energy use. Based on *New York City's Local Law 84 Benchmarking Report*, after year one of benchmarking, New York City found that, on average, there was a potential to save 36% energy in low-performing buildings (buildings below the median EUI score).[58] Not all of these savings would be cost effective, but this supports that a greater than 20% savings would be possible in the top quintile of energy users. Given the high savings potential, many who invest in energy efficiency improvements due to the policy will exceed the mandated 20% savings. Based upon New York City's report and discussions with experts, we assume that building owners would see a 27% savings if they pursued all cost effective energy measures. Applied across the building stock, this policy results in an independent savings rate of 5.4% as only 20% of buildings would be mandated to comply.

As previously mentioned, these policies would not result in a summative energy savings if any combination of the policies were enacted. When more than one policy is implemented, one cannot isolate the energy savings to one policy over another. We will adjust by assuming that more aggressive policies will have a more direct impact on the total savings. Mandatory upgrades are by far the most aggressive policy, followed by retro-commissioning. Both of these policies require that a building owner take action to reduce overall energy use. Audits and benchmarking, on the other hand, provide information to the building owner. Since audits provide detailed building information, it is more likely to impact a building owner's decision to improve the energy performance of his or her building as compared to benchmarking. Based upon these assumptions, each policy was weighted to create an adjusted savings rate for each policy combination.

[58] PlanNYC. "New York City Local Law 84 Benchmarking Report August 2012." *The City of New York*. 2012. http://www.nyc.gov/html/gbee/downloads/pdf/nyc_ll84_benchmarking_report_2012.pdf.

Estimated Total Savings*	Policy Combinations
7.57%	Benchmarking + Audits
15.14%	Benchmarking + Retro-commissioning
16.57%	Benchmarking + Audits + Retro-commissioning
12.75%	Benchmarking + Audits + Mandatory Upgrades
9.87%	Benchmarking + Mandatory Upgrades
17.11%	Benchmarking + Retro-commissioning + Mandatory Upgrades
18.35%	Benchmarking + Audits + Retro-commissioning + Mandatory Upgrades

*These energy savings rates are based on our input assumptions, using a modified and simplified version of IMT's City Energy Project Calculator. These savings rates represent the estimated annual savings rate across the building stock impacted by enacted policies and assume 100% compliance with all enacted policies.

After adjusting for policy overlap, retro-commissioning created the highest estimated energy savings. While the policies are not summative, the more policies that are implemented, the greater the potential savings overall. However, it is important to note that these are estimations that assume high compliance. If retro-commissioning has a low compliance rate, these numbers will decrease and less overall savings will be achieved.

Given the projected savings on energy efficiency, we calculated the total greenhouse gas emissions savings based on the carbon intensity of electricity provided by LADWP and the carbon intensity of natural gas. The amount of greenhouse gas emission reduction of one year, just from benchmarking, is equivalent to removing 550 billion lbs of CO_2 or 349,705 car trips from Los Angeles to New York City. Hence, these policies can have significant impact in reducing the city's carbon footprint.

Policy Options	Energy Savings	Greenhouse Gas Reduction (lbs CO2)	# of new car trips from Los Angeles to New York City saved
Benchmarking	4.50%	550,693,240	349,706.35
Retrocommissioning	12.16%	1,488,095,511	944,984.28
Audits	3.60%	440,554,592	279,765.08
Mandatory Upgrades	5.40%	660,831,888	419,647.62
Benchmarking + Audits	7.57%	926,388,406	1,176,567.60
Benchmarking + Retrocommissioning	15.14%	1,852,776,813	588,283.80
Benchmarking + Audits + Retrocommissioning	16.57%	2,027,774,887	1,287,696.50
Benchmarking + Audits + Mandatory Upgrades	9.87%	1,207,853,840	1,426,024.79
Benchmarking + Mandatory Upgrades	12.75%	1,560,297,514	990,834.67
Benchmarking + Retrocommissioning + Mandatory Upgrades	17.11%	2,093,858,076	1,329,661.27
Benchmarking + Audits + Retrocommissioning + Mandatory Upgrades	18.35%	2,245,604,657	767,022.60

See Appendix F for more calculations and sources

2) *Projected Compliance Rates*

High compliance rates signal that a policy is successfully implemented and that the public accepts the policy. On average, cities with benchmarking ordinances have high compliance rates. The largest barrier to compliance is lack of knowledge of the ordinance or inability to access whole-building data. In order to overcome the first barrier, most cities have created outreach strategies to inform building owners of the law and provide technical assistance for benchmarking. Many cities have created call centers for building owners, held trainings, and worked with community groups and local colleges to ensure that building owners are aware of all compliance requirements and deadlines.

Audits and retro-commissioning requirements have lower compliance rates in comparison to other benchmarking. However, only two cities had available data for compliance – Austin and San Francisco. San Francisco only has a 50% compliance rate but is working with many building owners. They expect to see this number rise to 80% "within a reasonable period of time."[59] Austin's low compliance may be due to lack of resources and limited outreach. [60]

[59] Barry Hooper (San Francisco Dept. of the Environment), email correspondence to authors, February 26, 2014.

[60] Scott Jarman, Minh Bruce, and Jessica Galloway (Austin Energy), interview by Saira Gandhi. February 18, 2014.

Cities	Benchmarking Compliance Rates	Audits/ Retro-Commissioning Compliance Rates	Mandatory Upgrades Compliance Rates
Austin	76%	66%	100% *only applied to 15 buildings
Seattle	93%	No Policy	No Policy
New York City	75%	No data, just began implementation	No Policy
San Francisco	No data,	50%	No Policy
Washington D.C.	83%	No Policy	No Policy
Boston	No data, not yet implemented	No data, not yet implemented	No Policy
Chicago	No data, not yet implemented	No Policy	No Policy
Minneapolis	No data, not yet implemented	No Policy	No Policy
Philadelphia	No data, not yet implemented	No Policy	No Policy

*See Appendix G for sources and more detail

Austin is the only city that has implemented a mandatory upgrade policy. Austin's Energy Conservation Audit and Disclosure Ordinance had 100% compliance for the 15 buildings required to upgrade far.[61] To incentivize compliance for all policies, Austin offers rebates for building owners to implement upgrades.[62]

Due to the limited data and sample size, it is difficult to estimate overall compliance rates for Los Angeles. However, compliance rates will have a large impact on the total energy saved. If only a small percentage of buildings comply, the expected energy savings and greenhouse gas reductions greatly decrease. As such, we calculated the following compliance rates for Los Angeles by comparing the compliance rates of our model cities. The average of the four cities that have already implemented benchmarking is 81% compliance. Thus, we rounded down to 80%. Since there are only two cities with data on compliance for audits and retro-commissioning, we estimate that the compliance rate will be roughly between 66% and 50%.

[61] Ibid.

[62] Ibid.

Our estimations are fairly uncertain but show that overall benchmarking has a higher compliance rate than audits and retro-commissioning.

Los Angeles Policy Options & Estimated Compliance Rates:		
Benchmarking	Audits / Retro-commissioning	Mandatory Upgrades
80%	60%	Unknown

3) Costs of Implementation

In order to estimate the cost of implementation, we compared the amount of staff needed by each city to implement an energy disclosure and benchmarking, audit, retro-commissioning, and mandatory upgrades (see Appendix H). Our data was limited as most cities have not yet implemented policies or do not have a mandatory upgrade and audit/retro-commissioning policy. Also, many cities appeared understaffed for implementation. For example, San Francisco noted that lack of staff resources is the reason that they have not yet publically released the energy use intensities and Energy Star scores of compliant buildings.[63]

Staff is needed to facilitate the drafting of the ordinance. Initial duties include engaging the building owner community, coordinating with the utility and city council to ensure political buy-in and that the project is technically feasible. Once the policy is passed, staff needs to create a database of all buildings that are expected to comply, educate building owners, and enforce compliance. Although most cities use formal and informal partnerships with non-profits, trade groups, and universities to assist with outreach, adequate staff is critical for success.

Based on our analysis of staff requirements in other cities, we recommend two full time employees (FTEs) for implementing a benchmarking and disclosure ordinance. One person would focus on outreach and education, while the other would maintain the energy use database and be responsible for compliance. The addition of an audit/retro-commissioning policy will require an additional FTE resulting in three FTEs. This staff member would focus on outreach

[63] Barry Hooper (San Francisco Dept. of the Environment), email correspondence to authors, February 26, 2014

and compliance specifically for audits and retro-commissioning. Finally, if the city implements a mandatory upgrade policy, an additional compliance officer would be needed.

Additionally, LADWP may require more staff to provide building owners with aggregated whole building data for benchmarking. Neither Austin Energy nor San Francisco's utility, PG&E, needed additional staff to provide data to customers.[64] However, if LADWP is not set-up to provide data, it may require additional resources to update their data system. In response to AB 1103, the Heschong Mahone Group (HMG), an energy efficiency consulting group, surveyed the necessary upgrades and cost required by all California privately owned utilities to estimate total costs. It found that for a modern Customer Information System (CIS), database upgrades to provide automated benchmarking would cost up to $160,000.[65] This would be a one-time upfront cost to the city as LADWP is owned and managed by the city. While this is a large up front cost, it is a small fraction of the $162 Million LADWP recently paid to modernize and upgrade their entire CIS system.[66]

Based on the above assumptions, the total estimated costs for Los Angeles are:

<table>
<tr><td colspan="4">LA Administrative Cost estimates</td></tr>
<tr><td>Policy</td><td>Item</td><td>Cost</td><td>Total</td></tr>
<tr><td rowspan="2">Benchmarking Costs</td><td>Staffing (2 FTE)</td><td>$ 174,264</td><td rowspan="2">$ 274,264.00</td></tr>
<tr><td>Database costs</td><td>$ 100,000</td></tr>
<tr><td>Audits/Retro-commissioning</td><td>1 FTE Additional Staff</td><td>$ 87,132</td><td>$ 361,396.00</td></tr>
<tr><td>Mandatory</td><td>1 FTE Additional</td><td>$</td><td>$</td></tr>
</table>

[64] Scott Jarman, Minh Bruce, and Jessica Galloway (Austin Energy), interview by Saira Gandhi. February 18, 2014.

[65] Heschong Mahone Group. "California's Automated Benchmarking Cost System." White Paper. July 2009. http://www.h-m-g.com/downloads/energybenchmarking/For%20Utilities/CA%20ABS%20Cost%20Summary%207-7-09.pdf

[66] Catherine Saillant. "Full tab for troubled billing system was $162 million, DWP confirms," *Los Angeles Times*, November 22, 2013, http://www.latimes.com/local/lanow/la-me-ln-dwp-20131122,0,5290943.story#axzz2w0Zdiy68.

Upgrades	Staff	87,132	448,528.00

It is important to note that these costs are summative. As such, we believe that the administrative cost differential between these policies is not great. Further, the city can leverage community partnerships to alleviate the cost burdens associated with hiring additional staff.

