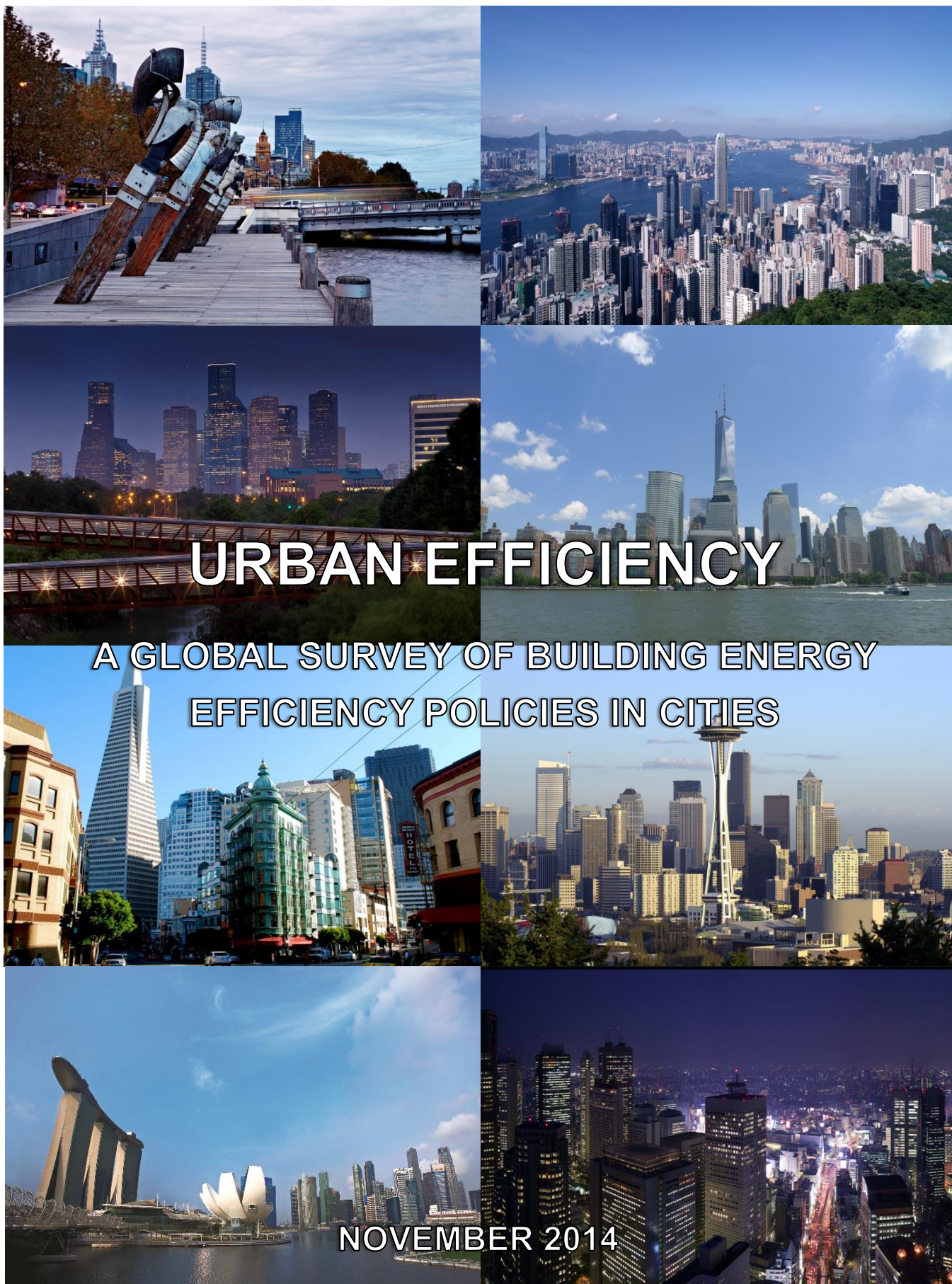




URBAN EFFICIENCY

A GLOBAL SURVEY OF BUILDING ENERGY EFFICIENCY POLICIES IN CITIES

NOVEMBER 2014



TOKYO
METROPOLITAN
GOVERNMENT

C4O
CITIES
CLIMATE LEADERSHIP GROUP

Urban Efficiency:

