City energy savings performance assessment of selected U.S. communities

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Abstract

In the United States, leadership on energy and climate policy has largely shifted to state and local governments as many federal energy and climate efforts have languished. This along with other factors, such as increasing concern about climate change and improved understanding of the local economic impacts of energy use, has led a significant number of U.S. local governments to develop goals to improve energy efficiency, decrease greenhouse gases (GHG) emissions, and/or adapt to climate change through changes in municipal government operations and actions in their community. Some cities have adopted long-term energy goals and strategies by leveraging goal-setting frameworks from government agencies and networks of local governments, such as the U.S. Conference of Mayors Climate Protection Agreement, while others have undertaken locally-led energy and climate planning processes. Developing these goals and strategies demonstrates leadership, but many cities are struggling to achieve their objectives for carbon reduction and energy savings.

This research provides a meta-analysis of the energy performance of 51 of the largest cities in the U.S. to determine trends in city energy performance, which cities are on track to achieve their energy efficiency-related goals, and the policy drivers for city success. When evaluating city performance, we collected and analysed energy use and/or climate data from each city at four scales, as available: 1) local governments' municipal operations, 2) the community-at-large, 3) municipal buildings and 4) private buildings. We also collected data on energy strategies implemented at each scale. Using this data, we explored the factors contributing to successful performance toward goals in these communities with a particular focus on locally enacted policies and programs. Our analysis will be able to inform the efforts of cities both in the U.S. and Europe looking to achieve deeper energy savings or GHG emissions reductions.

Introduction

U.S. cities have made energy and climate change commitments that vary in size and scope; cities' program implementation efforts toward goals vary as well. One of the initial frameworks to help U.S. municipal governments create energy or climate goals was the Mayors Climate Protection Agreement of 2005, which committed signatories to several actions, including seeking to achieve the Kyoto Protocol greenhouse gases (GHG) reduction targets of 7 % from 1990 levels by 2012. Municipal leaders in 1,060 communities signed on to the agreement to demonstrate their commitment to reducing emissions, while other communities have undergone rigorous energy and climate planning that included the formation of long-term energy-related goals (U.S. Conference of Mayors 2014).

Several supporting organizations and sustainability networks developed to assist communities in achieving their goals. For example, ICLEI–Local Governments for Sustainability USA (ICLEI-USA) spearheaded the Mayors Climate Protection Agreement. Now ICLEI-USA provides technical assistance and tools to communities to allow them to track progress on climate goals. While many resources are climate focused, some are more specifically energy related. The American Recovery and Reinvestment Act of 2009 (ARRA) included $17 billion for energy efficiency, with much of the funding going directly to states and communities through the Weatherization Assistance Program, State Energy Program, or Energy Efficiency and Conservation Block Grant (EECBG) Program (Committee of Conference 2009). Communities that accepted EECBG funding were required to formulate energy conservation plans that either established or added additional goals for energy efficiency and conservation. The U.S. Department of Energy's (DOE) Better Buildings Challenge (BBC) provides technical assistance to communities seeking to reduce building energy consumption in a portfolio of buildings in the commercial and industrial sectors.

Many communities have leveraged these or similar frameworks to develop climate and energy goals or strategies, but communities are at varying stages of implementation and many appear to be struggling to achieve their goals. Documented, verifiable progress toward goals is more difficult and rarer than establishing commitments. This paper seeks to answer two fundamental questions: While many communities have set energy efficiency-related goals, how have the largest cities in the United States been progressing toward their goals? For those who have demonstrated some success toward achieving their goals, what lessons do they have for other cities that have not?

Methodology

Our initial focus was to assess cities' progress toward their nearest-term energy efficiency-related local government operations and/or community-wide goals, if they had any. We based this analysis on data collected for the upcoming *2015 City Energy Efficiency Scorecard*, an update to the *2013 City Energy Efficiency Scorecard* (Mackres et al. 2013). The *2015 City Scorecard* will evaluate 51 of the largest cities in the U.S. based on energy efficiency policies and programs they have implemented. The cities selected for the *2015 City Scorecard* are the central cities of the 50 most populous U.S. Metropolitan Statistical Areas (MSAs) plus El Paso, TX. In this paper, we assess the same 51 cities.

Several cities had multiple community-wide and/or local government operations goals with varying time horizons. We only evaluated cities based on their progress toward their goal nearest in time. For example, if cities had energy reduction goals for 2020, 2030, and 2050, we only assessed progress toward their 2020 goal. Also, few cities had explicit energy efficiency goals, such as reducing total community-wide energy use by a certain percentage by a certain date. We broadened our consideration of goals to those that can be achieved through energy-efficient actions, such as reducing greenhouse gases emissions.

To be deemed "on track" for their nearest-term local government operations or community-wide goal, cities must have demonstrated past energy savings or GHG emissions reductions that, assuming an equal average annual savings rate for all future years until the goal year, would result in energy use or GHG emissions at or below the goal level in the goal year. To have had sufficient data for us to evaluate progress toward goals, cities must have had the following:

- A quantifiable and measurable energy efficiency-related goal, such as an energy savings or GHG reduction goal, articulated in an energy or climate plan. We consider community-wide goals those that spur savings across all sectors of local economies and local government operations goals those that apply to all facets of local government energy use. We did not consider secondary goals applicable to specific sectors, such as the buildings sector, or fuel sources, such as renewable energy.
- At least two publicly available energy consumption or GHG emissions inventories with one providing baseline data and the other measuring progress in a recent year. To ensure we reflect recent energy use or greenhouse gases levels in our savings projections, cities had to have published an updated inventory within the last five years (2010–2014) to be considered. If inventories were not available, we accepted other quantitative data from cities, if available.