4) Costs to Owner

One barrier to energy efficiency improvements is the upfront cost to the owner. Although our policy options mandate action, upfront costs are still a deterrent even though these costs will be offset in the future through reduced energy consumption. As discussed previously, this failure to act on cost-saving energy efficiency measures due to upfront costs is a major market barrier for energy efficiency.

Benchmarking costs to owners are fairly limited. Owners can either chose to internally benchmark their data or hire an outside contractor to assist with the process. In New York City, the average cost of a contractor is $500.[67] Most utilities (with the exception of Con-Ed in New York), will provide energy use data for free.[68] In Los Angeles, we assume that LADWP will be able to provide aggregated building data to owners for free provided that it meets specific guidelines for privacy or tenants have provided consent. Additionally, the Energy Star Portfolio Manager is a free tool. However, if a building owner needs permission for energy data from tenants, this can be burdensome and add additional costs. Overall, benchmarking costs are minimal.

[67] Interview with New York City real estate expert, February 19, 2014

[68] PG&E indicated during our interview that this data is free and So Cal Gas provides free data as well. We assume that LADWP will also provide this data for free. Laura Mogilner (Pacific Gas & Electric Company), interview by Amanda Morrall, February 14, 2014.

Cost Estimations for Building Owners

	Inputs	Cost	Units	Subtotal	Total per Building
Benchmarking & Disclosure	EPA Portfolio Manager tool	Free			$ 300.00
	Permission from Tenants	$15 transaction cost per tenant	$ 15.00	$ 225.00	
	Automatic Data upload from Utility	Free			
	Time to process data	$15 per hour	$ 5.00	$ 75.00	
	OR Hiring a Contractor		N/A	500	$ 500.00

	Policy	Estimated Low Cost (per sq. ft.)	Estimated High Cost (per sq. ft.)	Average cost (per sq ft)	Average Cost Per Building (10K sq ft)
Audits & Retro-commissioning	Audits	$ 0.17	$ 0.73	$ 0.45	$ 7,300.00
	Retro-Commissioning	$ 0.15	$ 0.63	$ 0.33	$ 6,300.00

	Types of Upgrades	Low Estimate	High Estimate	Average Cost	Average Cost Per Building (10K sq ft)
Mandatory Upgrade	Lighting	$ 3.00	$ 5.00	$ 4.00	$ 40,000.00
	Ventilation	$ 2.00	$ 5.00	$ 3.50	$ 35,000.00
	Cooling	$ 3.00	$ 7.00	$ 4.50	$ 45,000.00
	Heating	$ 1.00	$ 2.00	$ 1.50	$ 15,000.00
	Total	$ 10.00	$ 20.00	$ 15.00	$ 150,000.00

*All listed prices have been adjusted to a 2013 dollars

**See Appendix I for sources

Audit, benchmarking and mandatory upgrade costs are all estimated based on existing literature. However, since the studies looking at different energy efficiency policies were published in various years, all of these cost estimates have been adjusted to 2013 dollars using the CPI index. In general, costs for audits, benchmarking and energy efficiency upgrades are highly variable and

depend on individual building characteristics. Overall, we found that upgrades had the largest range of possible costs, followed by audits, and retro-commissioning.

Additionally, mandatory upgrades were the most expensive while most of the audit and retro-commissioning price range overlapped. The cost to owners will fluctuate depending on which mandatory upgrades building owners choose to implement. Austin currently has a cap on how much building owners should spend on upgrades in addition to rebate programs. Austin Energy offers rebate programs that offset up to 80% of upgrades' costs.[69] If the city were to consider such expensive policies, it should also consider financing, rebate, and other programs to help owners access capital and pay for these upgrades.

5) Political Feasibility

Energy efficiency policies aimed at existing buildings are gaining momentum in large cities. All cities surveyed underwent a political and stakeholder engagement process prior to proposing any policy to the legislature. To examine the political feasibility of passing such policies through the legislature, we mapped the density of buildings in Los Angeles by City Council District (Appendix K-M). These maps looked specifically at commercial, industrial, and multifamily buildings. While buildings of all sizes are well distributed throughout the city, we found that Council District 14 has the highest concentration of large buildings of all types. Additionally, Council Districts 2, 12, 14 have a high density of commercial and industrial buildings and Council District 9, 10, and 11 have the highest density of multifamily buildings. The Mayor's office should prioritize political engagement in these areas by engaging building owners, environmentalists, tenant organizations, and trade schools.

Data privacy is one major area of contention when considering benchmarking and disclosure. California has a reputation of conservatism with regards to releasing energy use data. The precedent of the 15/15 rule may be difficult to change. In light of this, the Mayor's Office should work closely with community groups that have an interest in privacy to ensure their concerns are addressed. In general, privacy concerns may be greater in multi-family buildings compared to

[69] John Mitchell and Will Nissen. "Enabling Energy Efficiency in Rental Housing Overcoming the Split Incentives Barrier," *University of Minnesota Humphrey School of Public Affairs*, May 2011, http://conservancy.umn.edu/bitstream/11299/107532/1/Mitchell_Enabling%20Energy%20Efficiency%20in%20Rental%20Housing.pdf.

commercial buildings. As such, the Mayor's Office should create a strategy for engaging stakeholders across the different building sectors. Overall, privacy concerns should not impede the Mayor's ability to pass the ordinance through city council. The state of California along with San Francisco have enacted similar disclosure ordinances and the policy requires only aggregated building data.

The more contentious issue will be the cost to the building owner. We estimate that political feasibility of these policy mandates will decrease as the estimated costs increase. Mandatory upgrades, in particular, are unlikely to be politically feasible as it could require a building owner to expend a large sum of money in order to comply. It is possible to design the policy to have a cap on expected expenditures and include rebates or financing, but the overall policy will face an upward battle. The additional policy uncertainty surrounding mandatory upgrades also lowers its political feasibility. The Mayor's Office needs to be transparent in regards to upfront costs to building owners, while at the same time emphasizing the long-term benefits associated with energy efficiency. In addition, the Mayor's Office should leverage the support of building owners already invested in energy efficiency. Los Angeles has a large number of Energy Star and LEED certified buildings. These owners view energy efficiency as a good financial investment and will lobby support of other building owners and the Building Owners and Managers Association (BOMA).

Policy Selection & Recommendations

Based on our analysis, criteria, and interviews, we determined certain policy options to be more efficient than others. When evaluating each policy option, we used five criteria: 1) Impacts on Energy Use and Greenhouse Gas Emissions, 2) Projected Compliance Rates, 3) Costs of Implementation, 4) Costs to Owners, and 5) Political Feasibility.

	Potential Energy Savings Rate	**Estimated Compliance Rates**	**Estimated Administrative Cost**	**Estimated Cost to Owner**	**Political Feasibility**
Benchmarking & Disclosure	Low-Medium	High	Low-Medium	Low	High
Retro-commissioning	High	Medium	Low-Medium	Medium	Medium
Audits	Low-Medium	Medium	Low-Medium	Medium	Medium
Mandatory Upgrades	Medium	Unknown	Low-Medium	High	Low

Recommendation: Policy Selection

We recommend that the city pursue a policy that includes energy benchmarking and disclosure as well as audits and retro-commissioning. We recommend following the model developed by San Francisco where a building owner may choose at his discretion whether to have an AHSRAE Level II audit or retro-commission of his building. However, we recommend that the city follow

New York City's timeline, requiring compliance every 10 years. We do not recommend that the city pursue a mandatory upgrade policy given its high cost to building owners and the uncertainty of its effectiveness. Overall, we recommend that the policy be set at a 10,000 ft^2 threshold for non-residential and multifamily buildings. This will have maximum impact on the city's total floor area while only affecting a relatively small percentage of building owners

Recommendation: Phased Implementation

Every city with an energy efficiency policy, has phased-in their policy over a period of two to four years.[70] Implementing the policy over several years allows the city to 1) engage stakeholders and receive input, 2) lead by example and apply the policy to municipal buildings, 3) provide education for building owners, 4) identify potential problems and 5) enforce compliance. We recommend the following five-year phased implementation timeline:

Year Zero: A year before the policy is implemented, the Los Angeles Mayor's Office of Sustainability will need to engage building and association stakeholders to secure feedback and support on the policy. Several cities participated in pre-implementation stakeholder engagement. In interviews with San Francisco, Austin and New York, these cities emphasized the importance of working with stakeholders. Working relationships with stakeholders removed significant political barriers to the policy implementation process and provided an opportunity for the stakeholders to give feedback. Austin, Boston, Chicago, Minneapolis, New York City, Philadelphia, San Francisco, Seattle, and Washington D.C. have followed this model.

Year One: Once the policy is implemented, the first year should focus on the city of Los Angeles leading by example and implementing policy recommendations for municipal buildings. Several cities require their municipal buildings to disclose energy usage data. In New York City, the government benchmarked municipal buildings one year before other building types (Benchmarking Report). Benchmarking municipal buildings allows the city to show building owners that energy efficiency is a priority. Austin, Boston, Chicago, Minneapolis, New York City, San Francisco, Seattle, and Washington D.C. have followed this model.

[70] See Appendix C and D

Year Two: The second year will focus on introducing the policy, which includes disclosure, audits, and retro-commissioning, to residential and commercial building owners. Based on interviews with several cities, including San Francisco, Seattle, and Austin, we recommend that the city of Los Angeles provide education outreach which includes facilitating policy information sessions, training owners on Energy Star Portfolio, creating a 24-hour call center, and partnering with local universities to analyze data. Since this will be a "learning" year for building owners, we recommend that the city wait to enforce compliance. Austin, Boston, Chicago, New York City, Seattle, and Washington D.C. have followed this model.

Year Three: The third year will require mandatory disclosure for all building types. Several cities, including Austin, New York City, and Washington D.C., have two to five years between enacting a policy and the first compliance deadline. However, all cities have enforced penalties for non-compliance ranging from monetary fines to misdemeanors. We recommend the city of Los Angeles hold off requiring mandatory compliance until year three so that building owners are educated on the policy and understand their role in complying with the policy. Austin, Boston, Chicago, Minneapolis, New York City, Philadelphia, San Francisco, Seattle, and Washington D.C. have followed this model.

Year Four: The fourth year will require building owners to audit and retro-commission their buildings. Three cities currently require audits and/or retro-commissioning. San Francisco requires buildings to audit every five years[71]; however, New York City requires audits and/or retro-commissioning every 10 years.[72] San Francisco's policy only affects 2,700 buildings while 26,000 buildings are affected under New York City's policies. This number is closely approximate to the 20,000 buildings affected by such an ordinance in Los Angeles.[73]

Additionally, Los Angeles would need to hire new staff members to monitor buildings' compliance with audits and retro-commissioning. Requiring building owners to audit and retro-commission once every 10 years, as opposed to once every 5 years, is easier to track and enforce compliance. Austin, New York City, and San Francisco have followed this model.

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[71] San Francisco Department of the Environment. "Existing Commercial Buildings Energy Performance Ordinance," *San Francisco Department of the Environment*, 2014, http://www.sfenvironment.org/energy/energy-efficiency/commercial-and-multifamily-properties/existing-commercial-buildings-energy-performance-ordinance.