A Global Survey of Building Energy Efficiency Policies in Cities

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Foreword

Zoe Sprigings

C40 Network Manager, Energy Efficiency

Buildings shape the iconic skylines of our global megacities. For many of these cities, buildings also hold the key to tackling climate change. Building energy use is one of the leading sources of greenhouse gas (GHG) emissions in cities – almost half of the emissions from member cities of the C40 Cities Climate Leadership Group (C40) come from energy consumed in buildings¹.

The importance of building energy efficiency is indisputable. It cuts emissions, it cuts energy bills, and it can bring a whole host of additional benefits: healthier workplaces, new jobs and greater energy security, to name but a few. However, although the benefits of efficient buildings are obvious, time and resources are often in short supply in city administrations, and city officials need to know quickly what has worked in other cities, and how exactly it was achieved. And, if they run up against barriers, they need allies.

Tokyo co-leads a network of cities committed not only to tackling energy efficiency in their own buildings, but also to collaborating with others so they can take faster action, and have more impact. The Private Building Efficiency Network is one of 15 networks run by C40, a group of the world's megacities taking action on climate change together. Each network links officials working on a different aspect of climate change, such as waste or transport. Cities in the Private Building Efficiency Network are already pioneering new policies for their buildings, often moving faster than nations or regions. Despite this, there is an evidence gap on what is happening at the city level. It was through discussions with fellow members of the Network that Tokyo saw the need to capture best practice from cities around the world, and share it.

The resulting report, *Urban Efficiency: A Global Survey of Building Energy Efficiency Policies in Cities*, is a compelling example of C40 cities collaborating, freely sharing their information for the collective good. It was made possible by the foresight and generosity of the Tokyo Metropolitan Government, and C40 is privileged to be a partner.

For a city just starting out in energy efficiency, this report offers a menu of possibilities. For a city in the midst of implementation, it's a guide to finding solutions to common challenges. For a city that has just completed a programme, it's an inspiration of where to go next.

For the rest of the world, it's concrete proof of how C40 cities are leading the way on climate change solutions.

¹ C40 Climate Leadership Group and Arup (2011) *Climate Action in Megacities 1.0*.

Foreword

Yuko Nishida

Bureau of Environment, Tokyo Metropolitan Government

In Tokyo, we take the challenge of climate change very seriously. The Tokyo Metropolitan Government has set a target to reduce citywide greenhouse gas (GHG) emissions by 25% and energy consumption by 20% below 2000 levels by 2020. Carbon emissions from the building sector account for a significant portion of Tokyo's total emissions, and so our climate change policy and programmes focus on the building sector as a matter of course. To achieve these targets, promoting energy efficiency in existing buildings is essential.

In 2010 we introduced a cap-and-trade carbon emissions scheme which sets mandatory targets for large buildings. This has been successfully implemented. Nonetheless, more work is still needed to encourage smaller buildings and residential buildings to use energy efficiently. Information and experiences from other major cities are very relevant to us, and participating in C40's Private Building Efficiency Network provides us with a wonderful opportunity to learn. Moreover, given an increasing urban population and growing emissions from buildings, city alliances to promote energy efficiency in buildings seem crucial for tackling climate change globally. Therefore, Tokyo sees great value in being a part of the Private Building Efficiency Network and is happy to be a lead city with Sydney.

This Network continues to grow and now has dozens of active members, spanning Asia, Oceania, Africa, Europe, Latin America and North America. Member cities are learning from one another through webinars, conference calls, the sharing of useful documents and materials, and undertaking joint research and projects to extend our knowledge. Meeting in person in Houston (2013) and Tokyo (2014) has helped to build mutual trust among members, which leads to quality discussions and precious information sharing.