For those cities that satisfied the criteria, we used the quantitative data collected from inventories or other sources to forecast the community's percent energy savings or emissions reductions, as was appropriate for the goal, for the stated goal's target year. We did this for both community-wide and local government operations savings. This calculation was a two-step process. First, we converted the difference between a community's and/or local government's savings level in their most recent inventory year and their original baseline level into average annual percent reduction values, as illustrated in Equation 1.

$$\frac{\text{(Baseline Level – Update Level)/Baseline Level}}{\text{Update Year – Baseline Year}}$$

Equation 1. Equation for average annual percentage reduction.

The resulting value was the average percent of energy or GHG savings level a community achieved each year since its baseline. Using the annualized community progress to date, we then used this value to project the impact of the continuation of the achieved rate of annual energy or emissions savings until the stated goal's target year, as shown in Equation 2.

$$\text{(Target Year – Baseline Year)} \\ \times \text{ Average Annual Percent Change}$$

Equation 2. Equation for percentage emissions and energy use reduction in target year.

We compared this projected percentage reduction against the goal's target percentage reduction to determine whether communities were on track for their goals.

There are limitations with our projections due to the shortcomings and inconsistencies of the self-reported energy-related data from cities. In our data collection and analysis, we found energy data reported by cities to be infrequent, sporadic, and imperfect. In the U.S., cities are not required to report their energy consumption data to any centralized entity nor is there a database that independently compiles city-level energy data for all U.S. cities. DOE's Energy Information Agency compiles energy supply and consumption data at the state-level, but not for county, metro, or city level data. Perhaps the most comprehensive collection of city-level energy data is compiled by CDP Cities from reports submitted by cities from around the world (CDP 2014). This dataset includes greenhouse gas emissions data for many large U.S. cities (though certainly not all large U.S. cities), but disappointingly, few cities report the underlying energy consumption information used to estimate their greenhouse gas emissions. Because a comprehensive database for U.S. city-level energy data does not exist, we are limited to using self-reported data from cities' greenhouse gas inventories. Though inventory methodologies and quality may differ, greenhouse gas inventories remain the best data sources. Even with these limitations, it is still worth attempting to evaluate city progress toward goals because cities, rather than the federal government, are leading the way on climate initiatives in the U.S. However, our analysis should be seen as a preliminary attempt to assess city energy performance that was limited by imperfect data.

Due to annual variations in energy use and the changes in energy savings over time as market factors, technologies, policies, and programs change, energy savings or greenhouse gases emissions reductions will not necessarily occur linearly over time. While our forecasting methodology does not account for these variations and it cannot estimate future performance toward goals, it allows us to determine if cities have already demonstrated the average annual savings levels needed to meet targets. This methodology is also optimistic in forecasting for future savings because it may become difficult to achieve the same level of savings annually as total energy consumption and greenhouse gases emissions decrease year after year. However, given the sporadic and infrequent data reported by cities, we found this to be the most consistent method of evaluating progress toward goals among varying cities with varying goals.

This methodology also does not evaluate the stringency or efficacy of the goals themselves in relation to a city's capability to achieve energy or emissions savings. Rather, we evaluated cities against the goals their policymakers established through their own local planning process, with the optimistic assumption that policymakers formulated goals that they deemed feasible and realistic for their cities. There are differences in each city's local context, such as the makeup of the existing building stock, energy intensity of the local economy, and weather patterns, that inherently impact energy consumption patterns. Also, cities whose populations grow and economic activity increase over time may see higher energy consumption and greenhouse gases emissions than cities with stagnant growth. An analysis of the goals themselves in relation to cities' potential to save energy would require an examination of all of these factors and was outside the scope of the research.

To identify the potential policy drivers of city success toward goals, we supplemented our data with desktop research on the associated energy savings of locally implemented policies and programs. We found limited data from this research. As an alternative, we tried to gauge the influence of policy-related factors by focusing on the sectors of the local economy in each community that achieved the greatest energy savings and exploring the policy- and program-related efforts undertaken by cities in those sectors. Again, we found the data to be limited. Finally, we relied on program and policy information we collected from cities for the upcoming *2015 City Energy Efficiency Scorecard*, to identify noteworthy program and policy-types in cities on track for their goals. The *Scorecard* uses over 50 metrics to measure cities' adoption and implementation of best practice policies and programs within local government operations, community-wide initiatives, buildings policies, energy and water utility policies, and transportation policies. Using this data, we compiled common policy and program-types that most cities on track for their goals implemented. We cannot draw causal linkages between these initiatives and progress toward goals, but the policies and programs may be instructive for cities looking for success stories from peer cities.

After assessing city progress toward goals, we analysed the energy use of public and private buildings in cities, as data was available. To gather this data, we compiled public and private building energy use data from available GHG inventories or other related city reports. We normalized the annual levels of energy use by city population in the appropriate years to develop energy use per capita values and calculated the average annual change in energy consumption per capita in buildings between the baseline and most recently updated year. This value provided the annual level of energy savings per capita in the building stock between a city's baseline and most recently inventoried year. As is further discussed later in the paper, the data was too limited to establish trends in public or private building energy performance.

Results

PROGRESS TOWARD COMMUNITY-WIDE ENERGY EFFICIENCY-RELATED GOALS

Based on our review of available data for the 51 cities, we confirmed that 32 cities had community-wide energy efficiency-related goals. Of those, 15 cities had at least two energy-related inventories, allowing us to calculate their progress toward their nearest-term goal. Based on our projections, 7 cities, 14 % of the overall sample, are on track for their nearest term goal, namely Austin, TX; Boston, MA; Los Angeles, CA; Minneapolis, MN; New York City, NY; Riverside, CA; and Washington, DC. These cities are diverse in terms of geography, population, and especially climate. Several of the climate zones in the U.S. are represented by cities on track for their community-wide goals. New York is in a mixed-humid climate, Austin in a hot-humid climate, Riverside in a hot-dry climate, and Boston and Minneapolis in cold climates. It is surprising that a city in the more temperate, marine climate on the West Coast was not on track for a community-wide goal.