[72] PlanNYC. "How to comply," *City of New York*, 2014, http://www.nyc.gov/html/gbee/html/plan/ll87_comply.shtml

[73] See Appendix K

Recommendation: Data Privacy and Aggregation

Data is a critical component of the benchmarking and disclosure policy. Ensuring that building owners have access to their buildings' data in order to benchmark is tantamount to the success of the policy. At the same time, the availability of the data and the ability for people to understand the energy use data is critical for driving change in the energy efficiency market. Below are three recommendations that the Mayor's Office should pursue to maximize the utility of their data. Work with LADWP, CPUC, and other stakeholders to ensure that building owners can access their whole building's aggregated data, even if the building owner has multiple tenants.

Currently, the release of data occurs on a piecemeal basis—individual tenants must consent to disclosure of their energy use due to the existing privacy policy. Other cities with benchmarking ordinances where the utility is able to provide aggregate whole building data and automatic upload to the Energy Star Portfolio Manager have had greater success with implementation. As discussed in the report, these data privacy laws impinge on building owners' ability to benchmark. The city must work with the utilities, state regulators, and stakeholders to find a solution that both protects individual privacy and allows for whole building data to be tracked and shared.

Coordinate the creation of Los Angeles' energy use database with the federal government, state of California, and Los Angeles County. At all three government levels, individuals are considering creating a data aggregation center to promote studying the trends of energy use. Additionally, the County has expressed interest in creating one energy database that could be used by all 88 cities in Los Angeles County.

Ensure that the data are easy to access for all constituents. If the city can help tenants, prospective buyers, and brokers successfully access and understand the data, there will likely be an increased demand for energy efficient buildings.

Opportunity for Future Study: Water Benchmarking and Efficiency

When benchmarking energy through the Energy Star Portfolio Manager, building owners and managers currently have the option to include water consumption data. Requiring an owner to upload water data with energy data should have no increased impact on a building owner's cost and ability to comply with the law. As such, six cities have decided to include water benchmarking and disclosure as part of their energy benchmarking ordinances.

Given Los Angeles' dry climate and the current California drought, we believe that including water efficiency will both be politically feasible and beneficial for the community. Through water disclosure, the city and public could understand how water is used in large buildings and how to target water efficiency policies. Water is an important resource to the City as 70% of water is imported.[74] Increased information on water use could help the City and DWP meet its' goals to reduce water imports by 31% in 2035.[75] Further, water is linked to climate change and

[74] Los Angeles Department of Water & Power. "Urban Water Management Plan," *Los Angeles Department of Water & Power*, 2010, http://www.water.ca.gov/urbanwatermanagement/2010uwmps/Los%20Angeles%20Department%20of%20Water%20and%20Power/LADWP%20UWMP_2010_LowRes.pdf: 19.

[75] Ibid, pg. 19

the city's carbon footprint. On average, 3,845 kWh of energy is required to transport one acre foot of water over the Tehachapi from Northern California.[76] Conserving water will further reduce the city's total carbon footprint.

Despite these benefits, there are some key concerns that Los Angeles should explore when considering adding water to its energy efficiency policy proposals.

Water data are usually collected for both indoor and outdoor use. Water data that aggregate indoor and outdoor use may have limited ability to show where inefficiencies occur. Currently, Los Angeles does have a program to sub-meter water used for irrigation through its sewage program. Sewage fees in the City are high and sub-metering allows for an account holder to discount outdoor water use.[77] Our client should consider investigating how many accounts are sub-metered if that impacts overall water use.

The Energy Star Portfolio Manager currently only gives a building a Water Use Intensity score (total water/total ft^2).[78] It does not compare water use to similar buildings as it does with energy data. Thus, it may be hard for an owner or tenant to recognize if the water use intensity is above or below average. Currently the EPA is considering improving Portfolio Manager to provide more useful information to buildings that benchmark water use.[79] The city should work with the EPA to help develop these tools so that they are both beneficial and useful to local stakeholders. Audits, Retro-commissioning, and Mandatory Upgrades: Usually, these policies only look at energy systems.[80] Energy service companies may not have the expertise to improve water efficiency. If Los Angeles implements any required action to drive energy efficiency, the City needs to investigate what extra resources would be required.

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[76] Ibid, pg. 260

[77] City of Los Angeles Department of Public Works- Bureau of Sanitation. "RESIDENTIAL PRIVATE WATER SUB-METER INFORMATION PACKAGE," *City of Los Angeles Department of Public Works- Bureau of Sanitation*, July 3, 2012, http://www.lacitysan.org/fmd/pdf/submtrres.pdf.

[78] United States Environmental Protection Agency (EPA). "Energy Star Portfolio Manager Water Use Tracking," *United States Environmental Protection Agency (EPA)*, October 2012, http://www.energystar.gov/buildings/sites/default/uploads/tools/DataTrends_Water_20121002.pdf?f587-65dc.

[79] EPA Web Seminar. "State of the ENERGY STAR Commercial and Industrial Program." Energy Star Traning. US Environmental Protection Agency. March 5, 2014.

[80] Interview with New York City real estate expert, February 19, 2014

Conclusion

We recommend the Los Angeles Mayor's Office of Sustainability pursue a policy combining disclosure, audits, and retro-commissioning. The Mayor's goal of improving our local environment is attainable by implementing the above recommendations. However, investments made towards energy efficiency are not solely for improving the environment – they will also result in the creation of "green jobs". These jobs promise to improve the quality of life for the city's inhabitants, which is another top priority of the Mayor.

The recommended policy options should be pursued over a five-year period, including one year focused on stakeholder engagement. Energy benchmarking and disclosure give building owners access to data that allow them to see energy inefficiencies and waste. Combined with mandated audits and retro-commissions, this policy is the first step in improving the performance of the building stock of Los Angeles by serving as an impetus to overcome status quo bias and increase energy efficiency investments.

Los Angeles is a leader in environmental policy and sustainability. The city is perfectly poised to adopt new energy efficiency policies that will drive investment in the city's buildings and infrastructure. The Los Angeles Mayor's Office of Sustainability has an opportunity and responsibility to take a stand on energy efficiency that will undoubtedly have positive externalities for years to come.

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Appendices

Appendix A: Glossary of Terms

BTU British thermal unit

CEC California Energy Commission

CEP City Energy Project

CPUC California Public Utilities Commission

DOE U.S. Department of Energy

EPA Environmental Protection Agency

EUI Energy Use Intensity

GGBP Greener, Greater Buildings Plan (New York City)

HVAC Heating Ventilating and Air Conditioning

IMT Institute for Market Transformation

IOU Investor Owned Utility

LADWP Los Angeles Department of Water and Power

LEED Certified

NRDC Natural Resources Defense Council

NYC Local Law 84 Benchmarking and Discloure Policy

NYC Local Law 85 Energy Conservation Code

NYC Local Law 87 Energy Audits and Retro-commissions

NYC Local Law 88 Lighting Upgrades and Sub-metering

SEED Standard Energy Efficiency Data

PG&E Pacific Gas and Electric

Appendix B: Key Terms

Aggregated Data: the act of combining tenant energy use data and removing identifying information to protect privacy

Benchmarking: building owners or property managers normalize their energy use data to understand how their building performs in comparison to buildings of similar size and usage.[i]

British Thermal Unit: a degree Fahrenheit is the amount of heat needed to elevate the temperature of 1 pound of water.[ii]

Disclosure: building owner or property manager sharing their energy use data with one or more parties. In our policy options, we will assume that the disclosure is public where any individual would have access to aggregated, whole building data. Other types of disclosure can include disclosure to government entities, prospective buyers, tenants, or another specific entity.

Audits: the act of assessing a building's energy performance and identifying opportunities for energy efficiency.

Commissioning: optimizes a building's operational settings to increase efficiency. Retro-commissioning is the first commissioning of an existing building that was never commissioned at the beginning of its use. Re-commissioning is when a building's operational settings are re-set over time to ensure optimization.[iii]

Mandatory Upgrade: a legal requirement for an existing building to improve its energy performance. Regulations can be designed to dictate a specific energy use reduction target or a set of specific actions that must be taken.

Energy Performance Rating: the energy use of a building under current working conditions. Energy use information can be used for the building design process (e.g. EPA Energy Performance Rating Score).[iv]

Energy Star Portfolio Manager: a tool created by the EPA to track and benchmark energy use. Once a building's energy data has been entered for a 12-month period, the Portfolio Manager generates the energy use intensity of a building and generates an Energy Star score.[v]

Energy Use Intensity (EUI): is the "total energy consumed by the building in one year (measured in kBtu or GJ) by the total gross floor area of the building."[vi] The Portfolio Manager measures both site and source EUI for a building. Site EUI is the amount of energy used on site in the building.[vii] Source energy intensity takes into account the source of the energy used in the building to account for energy loss through the transfer and burning of fuel.[viii] The EPA also

provides a weather-normalized EUI score to account for weather patterns that increase the need for heat or air conditioning.[ix]

Energy star score: a 1-100 scale that compares a building's energy use to similar buildings.[x] The EPA takes into account the number of occupants, number of computers, weather patterns, and other information regarding a buildings use to rank its EUI score against similar buildings. An Energy Star Score of 50 represents the national median energy use.[xi] A score of 75 or higher is considered a top performer. These buildings can be eligible for Energy Star certification.[xii]

15/15 Rule: an energy data privacy rule that states that aggregated building data may be released if more than 15 accounts are aggregated and no one account represents 15% or more of the energy usage.[xiii]

[i] Krukowski, Andrea and Cliff Majersik. "Utilities' Guide to Data Access for Building Benchmarking." Energy Efficient Buildings Hub. March 2013. Institute for Market Transformation. http://s146206.gridserver.com/media/files/IMT_Report_-_Utilities_Guide_-_March_2013.pdf

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[ix] ibid

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[xi] ibid

[xii] ibid

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APPENDIX C: City Comparisons (Part 1)