The research for this *Urban Efficiency* report was initially conducted by the Tokyo Metropolitan Government in preparation for the 2014 C40 Tokyo workshop, in order to enable a discussion about various private sector building energy efficiency policies. Through documenting the experiences of cities, we can identify our common issues and challenges, and also get inspired by great ideas which we can then take home and implement in our cities.

We really hope this report will be a great reference not only for the Network members, but also for other colleagues in cities around the world who also recognise the importance of building energy efficiency.

Executive Summary

Urban Efficiency: A Global Survey of Building Energy Efficiency Policies in Cities is a resource for city officials around the world as they design new policies for building energy efficiency, or review existing ones. The research should help close the evidence gap regarding city-level activity in building energy efficiency. As such, it is designed to be accessible to those working in the field in general, including researchers.

The *Urban Efficiency* report's specific objectives are:

- to begin to capture the range of different policies being implemented in cities around the world;
- to obtain detailed information on the necessary conditions, opportunities and potential challenges when introducing and implementing such initiatives; and
- to analyse what approaches have been successful in which context and why.

This research is not an exhaustive study of all cities promoting building energy efficiency policies. Instead, it focuses on a readily available selection of pioneering cities: active members of the C40 Cities Climate Leadership Group's Private Building Efficiency Network. C40 is a unique coalition of large cities around the world committed to addressing climate change locally and globally. Within the C40 are smaller working groups – or networks – of cities focused on specific topics.

A combination of methods was used to produce this research: literature review, written questionnaires, semi-structured telephone interviews and analysis of key documents. The report is organised into chapters focusing on broader trends followed by specific city case studies.

Chapter 1, 'A macro view of city-level policies', provides an overview of global trends in building energy efficiency among C40 cities, illustrated with findings from C40's landmark research report, *Climate Action in Megacities 2.0*.

Chapter 2, 'Objectives and methodology', sets out more detail regarding the rationale of this research, and how it was executed.

Chapter 3, 'Policy maps and global trends', identifies global trends in city-led initiatives for building energy efficiency as highlighted in case studies from Chicago, Hong Kong, Houston, Johannesburg, London, Melbourne, New York City, Philadelphia, Portland, San Francisco,

Seattle, Singapore, Stockholm, Sydney, Tokyo, and Toronto. Twelve ‘policy elements’ are documented in two policy maps, one for new buildings and one for existing buildings. See **Table 3.1** *Definition of policy elements* for more information. The key conclusions are as follows:

Building energy codes

Many cities around the world develop their own codes for new buildings and major renovations that are broader or more stringent than national or state codes. In the US, for example, some cities set codes that are stricter or wider in scope than the state codes. European cities implement the national energy codes required by European Union (EU) directive requirements and Australian cities follow state codes. In Japan, as the national code has yet to be mandated, Tokyo has its own more ambitious requirement of submitting a plan with minimum energy efficiency performance specifications for large facilities. Energy code application and enforcement is still rare for existing buildings, with the exception of those undergoing major renovations. However, some cities set minimum standards for building equipment to help bridge the gap.

Reporting and benchmarking of energy performance data

Reporting and benchmarking is a rather new but increasingly popular area of activity in city programmes, with the majority of initiatives targeting large buildings. Disclosure policies vary from city to city. A number of US cities are implementing reporting and benchmarking legislation, whereas Tokyo is undertaking reporting efforts aimed at smaller buildings on top of mandatory reporting required of large buildings under its Emissions Trading Scheme. In European cities, Energy Performance Certificates required by EU directives are playing a similar role. Some cities are also encouraging benchmarking without reporting obligations.

Mandatory auditing and retro-commissioning

Many cities require periodic auditing and/or retro-commissioning every three to ten years, mainly for large commercial buildings (with some exceptions). The coverage varies from an exclusive focus on the building cooling systems to one that addresses the entire building, including both tenant and common areas. It is noteworthy that audits and retro-commissioning are often mandated along with reporting and benchmarking schemes.

Emissions trading schemes

The pioneering emissions trading scheme in Tokyo is a mandatory cap-and-trade

programme with an emissions reduction target. Tokyo's cap-and-trade scheme is unique in that it was developed by and is managed by the city, and is focused on buildings¹.