Boston, Los Angeles, Minneapolis, New York City, Riverside, and Washington have cumulative GHG goals that require the cities to reduce their GHG emissions by a certain percentage under their baselines by a future year. Austin has a goal to reduce its community-wide peak energy use by 800 MW. The city has reduced its peak energy use by 9 % per year since 2007, making it on track to achieve more than 800 MW of peak energy reduction (Austin 2014). Riverside has a 1 % incremental energy savings goal for the community and achieved a reduction of 1.08 % in 2013.

Figure 1 details the level of targeted community-wide savings and projected community-wide savings from each city's respective baseline for the 13 cities with available data and cumulative energy efficiency-related goals (which excludes Austin and Riverside). The time horizons and baseline years for goals vary. Most of the target years analysed are between 2015 (as in the case of Minneapolis and Philadelphia) and 2030 (as with New York City and Los Angeles). The target dates farthest out in the future are Portland's and Seattle's, which are 2050. The figure is organized so that cities farthest to the left on the x-axis have goals that are closer in time and the cities farthest to the right on the x-axis have goals that are furthest away in time.

PROGRESS TOWARD LOCAL GOVERNMENT OPERATIONS ENERGY EFFICIENCY-RELATED GOALS

Next we evaluated progress toward goals related to local government operations. We confirmed that 32 of the 51 cities had energy efficiency-related goals for their local government operations. This is the same number of cities that had community-wide goals, but not all of the cities with community-wide goals had local government operations goals. Of those, 15 cities had at least two energy-related inventories, allowing us to calculate progress toward their nearest-term goal. Based on our projections, 9 cities, 18 % of the overall sample, are on track for their nearest-term goal, namely Boston, MA; Dallas, TX: El Paso, TX; Houston, TX; Las Vegas, NV; Minneapolis, MN; New York City, NY; Phoenix, AZ; and Washington, DC. More cities are on track for local government operations goals than community-wide goals, but there is less geographic diversity among the cities on track for local government operations goals. For example, three of the cities on track for local government operations goals are located in Texas and there are not any cities along the West Coast on track for their goal.

Boston, Dallas, Houston, Las Vegas, New York City, Phoenix, and Washington have cumulative GHG goals that require them to reduce their GHG emissions by a certain percentage under their baselines. Minneapolis has a goal to reduce greenhouse gases emissions from local government operations by 1.5 % annually. El Paso is the only city among these 9 whose primary goal is a specific energy efficiency goal, namely to reduce energy use by 30 % by 2014. The city is projected to reduce its energy use by 37 % by 2014.

Similar to Figure 1, Figure 2 details the level of targeted local government operations savings and projected savings from each city's respective baseline for the 13 cities with available data and cumulative energy efficiency-related goals (which excludes Minneapolis). The target dates for goals vary with most occurring between 2014 (as is the case with El Paso) and 2020 (as is the case with Las Vegas, Washington, and Austin). The farthest term goal is Boston whose goal is for 2050. As with Figure 1, Figure 2 is organized so that cities farthest to the left on the x-axis have goals that are closer in time and the cities farthest to the right on the x-axis have goals that are furthest away in time.

Factors contributing to city progress

Beyond assessing city progress toward goals, our aim was to better understand the policy factors that contributed to city success toward achieving their local government operations or community-wide energy efficiency-related goals. Better understanding these factors could help us identify noteworthy local initiatives that may be of interest to other cities seeking to reduce energy consumption and reduce greenhouse gases emissions. However, we must acknowledge that external, exogenous factors could also impact city performance toward energy goals. For example, progress to reduce energy use in a community could be driven by programs run by the local government to inform residents about how to use less energy (endogenous) or it could be driven by a decline in population (exogenous).

To explore this, we drew from previous ACEEE research that explored the relationship between climate goals and exogenous factors in a selection of U.S. cities, including eight that we assess in this paper (Ribeiro et al. 2014). The analysis compared

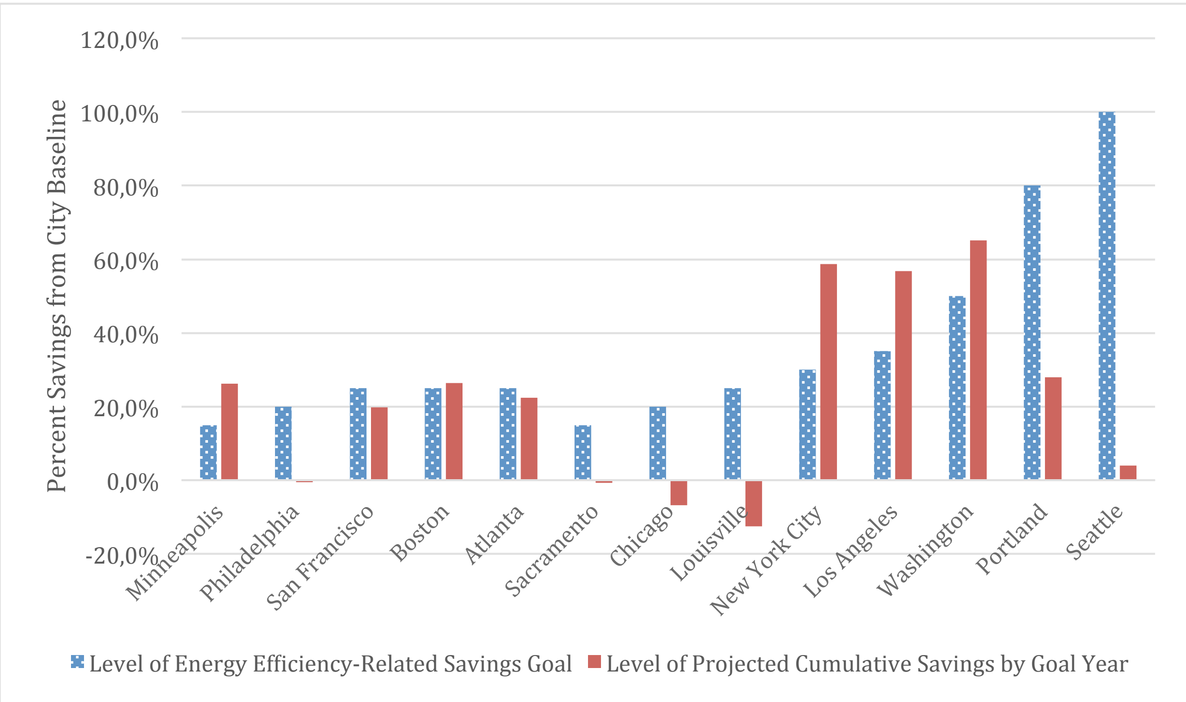

Figure 1. Community-wide energy efficiency-related goals of select U.S. cities and progress toward achieving goals. Notes: Goals compiled from city sustainability plans, climate plans, or other city documentation.