City/State	Name of Ordinance	How were these implemented?	Enacted	First Compliance Deadline	Thresholds-Municipal	Thresholds-Commercial	Thresholds-Multi Family	Disclosure-Public Website	Disclosure-Time of Transaction	No. or % of Buildings covered	Water Disclosure	Requirement of Audit	Phased in Implementation
Austin	Energy Conservation Audit and Disclosure Ordinance	Ordinance, Austin City Council passed	November 2008	June 2011	All	10,000 sq ft +	Audits	-	Buyers	50% of buildings (90% of the sq ft)		Yes, valid for 10 years (audits for multifamily buildings)	Yes, 3 phases over 3 years
Boston	Building Energy Reporting and Disclosure Ordinance	Executive Order, Mayor signed	May 2013	May 2014	All	35,000 sq ft +	35+ units or 35,000 sq ft +	Yes	-	1,600 buildings (1% of buildings)	Yes	-	Yes, 4 phases over 4 years
Chicago	Chicago Energy Use Benchmarking Ordinance	Ordinance, City Council passed	September 2013	June 2014	50,000 sq ft +	50,000 sq ft +	50,000 sq ft +	Yes	-	3,500 buildings	-	-	Yes, 3 phases over 3 years
Minneapolis	Commercial Building Rating and Disclosure Ordinance	Ordinance, City Council passed	January 2013	May 2014	25,000 sq ft +	50,000 sq ft +	-	Yes	-	600 buildings	Yes	-	Yes, 3 phases over 3 years
New York City	Benchmarking (Local Law 84) / Energy Audits and Retro-Commissioning (Local 87)	Multiples Laws, New York City Council passed	December 2009	August 2011	10,000 sq ft +	50,000 sq ft +	50,000 sq ft +	Yes	-	26,680 buildings, less than 2%	Yes	Yes every 10 years (ASHRAE level II audits)	Yes, 4 phases over 4 years
Philadelphia	Bill No. 120428	Ordinance, City Council passed	June 2012	October 2013	-	50,000 sq ft +	-	Yes	Buyers. Lesses	2391 buildings	-	-	2 years, 2 phases (reporting and public disclosure)
San Francisco	Existing Commercial Buildings Energy Performance Ordinance	Ordinance, San Francisco Board of Supervisors passed	February 2011	October 2011	10,000 sq ft +	10,000 sq ft +	-	Yes	Buyers, Lesses, Lenders	2,700 (205 million sq ft)	No	Yes every 5 years (ASHRAE level I & II audits)	4 years, 4 phases
Seattle	CB 116731	Ordinance, Seattle City Council passed	January 2010	October 2011	20,000 sq ft +	20,000 sq ft +	20,000 sq ft +	Yes	Buyers, Lesses, Lenders	3,607 (295 million sq ft)	No	-	2 years, 2 phases
Washington DC	The Clean and Affordable Energy Act of 2008	Act, DC Council passed	July 2008	April 2013	10,000 sq ft +	50,000 sq ft +	50,000 sq ft +	Yes	-	350+ million sq ft	Yes	-	2 years, 2 phases
California	AB 1103	AB, State Legislature passed	October 2007	July 2013	Required by previous action	5,000 sq ft +	-	-	Buyers, Lesses, Lenders	13,600 (347 million sq ft); Percentage unknown	-	-	2 phases 5 months apart
Washington State	SB 5854	Law, Governor signed	May 2009	January 2011	10,000 sq ft +	10,000 sq ft +	-	-	Buyers, Lesses, Lenders	N/A	No	Yes (public buildings)	3 years, 3 phases

APPENDIX D: City Comparisons (Part 2)							
City/State	Short Description of Outreach	Subsidies/ Incentives	Data Validation	Public or Private Utilities	Frequency of Audits	Enforcement of Penalities	Additional Requirements
Austin	Hosted 30 Portfolio Manager training workshops; training through Austin Apartments Association; Portfolio Manager webinars	Rebate Programs	Keep their own databases. Challenge to keep them accurate.	Public	Valid for 10 yrs	Non-compliance is a Class C misdemeanor, customers can report violations	Audits & mandatory upgrades for multifamily buildings
Boston	Energy Star training on website; Multiple City resources	Mass Save Home Energy Services Program		Private (gas/electricity)/ Public (water)	Some buildings are required to conduct aduits every 5 years	Fines range from $35-$200 per violation. Each day of non-compliance is a separate violation.	Periodic energy assessments and/or actions
Chicago	Online trainings; guides; utility resources	Utilities offer incentives	Data must be verified by a licensed professional	Private (gas/electricity)/ Public (water)	-	Commissioner- $100 for initial violation, $25 for each day the violation continues	
Minneapolis	Information sessions; Mailed letters; Public meeting; workshops			Private (gas/electricity)/ Public (water)	-	Email; failure to comply results in penalty and no certification	-
New York City	Outreach to consultants; mailings; trainings; call-help center; presentations		City has general data checks; NYU & UPenn partnership	Private (gas/electricity)/ Public (water)	Every 10 yrs	Subject to a $500 fine first time, up to $2000; levied quarterly for continued noncompliance	ASHRAE level II audits & RCx (LL 87), lighting upgrades & submetering (LL 88)
Philadelphia	Regular events; working with schools and BOMA; planned trainings with EPA; DVGBC; EEBHUB		Working with EEBHUB and UPenn	Private (electricity)/ Public (gas/water)	N/A	$300 fine for the first 30 days, $100 per extra day	-
San Francisco	Letters; targeted outreach to owners; public presentations; media outreach; PG&E workshops and call center	Rebates, custom plans, zero interest loans offered by Utility companies	Not formally. Public data relase delayed	Private (gas/electricity)/ Public (water)	Every 5 yrs	$50-$100 per day for a max of 25 days	ASHRAE level I or II audits or RCx every 5 years
Seattle	Help Center; distribution of materials at conferences; drop in hours; direct mailings; website; e-news alert; newsletters	Utility incentives	Minimal data validation, working with UPenn; PNNL/DOE	Public (water/electricity])/ Private (gas)	-	1st violation $150, subsequent violations $500 for misrepresentation; $500-$1000 quarterly fine	-
Washington DC	Website; newsletter; mailing list; twitter; events	up to $1,800 in incentives from the DC SEU	District Department of the Environment	Private (gas/electricity)/ Public (water)	-	$100/day for each day of non-compliance	-
California	CEC created materials, website, listed resources; CEC plans to publish manual and hire marketing company; relying on existing EPA resources	-	CEC is working wiht CPUC	-	-	TBD (probably not)	Mandatory upgrades to be developed (AB 758)
Washington State	Department of Enterprise Services & EPA training;	DOE Grant (piloting free benchmarking service)	N/A (Washington State University and DOE Grant)	-	-	Only for public buildings (State cannot renew or lease space without compliance)	Audits for public buildings with low ratings

APPENDIX E: Estimated Energy Savings Rate

Policy	Description	Input Assumptions	Estimates	Notes	SOURCES
Benchmarking	(a) Mandatory annual reporting of energy and water use by large commercial and multifamily properties using EPA ENERGY STAR Portfolio Manager, (b) A summary of results gets publicly disclosed.	Average savings in compliant buildings	5%	*A 2012 ENERGY STAR data trends report found that buildings that consistently benchmark reduced energy-use intensity by 7% after three years. IMT assumes a conservative 5% reduction because the ENERGY STAR report likely benefits from self-selection bias.	U.S. Environmental Protection Agency. (October 2012). "ENERGY STAR Portfolio Manager: Benchmarking and Energy Savings". Data Trends.
		Share of floor space that would have benchmarked without the policy (Assumed to be the ENERGY STAR/LEED market share)	9%		
		Independent energy savings rate	4.5%		
Retro-commissioning	(a) For large buildings, retro-commissioning would be required once every 10 years, thereby optimizing the existing base building systems (including the HVAC system, electrical and lighting systems, building envelope).	Peak savings rate in compliant floor space	16%	*A 2009 Lawrence Berkeley National Laboratory (LBNL) study underlies this tool's assumptions for the peak savings rate, rate of degradation, and the baseline prevalence of retro-commissioning.	LBNL. (July 2009). "Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions".
		Degradation rate (Assume 40% degradation over 15 years, implying a 20% average degradation in any given year)	20%		
		Share of floor space that would have retro-commissioned without the policy	5%		
		Independent energy savings rate	12.16%		
Energy Audits	(a) ASHRAE Level II audit mandatory for commercial and multifamily properties by a licensed professional once every 10 years. (b) Audit results would provide actionable information about the potential energy savings and cost-effectiveness of recommended performance improvements.	Share of audited space that improves operations due to policy	40%	*Little research is available with regard to the typical energy savings from energy audits. We assume that operations efficiency improvements will create a 10% energy savings and that a capital upgrade will create a 20% savings. We will also assume that only 40% of people who recieve an audit will act on the information.	
		Savings rate for operations improvement	10%		
		Share of audited floor space that upgrades equipment/capital due to policy	5%		
		Savings rate for equipment/capital upgrades	20%		
		Degradation rate	20%		
		Exemption rate (policy may exempt ENERGY STAR and LEED properties)	9%		
		Independent energy savings rate	3.6%		
Energy Efficiency Improvements	(a) For large properties, establish minimum levels of energy efficiency and/or require energy improvement measures based on cost-effectiveness. MODELED POLICY: A property in lowest quintile performance must improve by 20%.	Share of floor space falling below the standard	20%	*Requirements for an "Energy Efficiency Improvements" policy may vary widely. The default assumptions in this tool are based on a 2012 analysis of benchmarking data in New York City, which modeled a policy in which buildings with above-average energy-use intensities are required to improve to the average level.	City of New York. (August 2012). "New York City Local Law 84 Benchmarking Report".
		Average savings rate of affected floor space (Based on NYC modeling, 36% average savings potential in below-average buildings. Assume that 75% of those savings are cost-effective.)	27%		
		Independent energy savings rate	5.4%		

SOURCE FOR THIS TABLE: These energy savings rates are based on assumptions and estimates made in IMT's City Energy Project Calculator and other sources. The IMT assumptions were modified and simplified for our analysis.

"Independent" energy savings rates refer to a policy's expected reduction in site EUI (relative to a constant baseline) in the absence of other policies. The model assumes that these energy use reductions are realized in one year once the policy has reached a steady state in 2030 relative to current energy use. This table also assumes a 100% compliance rate.

Appendix E: Independent Energy Savings Calculations

Benchmarking (assuming 100% compliance)

Independent Savings Rate = (average savings in compliant buildings)*(% of building that benchmark due to policy)
Independent Savings Rate = (5%)*(91%) = 4.5%

Retrocommissioning (assuming 100% compliance)

Independent Savings Rate = [(peak savings rate)-(peak savings rate)*(degradation rate)]*(% of buildings that Retrocommission due to policy)
Independent Savings Rate = [(16%)-(16%)*(20%)]*(95%) = 12%

Audits (assuming 100% compliance)

Independent Savings Rate = [((% of space with operations improvement)*(operations saving rate))+((% of space with capital improvements)*(capital savings rate))]*(1-degradation rate)* (% of buildings that audit due to policy)
Independent Savings Rate = [((40%)*(10%))+((5%)*(20%))]*(1-20%)*(91%) = 3.6%

Mandatory Upgrades (assuming 100% compliance)

Independent Savings Rate =(Average savings rate)*(% of floor space that must comply)
Independent Savings Rate =(27%)*(20%) = 5.4%

Policy Overlap Adjustment

Estimated Total Savings*	Policy Combinations
7.57%	Benchmarking + Audits
15.14%	Benchmarking + Retrocommissioning
16.57%	Benchmarking + Audits + Retrocommissioning
9.87%	Benchmarking + Mandatory Upgrades
12.75%	Benchmarking + Audits + Mandatory Upgrades
17.11%	Benchmarking + Retrocommissioning + Mandatory Upgrades
18.35%	Benchmarking + Audits + Retrocommissioning + Mandatory Upgrades

*These energy savings rates are based on our input assumptions, using a modified and simplified version of IMT's City Energy Project Calculator. These savings rates represent the estimated annual savings rate across the building stock impacted by enacted policies and assume 100% compliance with all enacted policies.

Appendix F: Estimated Greenhouse Gas Emissions Reductions

	Commercial	Industrial	Multifamily	Government	Assumptions
Site EUI for Natural Gas* (therms/ft^2)	0.000518108	0.000767193	0.000296485	0.000476463	Based on estimates of EUI scores in Long Beach
Site EUI for Electricity* (therms/ft^2)	7.05202159	4.440141798	1.667477648	5.56324544	Based on estimates of EUI scores in LADWP territory
Total ft^2 Impacted by Policy	356,133,841	185,573,141	225,270,498	2918067	Assumes policy apples to buildings >10,000 ft^2
Natural Gas Total (therms)	184,515.76	142,370.38	66,789.33	1,390.35	
Electricity Total (therms)	2,511,463,536	823,971,060	375,633,520	16,233,923	

*Circella, Giovanni, Johnston, Robert A., Holguin, Andrew J., Lehmer, Eric W., Wang, Yang, and Michael McCoy. "Updating the PECAS Modeling Framework to Include Energy Use Data for Buildings." Public Interest Energy Research (PIER) Program. UC Davis, Urban Land Use and Transportation Center. February 2013.

INPUTS:

Carbon intensity of Natural Gas	0.005307031	Metric Ton CO2e/therm	PG&E "Greenhouse Gas Emission Factors: Guidance for PG&E Customers"April 2013.
Carbon intensity for LADWP electricity[5]	0.00148869	Metric Ton CO2e/therm	LADWP "Final Power Integrated Resource Plan." 2013. www.ladwp.com
Total estimated GHG emissions	5,550,894	lbs CO2e	
Total estimated electricity use	3,727,302,039	therms	
Total estimated natural gas use	395,066	therms	

Policy	Estimated Saving Rate	Saved Electricty	Saved Natural Gas	Saved Carbon (Metric Ton CO2e)	% Carbon saved	# of new car trips from Los Angeles to NYC saved*
Benchmarking (B)	4.50%	167,728,592	17,778	249,790	5%	24,889.15
Retro-commissioning (Rcx)	12.16%	453,239,928	48,040	674,989	12%	67,256.01
Audits (A)	3.60%	134,182,873	14,222	199,832	4%	19,911.32
Mandatory Upgrades (MU)	5.40%	201,274,310	21,334	299,748	5%	29,866.98
B+Rcx	15.14%	564,313,529	59,813	840,405	15%	83,738.15
B+A	7.57%	282,156,764	29,906	420,203	8%	41,869.08
B+Rcx+A	16.57%	617,613,948	65,462	919,783	17%	91,647.37
B+Rcx+A+M	18.35%	683,959,924	72,495	1,018,589	18%	101,492.41
B+A+M	12.75%	475,231,010	50,371	707,739	13%	70,519.25
B+Rcx+M	17.11%	637,741,379	67,596	949,758	17%	94,634.07
B+M	9.87%	367,884,711	38,993	547,873	10%	54,590.20

*U.S. Department of Energy " Carbon Emissions Comparisons." Buildings Energy Data Book. http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=1.5.3

Appendix G: Compliance Rates

POLICY: Comparison of City Overall Compliance Rates							
Cities / States	**Benchmarking & Disclosure Policy**			**Audits and/or Retro-Commissioning**		**Mandatory Upgrades**	
	Impacted Building Types	Public Disclosure	Compliance Rates	Impacted Building Types	Compliance Rates	Impacted Building Types	Compliance Rates
Austin[1]	Commericial	No	76%	Multifamily	66%	Multifamily	100% *only applied to 15 buildings
Seattle[2]	Commericial & Multifamily	No	93%	No Policy		No	
New York City[3]	Commericial & Multifamily	Yes	75%	Commericial	No data, just began implementation	Commericial - Lighting	No data, not yet implemented
San Francisco[4]	Commericial	Yes		Commericial	50%	No	
Washington D.C.[5]	Commerical & Multifamily	Yes	83%	No Policy		No	
Boston	Commericial & Multifamily	Yes	No data, not yet implemented	Yes	No data, not yet implemented		
Chicago	Commericial & Multifamily	Yes	No data, not yet implemented				
Minneapolis	Commercial	Yes	No data, not yet implemented				
Philadelphia	Commercial	Yes	No data, not yet implemented				
Washington State	Commercial, at point of sale	No	No data, not enforced				
California	Commercial, at point of sale	No	No data, just began implementation				

Sources:

1. Austin Energy. "Energy Conservation Audit and Disclosure Ordiance Data." Austin Energy ECAD Ordinance. 2014.
2. Seattle Office of Sustainability. "Seattle Building Energy Benchmarking Analysis Report 2011/2012." City of Seattle. January 2014.
3. PlanNYC. "New York City Local Law 84 Benchmarking Report August 2012." The City of New York. 2012.
4. Barry Hooper (San Francisco Department of the Environment), email correspondence to authors, February 26, 2014.
5. District Department of the Environment. "Green Building Report for the District of Columbia, 2012." District of Columbia. 2012.

Los Angeles Policy Options & Estimated Compliance Rates:			
Benchmarking	Audits	Retro-commissioning	Mandatory Upgrades
80%	60%	60%	Unknown

Appendix H: Adminstrative Costs

Number of Staff Needed By City for implementation (Full Time Employees - FTE)						
City	Benchmarking	Audits/Retro-commissioning	Mandatory Upgrades	Utility Staffing	Notes	SOURCE
Austin	1 FTE	1 FTE	0 FTE	No additional staff, but there was a need to build data capicity	Audit staff oversee mandatory upgrade requirement for multifamily residences.	Interview
San Francisco	1-2 FTE	1 FTE	No Policy	No additional staff	Staffing limitations have delayed data release*	Jurisdiction Briefs, IMT
NYC	1 FTE	Unknown	Unknown	Unknown		Jurisdiction Briefs, IMT
Seattle	3 FTE	No Policy	No Policy	Unknown		Interview
Washington DC	2 FTE	No Policy	No Policy	Unknown		Jurisdiction Briefs, IMT
Philadelphia	1 FTE	No Policy	No Policy	Unknown		Jurisdiction Briefs, IMT
CA	3-5 FTE	No Policy	No Policy	Unknown		Jurisdiction Briefs, IMT
WA	0 FTE	No Policy	No Policy	Unknown		Jurisdiction Briefs, IMT
Boston	Unknown	Unknown	No Policy	Unknown	Policies Not Yet Implemented	
Chicago	Unknown	No Policy	No Policy	Unknown	Policy Not Yet Implemented	
Minneapolis	Unknown	No Policy	No Policy	Unknown	Policy Not Yet Implemented	

*In an email exchange, San Francisco stated that they have delayed the public release of data due to limited staff availability

Inputs

Cost Estimation	**Item**	**Source**
$ 87,132.00	Average Cost for FTE in City of LA (Management Analyst)	* "ControlPanel LA" Los Angeles City Controller. www.controller.lacity.org
$50,000-160,000	Database Upgrade with modern customer information system	*Heschong Mahone Group. "California's Automated Benchmarking Cost System." White Paper. July 2009. http://www.h-m-g.com/ downloads/

LA Administrative Cost estimates			
Policy	Item	Cost	Total
Benchmarking Costs	Staffing (2 FTE)	$ 174,264.00	$ 274,264.00
	Database costs	$ 100,000.00	
Audits/Retro-commissioning	1 FTE Additional Staff	$ 87,132.00	$ 361,396.00
Mandatory Upgrades	1 FTE Additional Staff	$ 87,132.00	$ 448,528.00

Appendix I : Costs to Owner

Cost Estimations for Building Owners

	Inputs	Cost	Units	Subtotal	Total per Building	Assumptions & Sources
Benchmarking & Disclosure	EPA Portfolio Manager tool	Free			$ 300.00	Given that most data needs are free (Portfolio Manager tool is free and we assume DWP will provide data for free), the only costs are transactional and time. Thus, we estimate a $300 cost per building.
	Permission from Tenents	$15 transaction cost per tenant	$ 15.00	$ 225.00		
	Automatic Data upload from Utility	Free				
	Time to process data	$15 per hour	$ 5.00	$ 75.00		
	OR Hiring a Contractor		N/A	500	$ 500.00	Based on Real Estate Expert Interview, New York City

	Policy	Estimated Low Cost (per sq. ft.)	High Cost (per sq. ft.)	Average cost (per sq ft)	Average Cost Per Building	Sources
& Retro-commiss	Audits	$ 0.17	$ 0.73	$ 0.45	$ 7,300.00	Source: California Energy Commission. "How to Hire an Energy Auditor" January 2010http://www.energy.ca.gov/reports/efficiency_handbooks/400-00-001C.PDF
	Retro-Commissioning	$ 0.15	$ 0.63	$ 0.33	$ 6,300.00	Mills, Evan. "Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions". Lawrence Berkley Nationa Lab. July 2009

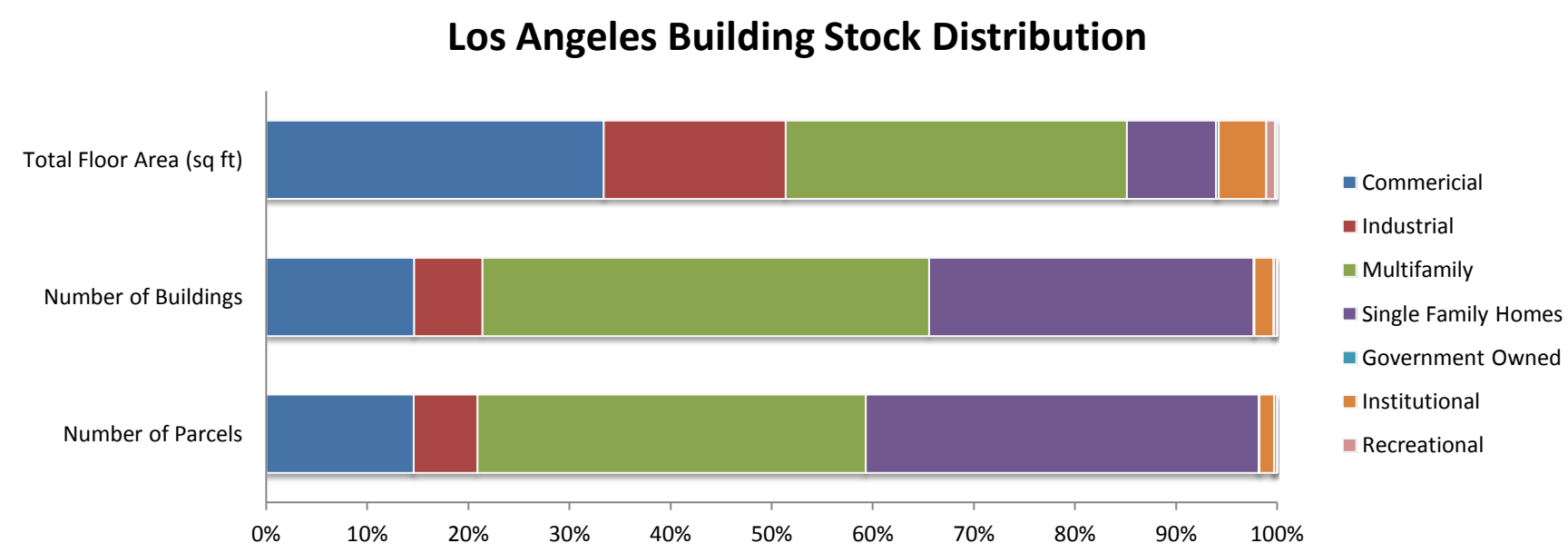
	Types of Upgrades	Low Estimate	High Estimate	Average Cost	Average Cost per Building	Sources
Mandatory Upgrade	Lighting	$ 3.00	$ 5.00	$ 4.00	$ 40,000.00	Kok, Nils, Norman Miller and Peter Noris. "The Economics of Green Retrofits." Journal of Sustainable Real Estate. January 2013. http://www.josre.org/wp-content/uploads/2013/01/The_Economics_of-Green_Retrofits-JOSRE_v4-11.pdf
	Ventilation	$ 2.00	$ 5.00	$ 3.50	$ 35,000.00	
	Cooling	$ 3.00	$ 7.00	$ 4.50	$ 45,000.00	
	Heating	$ 1.00	$ 2.00	$ 1.50	$ 15,000.00	
	Total	$ 10.00	$ 20.00	$ 15.00	$ 150,000.00	