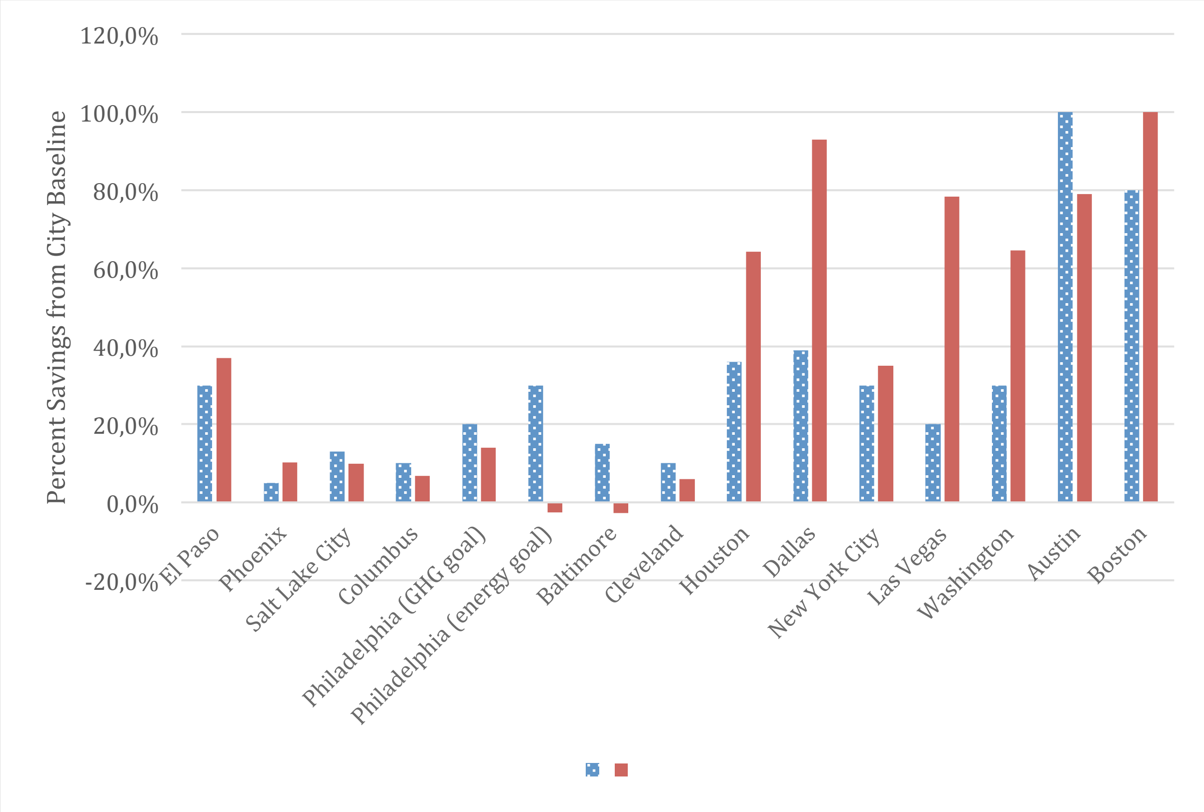

Figure 2. Local government operations energy efficiency-related goals of select U.S. cities and progress toward achieving goals. Notes: Goals compiled from city sustainability plans, climate plans, or other city documentation.

changes in several economic factors impacting cities, namely changes in their county's employment, population, and business establishments, to changes in city greenhouse gases emissions over a similar time period. The analysis did not establish causal relationships between any one factor and emissions, but was meant to inform whether economic and population factors could have had a role in emissions reductions. Cities that exhibited both growth in these economic factors and a significant decrease in emissions, such as Portland and Seattle in Figure 3, likely were not achieving emissions reductions through changes in local economic activity. Similarly, this analysis should be kept in mind as we explore the policy factors in the 51 cities in our paper so as not to overestimate policy impacts without being cognizant of exogenous factors.

Importantly, all but one of the cities in Figure 3 (Chicago being the exception) experienced a decrease in GHG intensity according to all three of our measures. While this evidence indicates economic growth may not generally be a significant barrier to these communities' progress toward GHG reduction goals, it does not rule out the possibility of other exogenous factors at work in cities.

To determine the impact of policy-related factors in progress toward goals, we compiled data on the energy savings impacts of local government policies and programs for those cities who were on track for their local government operations or community-wide goals. We initially did this through desktop research, including a review of sustainability plans and other publicly available sources. From our review, we found limited data on program or policy-related energy savings in those cities on track for their goals. Although it was also sparsely available, more data were available on the GHG emission-related impacts of programs, including GHG emissions savings from Boston's Renew Boston Initiative and a utility program in New York City to plug sulfur hexafluoride (SF6) leaks in the transmission system. Publicly reporting the associated energy savings from these programs would yield a more robust analysis of energy savings from these and similar programs.