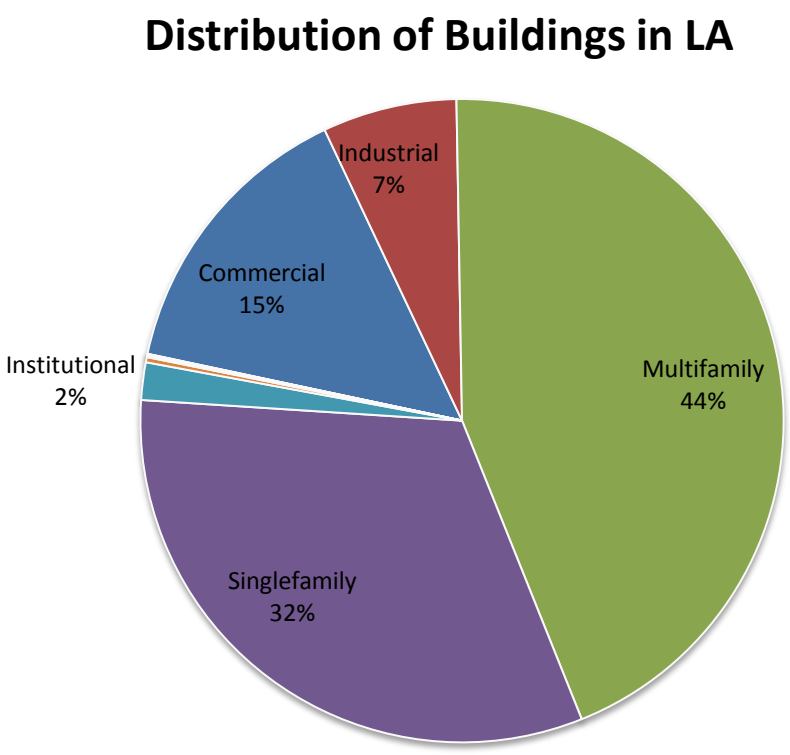
*All listed prices have been adjusted to a 2013 dollars using the Bureau of Labor Statistics CPI Calculator: http://data.bls.gov/cgi-bin/cpicalc.pl

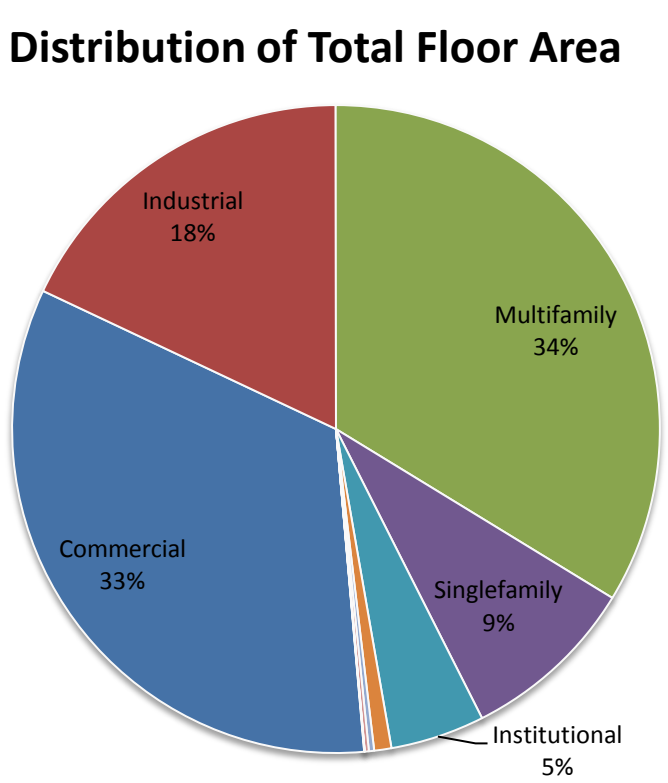
APPENDIX J: Los Angeles Total Building Stock

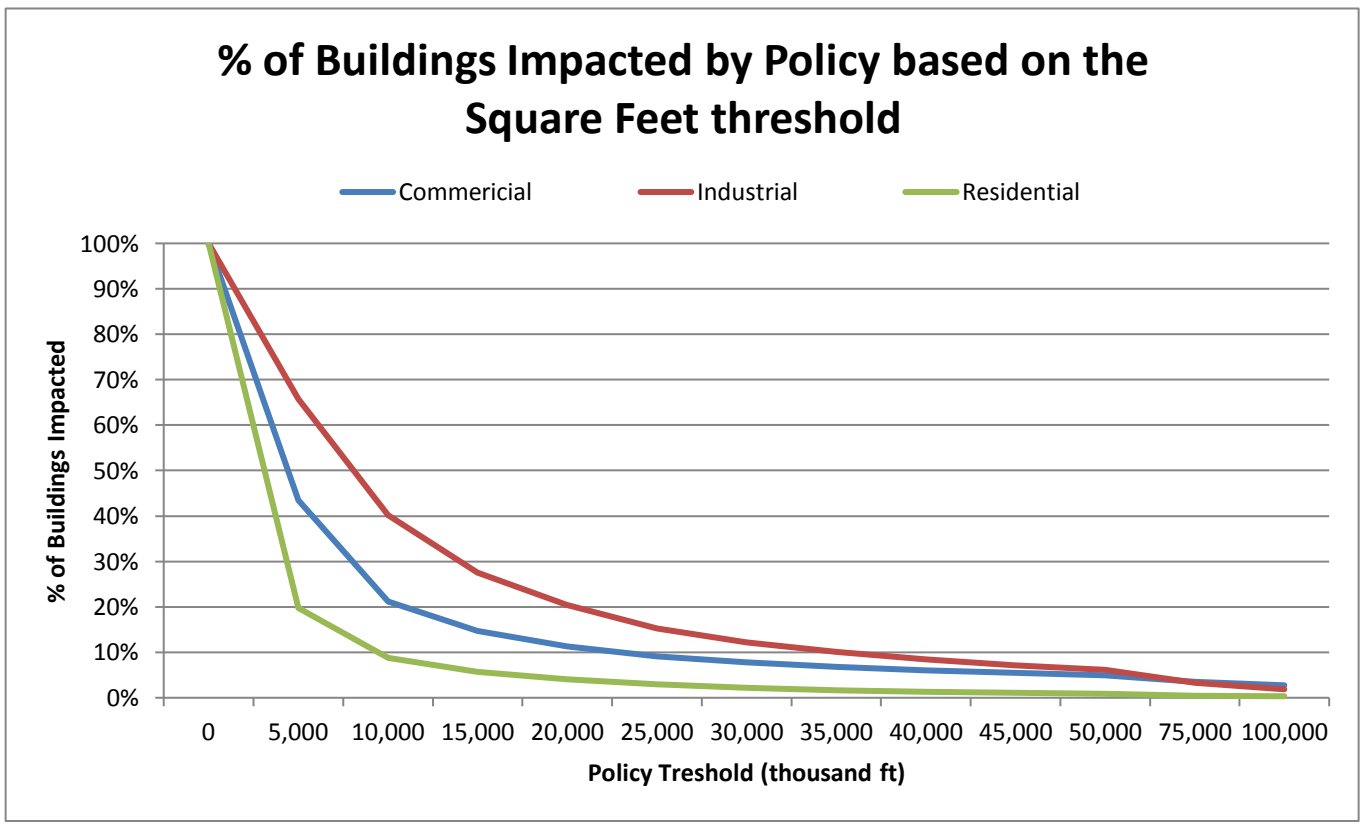
Building Type	Number of Parcels	Number of Buildings	Total Floor Area (sq ft)	% of Buildings Built Before 1978	% of Area over 10,000 sq ft	% of Buildings over 10,000 sq ft	Null/Vacant Parcels
Commericial	24528	29836	415950034	76%	86%	21%	880
Industrial	10619	13753	223829911	75%	70%	40%	306
Multifamily	64665	90085	420236159	91%	54%	9%	667
Single Family Homes	65404	65,407	109876373	79%	0.06%	0.006%	130
Government Owned	126	144	3273611	75%	89%	37%	5694
Institutional	2424	3839	58582258	80%	81%	33%	91
Public Schools	24	44	265020	95%	67%	14%	80
Recreational	404	525	10699901	80%	87%	39%	105
Miscellaneous	95	132	2536964	65%	88%	36%	1006
Farm	13	20	86550	75%	50%	15%	143
TOTAL	168302	203785	1245336781	84%	64%	10%	9102

* Numbers from the LA County Assessors' Database, provided by the Luskin Center of Innovation





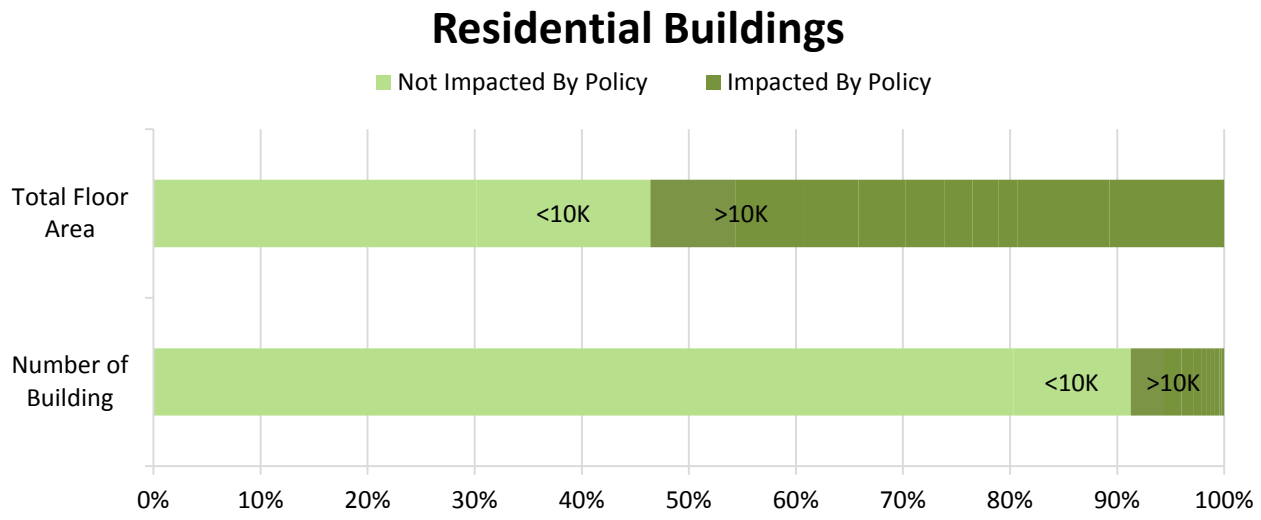


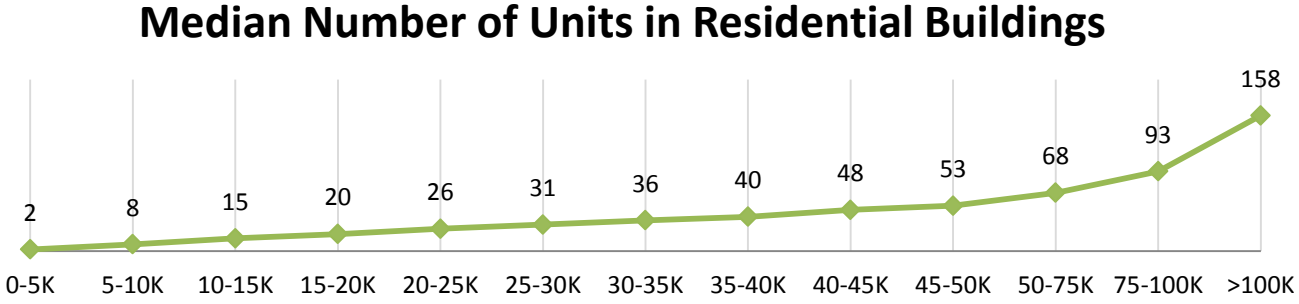


Appendix K: Residential Building Stock

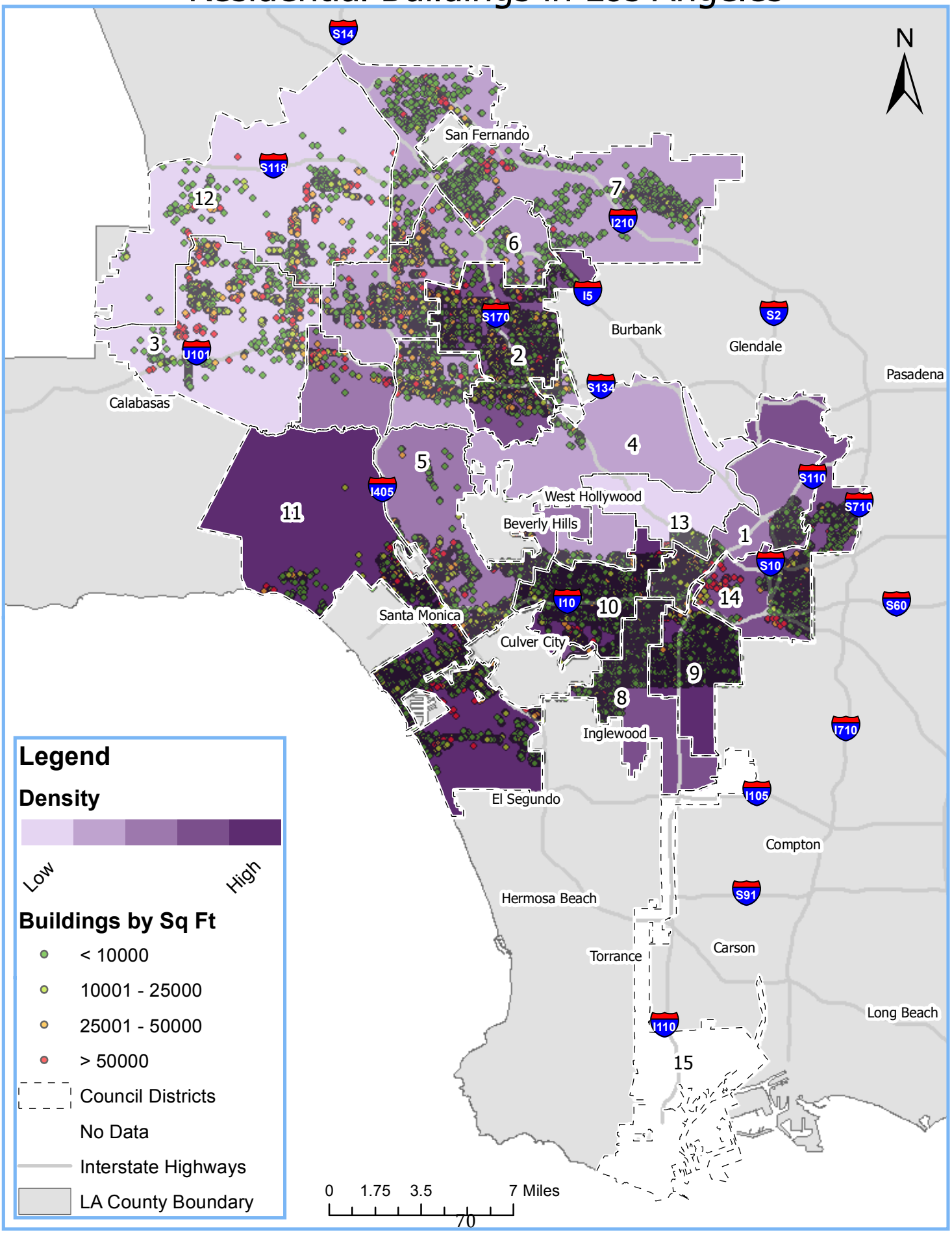
Residential Building Stock Data					Policy Impacts based on Threshold	
Building Area (Ft^2)	No. of Buildings	Total Area	Median # of Units	% Built before 1978	Percent of Buildings	Percent of Floor Area
0 - 5,000 Ft^2	72336	126,849,362	2	95%	100%	100%
5,000 - 10,000 Ft^2	9873	68,116,299	8	86%	20%	70%
10,000 - 15,000 Ft^2	2732	33,298,553	15	72%	9%	54%
15,000 - 20,000 Ft^2	1544	26,609,796	20	69%	6%	46%
20,000 - 25,000 Ft^2	973	21,808,943	26	68%	4%	39%
25,000 - 30,000 Ft^2	675	18,504,515	31	64%	3%	34%
30,000 - 35,000 Ft^2	477	15,418,216	36	63%	2%	30%
35,000 - 40,000 Ft^2	290	10,840,564	40	56%	2%	26%
40,000 - 45,000 Ft^2	238	10,049,233	48	70%	1%	24%
45,000 - 50,000 Ft^2	162	7,687,816	53	54%	1%	21%
50,000 - 75,000 Ft^2	378	22,916,646	68	51%	1%	19%
75,000 - 100,000 Ft^2	152	13,101,794	93	49%	0%	14%
>100,000 Ft^2	255	45,034,422	158	50%	0%	11%
TOTALS	90085	420,236,159	4	91%		

* Numbers from the LA County Assessors' Database, provided by the Luskin Center of Innovation