As an alternative, we tried to gauge the influence of policy-related factors by focusing on the locally enacted initiatives in the sectors that achieved the greatest energy savings and exploring the policy and program-related efforts undertaken by cities in those sectors. To do so, we analysed the energy inventories for all cities that were projected to be on track for their goals. Unfortunately, sector breakdowns of energy use were only available for three cities, so the sample was not large enough to identify trends. New York City was the only city to have data available for community-wide energy use and local government operations. Table 1 shows the sectors with the greatest energy savings as a percentage of overall city energy use in a given community based on the actual energy levels cities reported in inventories. Although there is not enough data available to develop conclusive findings, it is notable that all cities experienced their largest energy reductions in their buildings sectors, whether looking at community-wide or local government energy use.

Finally, we relied on program and policy information we collected from cities for the upcoming *2015 City Energy Efficiency Scorecard*, to identify notable program and policy-types in cit-

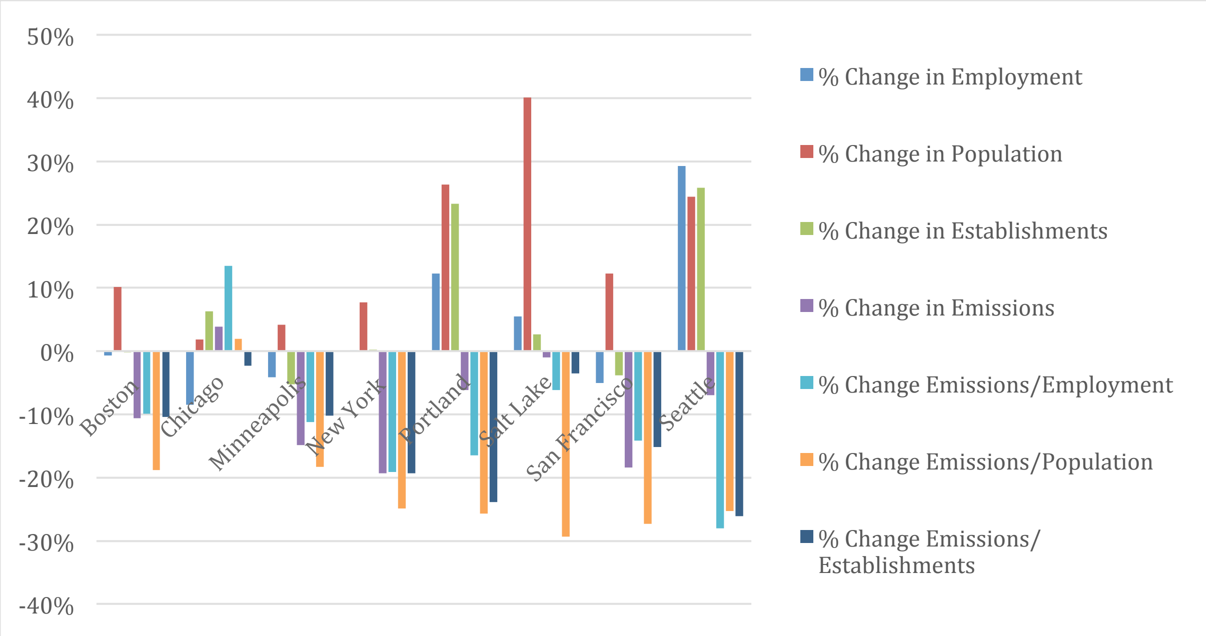

Figure 3. Comparison of exogenous factors to energy efficiency related community-wide goals. Source: Ribeiro et al. 2014.

Table 1. Community-wide and local government operations energy savings by city and year.

City	Jurisdiction	Baseline Year	Update Year	Sector	% Final Energy Savings
Boston	Community-wide	2006	2011	Buildings	2.41
Minneapolis	Community-wide	2006	2010	Buildings	3.41
New York	Community-wide	2005	2013	Buildings	0.71
	Local Government Operations	2006	2013	Public Buildings	1.26

Note: Data compiled from available energy use data in city inventories. Percent energy savings calculated from inventory data.

ies on track for their goals. The *Scorecard* uses over 50 metrics to measure cities' adoption and implementation of best practice policies and programs within their local government operations, community-wide initiatives, buildings policies, energy and water utility policies, and transportation policies. Using this data, we compiled common policy and program-types implemented by cities on track for their goals. All of the research in the following sections is compiled in the ACEEE State and Local Policy Database (ACEEE 2015). We cannot draw causal linkages between these initiatives and progress toward goals, but this information may be instructive for cities looking for success stories from peer cities. The current dearth of available data on the impacts of local programs on energy savings makes it impossible to draw direct relationships between policies and energy savings.

COMPREHENSIVE RETROFIT STRATEGIES FOR PUBLIC BUILDINGS

Eight of the nine cities on track for their local government operations goals had some form of comprehensive retrofit strategies for public buildings. Cities with these strategies proactively manage public building energy use and identify opportunities to make their buildings more efficient through retrofits or retro-commissioning. In 2013, New York City launched the Accelerated Conservation & Efficiency (ACE) program to fund high value capital projects to reduce energy costs and GHG emissions. We did not find data on the energy savings associated with the program, but it reduced GHG emissions by 270,000 $mtCO_2e$ and saved $105 million (New York 2014b). Several of the cities on track for goals, namely Boston, El Paso, Houston, Phoenix, and Washington, are also partners to DOE's BBC. BBC partner cities must commit to a 20 % reduction in the energy intensity of a portfolio buildings by 2020. The aforementioned cities have all made commitments that include a portion of public building space.

According to energy use data provided for their public buildings, El Paso's energy use per capita in public buildings has decreased by over 15 % between 2008 and 2013 (L. Baldwin, pers. comm., 2014). Over nearly the same time period, the city has used a series of energy saving performance contracts to reduce energy use. The first phase began with improvements to local government buildings and traffic signals and the most recent phase, Phase V, focused on improvements at the El Paso International Airport (El Paso 2014). Dallas also uses energy saving performance contracts to reduce energy use in public buildings.