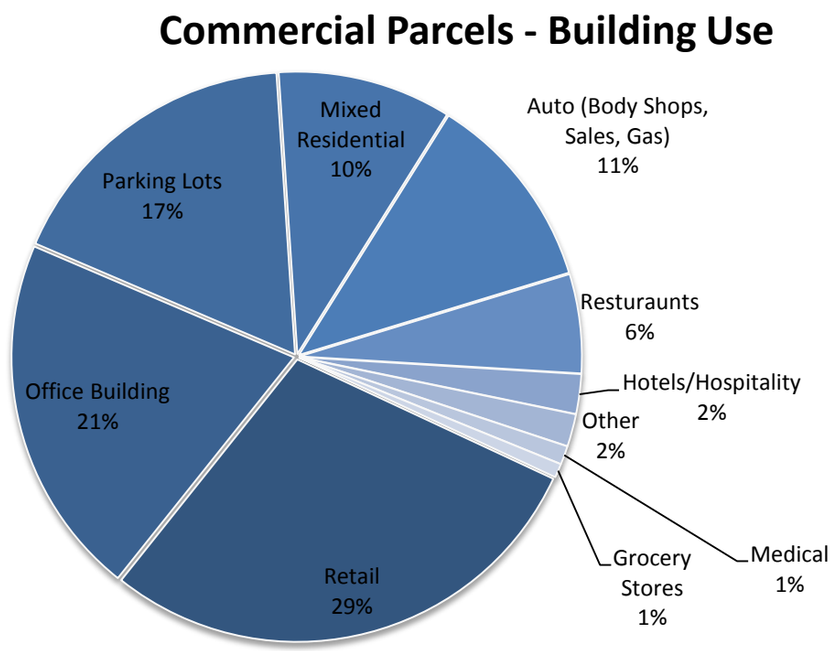
Residential Buildings in Los Angeles

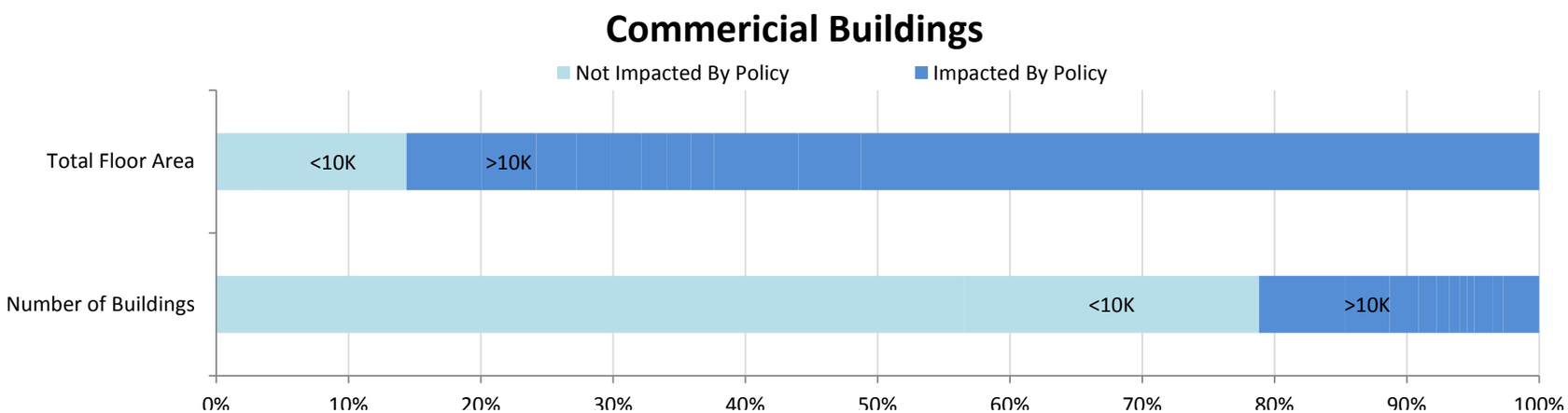


Appendix L: Commercial Building Stock

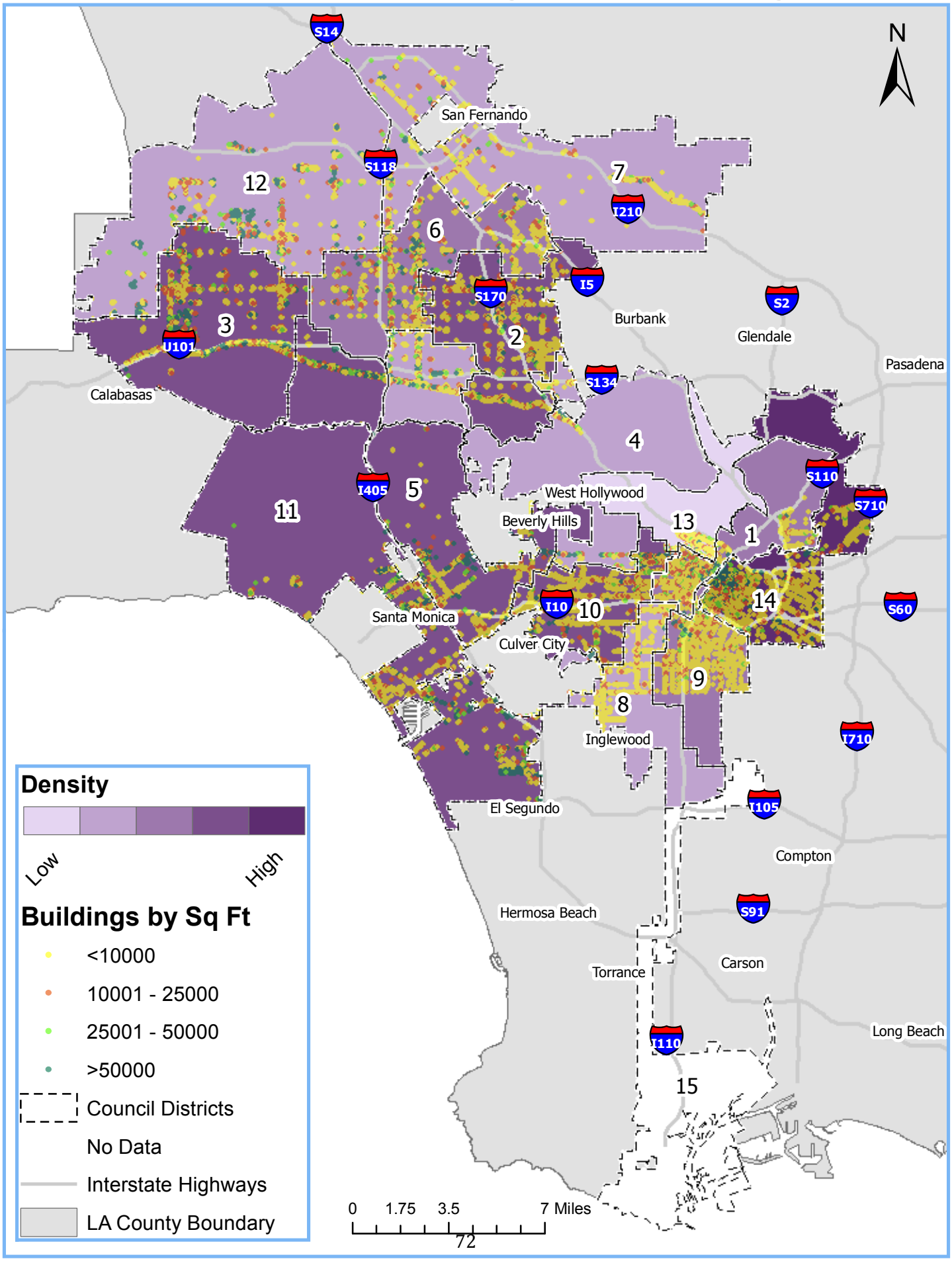
Commercial Building Stock Data				Policy Impacts based on Threshold	
Building Area (Ft²)	No. of Buildings	Total Area	% Built before 1978	Percent of Buildings	Percent of Floor Area
0 - 5,000 Ft²	16,876	13,720,871	84%	100%	100%
5,000 - 10,000 Ft²	6,644	46,095,322	74%	43%	97%
10,000 - 15,000 Ft²	1,938	23,524,412	66%	21%	86%
15,000 - 20,000 Ft²	1,008	17,337,047	63%	15%	80%
20,000 - 25,000 Ft²	657	12,580,354	53%	11%	76%
25,000 - 30,000 Ft²	397	10,865,025	62%	9%	73%
30,000 - 35,000 Ft²	300	9,598,463	61%	8%	70%
35,000 - 40,000 Ft²	219	8,080,527	61%	7%	68%
40,000 - 45,000 Ft²	178	7,537,933	57%	6%	66%
45,000 - 50,000 Ft²	152	7,196,097	46%	5%	64%
50,000 - 75,000 Ft²	433	26,502,148	53%	5%	62%
75,000 - 100,000 Ft²	225	19,642,403	59%	3%	56%
>100,000 Ft²	809	213,269,432	50%	3%	51%
TOTALS	29,836	415,950,034	76%		

* Numbers from the LA County Assessors' Database, provided by the Luskin Center of Innovation





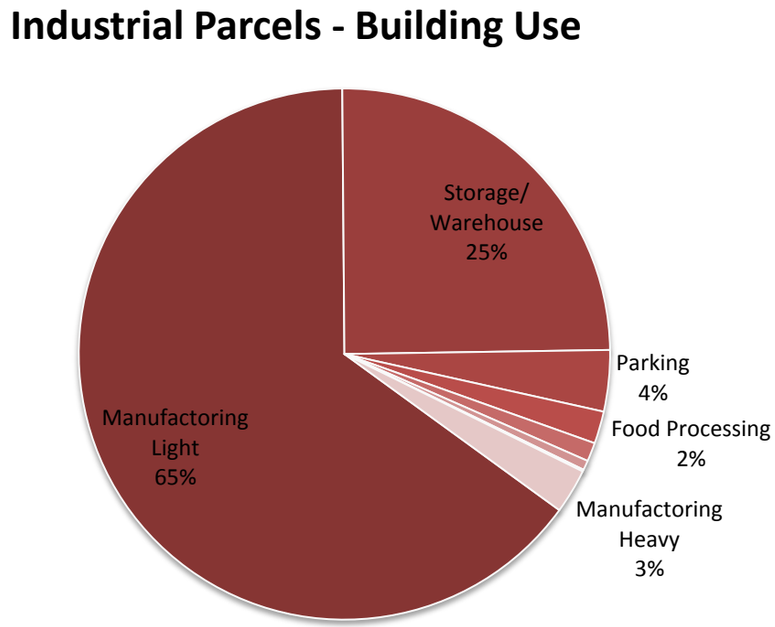
Commercial Buildings in Los Angeles

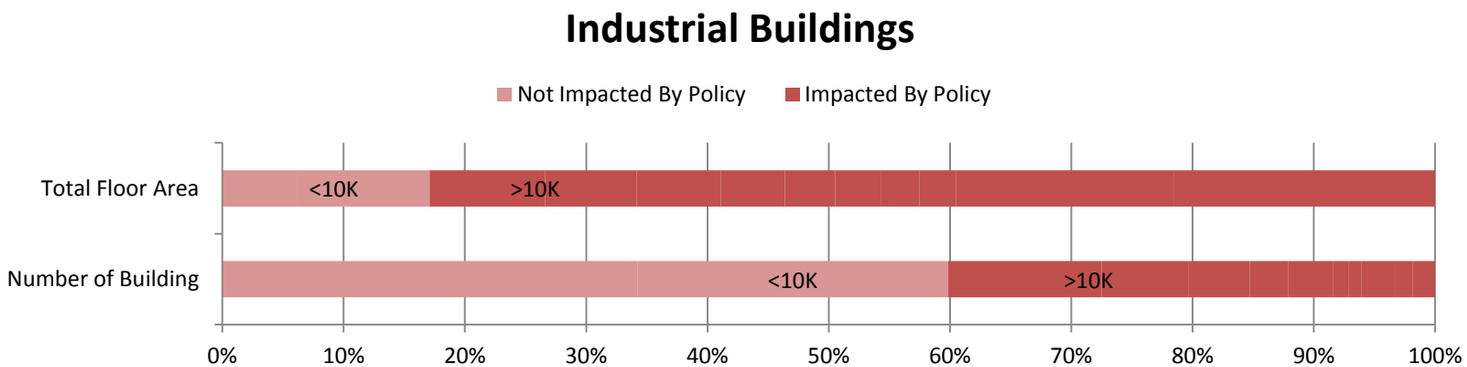


Appendix L: Industrial Buildings

Industrial Building Stock Data				Policy Impacts based on Threshold	
Building Area (Ft^2)	No. of Buildings	Total Area	% Built before 1978	Percent of Buildings	Percent of Floor Area
0 - 5,000 Ft^2	4706	13,720,871	80%	100%	100%
5,000 - 10,000 Ft^2	3526	24535899	76%	66%	94%
10,000 - 15,000 Ft^2	1737	21300510	70%	40%	83%
15,000 - 20,000 Ft^2	983	16907627	71%	28%	73%
20,000 - 25,000 Ft^2	702	15539841	69%	20%	66%
25,000 - 30,000 Ft^2	432	11830859	68%	15%	59%
30,000 - 35,000 Ft^2	288	9269296	61%	12%	54%
35,000 - 40,000 Ft^2	225	8,392,019	58%	10%	49%
40,000 - 45,000 Ft^2	171	7192182	66%	8%	46%
45,000 - 50,000 Ft^2	144	6777603	59%	7%	43%
50,000 - 75,000 Ft^2	385	23013484	51%	6%	39%
75,000 - 100,000 Ft^2	198	17052719	48%	3%	29%
>100,000 Ft^2	256	48297001	66%	2%	22%
TOTALS	13753	223829911	73%		

* Numbers from the LA County Assessors' Database, provided by the Luskin Center of Innovation





Industrial Buildings in Los Angeles