RESIDENTIAL BUILDING BENCHMARKING

Four of the seven cities on track for their community-wide goals have adopted and implemented residential benchmarking and transparency laws for segments of their residential housing sector. By making the energy efficiency qualities of properties more transparent, these policies can highlight the value of energy efficient properties during property transactions and encourage retrofits in inefficient buildings. Austin's Energy Conservation and Audit Disclosure Ordinance (ECAD), adopted in November 2008 and implemented in June 2009, requires audits of single-family homes prior to a sale and audits of large multifamily buildings. In Boston, the Building Energy Reporting and Disclosure Ordinance requires that all residential buildings over 35 units benchmark their energy and water use using DOE's Portfolio Manager tool and report the data to the city annually. The city publicly discloses the building-level energy use information on a website. In New York, the Greener, Greater Buildings Plan is a suite of four local laws targeting energy efficiency in large buildings through benchmarking provisions, lighting upgrade requirements, energy audit requirements, and the local energy code.

The three cities on track for their community-wide goals who have not implemented benchmarking and transparency laws, namely Minneapolis, Los Angeles, and Riverside, have Multiple Listing Services (MLS) that include inputs for the energy-efficient characteristics of properties. These inputs allow realtors to track specific energy efficient characteristics of properties so they can inform parties to housing transactions about the efficiency qualities of properties.

ENERGY EFFICIENCY SAVINGS TARGETS AND LOCAL UTILITY FUNDING AGREEMENTS

Savings targets for utilities, often called energy efficiency resource standards (EERS), are generally adopted at the state level. They can be a highly effective driver of energy efficiency investment. Cities with municipally owned utilities, which may or may not need to comply with state EERS policies, can enact similar savings targets of their own. The three cities who are served by municipal utilities and are on track for their community-wide goals have done exactly this. California requires municipal utilities to supply 10 % of their energy through energy efficiency by 2023, but Los Angeles's municipal utility, LADWP, has adopted a target of 15 % by 2020. In Riverside, Riverside Public Utilities is required to save 1 % of sales annually from 2013 to 2023.

For those cities served by investor owned utilities, cities can use franchise agreements as a potential tool to require their investor-owned energy utilities to invest in energy efficiency. In the case where franchise agreements do not require investments in energy efficiency, they may be used to foster greater collaboration between the city and its utilities around efficiency. For example, the city of Minneapolis just entered a unique partnership with Xcel Energy and CenterPoint Energy, the city's electric and natural gas utilities. The Memorandum of Understanding, referred to as the Clean Energy Partnership, is an agreement between the city and its utilities to work together to improve the delivery of energy efficiency to city residents and to reach its energy goals. This agreement follows the City's adoption of its Climate Action Plan which seeks to reduce greenhouse gas emissions by 15 % by 2015, 30 % by 2025, and 80 % by 2050.

Local governments can also enter into voluntary agreements with utilities to set efficiency targets or establish funding for efficiency efforts, independent of any state policies. Besides Minneapolis, the three cities with investor owned utilites who are on track for community-wide goals have entered into voluntary agreements. For example, in partnership with Boston's energy utilities, Renew Boston provides technical assistance and financial incentives to business and industrial consumers, including free energy analysis and incentives to cover a portion of the costs of efficiency upgrades. The utilities have agreed to provide the city with funds for marketing and community outreach, agreed to participate in strategic planning for Renew Boston, and agreed to provide a full-time utility staff member to be based in City Hall to coordinate energy efficiency promotion to large users. The program has led to the avoidance of over 100,000 mtCO_2e from commercial and industrial buildings.

PARKING REQUIREMENTS FOR LOCATION-EFFICIENT DEVELOPMENT

Where people live and how far they regularly travel has an impact on overall community-wide energy use. Living in compact, mixed-use communities with access to public transit gives households the chance to decrease their transporation-related energy use. Local governments can spur compact neighborhoods with provisions of the zoning code, including alterations to minimum parking requirements. Historically, zoning codes have had minimum parking requirments, such as one or more parking spaces on site per housing unit. These can perpetuate automobile-oriented neighborhoods rather than compact ones. Six of the seven cities on track for their community-wide goals have taken steps to remove parking minimums from their codes.

Leading the way among the seven cities are Boston and New York. Boston has several neighborhoods with one-half a parking space required per dwelling unit and parking freezes are in effect in their downtown. In New York City, developers are required to provide less than one-half parking space per each new housing unit constructed in New York City with no required parking in the Manhattan Core. Washington and Los Angelse are both in the process on reducing their parking minimums and Minneapolis and Riverside both have at least one neighorbood that require one or less space per housing unit.

LOCATION EFFICIENCY INCENTIVES

Beyond using zoning regulations to promote more compact communities, cities can also offer incentives to spur more compact neighborhoods in cities. Six of the seven cities on track for their community-wide goals have at least one location efficient incentive in place and four cities have two incentives in place. Austin's Safe, Mixed-Income, Accessible, Reasonably Priced, Transit-Oriented (SMART) housing program provides fee waivers, expedited review, and support to projects that provide certain levels of affordable housing and are transit-accessible. In Riverside, the city's Infill Incentive Program provides fee adjustments, density bonuses, and cost avoidance incentives for developers using the designated infill sites. New York City's R-10 program provides density bonuses to developments in medium- to high-density commercial neighborhoods that provide a certain number of affordable housing units. In Minneapolis, Chapters 548 and 549 of the zoning code include floor-to-area ratio premiums for development projects in downtown zoning districts and density bonuses for commercial districts.

ENERGY SAVING INITIATIVES FROM OTHER JURISDICTIONS

There were other policy-related trends impacting energy use in cities that could not be directly attributed to local government actions. While cities can take various steps to address energy efficiency in their communities, community-wide energy consumption is also impacted by entities regulated at higher levels of government than local governments. Six of the seven cities on track for their community-wide goals have stringent building codes, but several of these are set at the state level rather than the local level. Also, the energy utilities serving the cities on track for their community-wide goals spend more and actually save more from their efficiency programs on average than utilities serving the other 44 cities not on track for their goals. This could be due to myriad reasons including state EERSs or progressive utility leadership. Furthermore, six of the seven cities on track for community-wide goals have a higher transit connectivity index on average as measured by the Center for Neighborhood Technology than the other 44 cities not on track for goals. This means that residents have more options for public transit in walking distance than residents in many other large cities. Taken together though, this highlights the need for cities to have strong partnerships with other non-city entities impacting city-wide energy consumption, including state government, energy utilities, and regional transportation authorities.

Public and private building energy performance

Beyond reviewing city progress toward energy efficiency-related goals, we also reviewed the energy performance of cities' public and private buildings separately since they are major energy consumers. Based on an analysis of energy data used in the *2013 City Scorecard*, buildings accounted for 70 % of the total energy use within cities while transportation accounted for 30 % of energy use (Mackres et al. 2013). Rather than evaluating city progress toward a specific goal, we analysed the energy savings data from inventories to identify any trends in building energy use. We focused on levels of energy use, rather than actions that can be associated with energy efficiency such as greenhouse gases emissions.

Overall, we found limited comprehensive data on the total energy use of cities' public or private building stocks. For private buildings community-wide, we found city energy use data over multiple years for 11 cities. For public buildings, we found city energy use data over multiple years for eight cities. We also did not identify a discernible trend in the average annual percent change in energy use per capita in either public or private buildings. Private buildings in cities generally saw average annual increases or decreases in energy use per capita of between 0 % and 2 %. Public buildings in cities generally experienced average annual increases or decreases in energy use per capita of between 0 % and 5 %. We detail the average annual energy use savings per capita values we calculated for private and public buildings in the Appendix.

Several cities, including Chicago and New York City, have started releasing building benchmarking and transparency reports detailing the energy use in a selection of buildings, but these reports do not yet report energy use for all public or private buildings within a city. As published benchmarking reports start to include more data on additional segments of a city's building stock, analysis of energy use trends in buildings will become more robust.

Conclusions

Although over 30 of the 51 largest U.S. cities evaluated in our analysis have demonstrated leadership by adopting energy efficiency-related goals, less than 20 % of them are on track for either their community-wide or local government operations goals. The remaining communities were not on track for goals, did not have quantitative data that allowed us to evaluate goals, or simply did not have goals. The lack of public data on the energy impacts of locally enacted policies makes it difficult to identify best practices or specific program and policy recommendations for cities to adopt. U.S. cities would likely benefit by adopting some best practices from the utility industry in tracking and reporting changes in energy use, whether incremental or cumulative savings. However, we determined that those cities on track for their local government operations goals all had implemented some form of comprehensive retrofit strategies for public buildings. Most cities on track for their community-wide goals have implemented some form of residential building benchmarking and transparency measures, energy efficiency savings targets or utility funding agreements that included efficiency, progressive parking requirements, and location efficient incentives. Because exogenous and endogenous policy-related factors can impact energy savings, we cannot identify the exact drivers of city success toward their goals.

Future research on several topics could flesh out our analysis. A similar assessment focusing on the greenhouse gases reductions of cities would likely provide more lessons learned because cities publish more data on their GHG emissions. Also, a comparison of the energy efficiency efforts of European cities and the U.S. cities would likely provide more insights on energy efficiency programs and practices that would be beneficial to both U.S. and European cities. However, to truly improve many facets of this and future analysis, cities must begin publishing more of their energy consumption and GHG emissions data in standardized formats at more regular intervals.

References

ACEEE (ACEEE State and Local Policy Database). Database. aceee.org. Accessed February 2015.

Armstrong, Michael. 2014. Personal Communication. City of Portland.

[Atlanta] Georgia Institute of Technology. Borin, S., Wang, J., & Thomas, V. 2009. City of Atlanta Greenhouse Gas Emissions Inventory. Atlanta, GA:

Georgia Institute of Technology. http://s3.amazonaws.com/zanran_storage/atlantaga.govhost.com/ContentPages/17281607.pdf.

Austin Energy. 2014. Customer Energy Solutions: Program Progress Report 2013–2014. Austin, TX: Austin Energy. https://austinenergy.com/wps/wcm/connect/0cd540f6-41e0-48ba-96e4-a1bf8a505c91/energySolutionsProgress-Report.pdf?MOD=AJPERES.

[Baltimore] City of Baltimore. 2013. Baltimore Climate Action Plan. Baltimore, M.D.: City of Baltimore. http://baltimoresustainability.org/sites/baltimoresustainability.org/files/BaltimoreCAP_FINAL_130415.pdf.

Baldwin, Lauren. 2014. Personal Communication. City of El Paso.

[Boston] City of Boston. 2013a. Climate Action Plan. "Boston Community Greenhouse Gas Inventories." Boston, MA: City of Boston. http://www.cityofboston.gov/images_documents/updatedversionghg1_tcm3-38142.pdf.

—. 2013b. Municipal Greenhouse Gas Inventory: Fiscal Years 2005 – 2013. Boston, MA: City of Boston. http://www.cityofboston.gov/images_documents/FinalMuniInventoryFY12withNotes_Summary_tcm3-41272.pdf.

CDP (Carbon Disclosure Project cities program database). https://www.cdp.net/en-US/Results/Pages/responses.aspx.

[Cleveland] City of Cleveland. 2013. Cleveland Climate Action Plan: Building Thriving and Healthy Neighborhoods. Cleveland, OH: City of Cleveland. http://www.sustainablecleveland.org/wp-content/uploads/2013/10/Cleveland-Climate-Action-Plan-Final2013-web.pdf.

[Cleveland] City of Cleveland. 2013. Sustainable Cleveland Municipal Action Plan. Cleveland, OH: City of Cleveland. http://www.city.cleveland.oh.us/CityofCleveland/Home/Government/CityAgencies/OfficeOfSustainability/SustainableClevelandMunicipalActionPlan.

Committee of Conference. 2009. Conference Report to Accompany H.R. 1. United States House of Representatives, 111th Conference. Rep. NO 111–16.

[El Paso] City of El Paso. 2014. Programs-Energy Efficiency Retrofits. http://home.elpasotexas.gov/general-services/sustainability/energy-retrofits.php.

[Louisville] Trinity Consultants & Louisville Metro Air Pollution Control District. 2008. Greenhouse Gas Emissions Inventory Report: Louisville/Jefferson County Metro Government. Covington, KY: Trinity Consultants. http://louisvilleky.gov/sites/default/files/sustainability/pdf_files/louisville_metro_ghg_inventory_report_v420081120.pdf.

Mackres, E., K. Johnson, A. Downs, R. Cluett, S. Vaidyanathan, and K. Schultz. 2013. The 2013 City Energy Efficiency Scorecard. Washington, D.C.: American Council for an Energy-Efficient Economy. http://aceee.org/research-report/e13g.

[Minneapolis] City of Minneapolis. 2012a. City of Minneapolis Greenhouse Gas Inventories: A Geographic Inventory (2006-2010) and Household Consumption-based Inventory (2010). Minneapolis, MN: City of Minneapolis.http://www.minneapolismn.gov/www/groups/public/@citycoordinator/documents/webcontent/wcms1p-092812.pdf.

—. 2012b. Minneapolis GHG Emissions from Community-wide Activities. Minneapolis, MN: City of Minneapolis. https://docs.google.com/spreadsheet/pub?key=0Ai6xMn1H_MYadGV3Yy02THpCRldMZDBnSVdIeUNJN0E&single=true&gid=0&range=A1%3AI10&output=html.

—. 2012c. Municipal Operations GHGs. Minneapolis, MN: City of Minneapolis. https://docs.google.com/spreadsheet/pub?key=0Ai6xMn1H_MYadFVqbVRvdGRsSk02Vk8wUGQ3U3V1c1E&single=true&gid=0&output=html.

[New York] New York City. 2014. PlaNYC Inventory of New York City Greenhouse Gas Emissions. New York, N.Y.: City of New York.http://www.nyc.gov/html/planyc/downloads/pdf/NYC_GHG_Inventory_2014.pdf.

—. 2014b. Once City Built to Last. New York, N.Y.; City of New York. http://www.nyc.gov/html/builttolast/assets/downloads/pdf/OneCity.pdf.

[Philadelphia] City of Philadelphia. 2014. Greenworks Philadelphia Update & 2014 Progress Report. Philadelphia, PA: City of Philadelphia. http://www.phila.gov/green/PDFs/Greenworksprogressreport.pdf.

Ribeiro, D., E. Mackres, and J. Barrett. 2014. Climate and Energy Targets of Selected U.S. Cities: Progress Toward Their Achievement and Related Implementation Lessons Learned. Washington, DC: ACEEE. https://www.aceee.org/files/proceedings/2014/data/papers/10-972.pdf.

[San Diego] City of San Diego. 2005. City of San Diego Climate Protection Action Plan. San Diego, CA: City of San Diego. http://www.sandiego.gov/environmental-services/pdf/sustainable/action_plan_07_05.pdf.

[San Jose] City of San Jose. "Appendix K GHG Emissions." http://www.sanjoseca.gov/DocumentCenter/View/2205.

[San Francisco] City of San Francisco. "San Francisco Carbon Emissions Inventory 1990-2010."http://www.sfenvironment.org/sites/default/files/fliers/files/sfe_cc_emissions_inventory_summary_1990-2010.pdf.

[Seattle] Stockholm Environment Institute. 2014. 2012 Seattle Community Greenhouse Gas Emissions Inventory. Stockholm Environment Institute.http://www.seattle.gov/Documents/Departments/OSE/2012%20GHG%20inventory%20report_final.pdf.

[St. Louis] City of St. Louis. 2012. City of St. Louis 2005 & 2010 Greenhouse Gas Emissions Inventory Report. St. Louis, MO: City of St. Louis. http://stlouis-mo.gov/government/departments/mayor/documents/upload//120504-City-of-St-Louis-2005-2010-GHG-Inventory-Report-FINAL.pdf.

U.S. Conference of the Mayors. 2014. Map of Participating Mayors. http://usmayors.org/climateprotection/map.asp.

[Washington] District of Columbia. 2012. Reducing Our Greenhouse Gases…Growing Our Economy. Washington, DC: District of Columbia. http://ddoe.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/GHGinventory-1205-.pdf.

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Appendix

Table A-1. Private building energy savings by city.

City	Baseline year	Update year	Average annual % change in energy consumption per capita
Boston	2006	2011	-1.03 %
Chicago	2000	2010	-0.71 %
Denver	1990	2005	-0.36 %
Detroit	2011	2012	-10.63 %
Louisville	1990	2006	-0.12 %
Minneapolis	2006	2010	-1.68 %
New York City	2005	2013	-0.40 %
Portland	1990	2008	0.10 %
San Francisco	1990	2010	-0.23 %
Seattle	1990	2012	-0.54 %
St. Louis	2005	2010	1.05 %

Note: Data compiled from available energy use data in city inventories. We combined residential, commercial, and industrial energy use data from buildings to total a city's building energy use. The average annual percent change in per capita energy consumption was calculated from inventory data.

Table A-2: Public building energy savings by city.

City	Baseline year	Update year	Average annual % change in energy consumption per capita
Charlotte	2011	2013	-0.31 %
Denver	1990	2005	2.54 %
El Paso	2008	2013	-4.73 %
Las Vegas	2005	2008	10.62 %
New York	2006	2013	-0.58 %
San Francisco	1990	2010	0.24 %
Seattle	1990	2010	-2.09 %
St. Louis	2005	2010	4.92 %

Note: Data compiled from available energy use data in city inventories. The average annual percent change in per capita energy consumption was calculated from inventory data.