Green building rating and energy performance labelling

A number of cities incorporate green building and energy performance standards into planning or permitting processes, adopt them as pre-requisite for financial or non-financial incentives, and utilise them in the design of new developments or the renovation of municipal buildings.

Financial incentives

Although financial incentives for energy efficiency in new buildings are rare, many cities operate schemes focused on existing buildings, with a wide array of choices offered from city governments or national or state agencies. Additionally, utilities often provide energy efficiency grants and rebates, sometimes in response to regulation.

Non-financial incentives

Common forms of non-financial incentives include an expedited permit process and allowances for extra floor area in the case of new green building developments. As a further trend, cities often use existing green building certifications as a criteria for minimum levels of energy efficiency.

Awareness raising programmes

Apart from extensive online information focused on green buildings, energy efficient operations or energy efficiency retrofits, many cities offer information via free or subsidised energy audits or assessments, guidebooks or seminars. Also, many US cities have developed 'weatherisation' programmes targeting low-income households, which cover not only low-cost weatherisation improvements to the building envelop but also heating, cooling and electrical system upgrades and appliances.

Promoting green leases

Some cities promote green leases to tackle the split incentive problems separating building owners and tenants. The standard approach of cities has been to promote toolkits that recommend certain green lease provisions in order to improve the

¹ Since 2013, some Chinese cities not surveyed in this report have been targeting buildings (amongst other sectors) through pilot emissions trading schemes.

environmental performance of the building.

Voluntary leadership programmes

Cities encourage voluntary action amongst city businesses and residents in a wide variety of ways, including voluntary design guidelines, flagship development projects, friendly competitions, and voluntary projects developed in partnership with the commercial or residential sector. Competitions and voluntary projects are often coupled with energy assessments or recommendations and advice on available financial incentives. Participants are expected to lead by example and share their experience with the wider public.

Government leadership

City governments can also lead by example, and many are. The most common approach includes requiring compliance with green building standards for the construction or renovation of government buildings. The disclosure of energy performance data from government buildings is also occurring in several leading cities. In addition, cities are using municipal buildings as testing sites for innovative technology, inviting industry to trial new green building technology on city buildings before marketing it more broadly.

Other

Cities are engaged in a number of other initiatives related to building energy efficiency, such as the demarcation of low-carbon zones, the promotion of energy services companies (ESCOs), and the development of Better Buildings Partnerships. These have been grouped together in their own category because they were only recently developed, are rare, or represent more of a coordination role rather than active implementation role for cities.

Chapter 4, 'Experiences from Frontrunner Cities', presents detailed case studies from ten pioneering C40 cities implementing various kinds of programmes to drive energy efficiency and sustainability in existing commercial and residential buildings. The cities and programmes are:

Hong Kong: *Buildings Energy Efficiency Ordinance (BEEO)*

Houston: *Houston Green Office Challenge (HGOC)*

Melbourne: *1200 Buildings programme*

New York City: *Mandatory benchmarking scheme*

in the Greener, Greater Buildings Plan

Philadelphia: *Building Energy Benchmarking Ordinance*

San Francisco: *Existing Commercial Buildings Energy Performance Ordinance*
Seattle: *The Seattle Building Energy Benchmarking and Reporting Program*
Singapore: *Existing Buildings Legislation*
Sydney: *Smart Green Apartments programme*
Tokyo: *Tokyo Cap-and-Trade Program*

More detail on elements of the programmes surveyed appears in **Table 3.1, List of programmes surveyed**. Each case study focuses on one key programme from each city, and includes the following details:

- Programme context: key components of the programme and its relevance to localised challenges, existing climate and building targets, and other initiatives.
- Inputs for the programme: the process by which it was designed and implemented, including timeframes, resources, background research and stakeholder engagement.
- Programme results: results and impacts on the retrofit market and greenhouse gas emissions, etc.
- Lessons learned: successes and challenges encountered in the design and implementation phases.
- Reference list.

Chapter 4 then offers an overall analysis of the key characteristics and trends emerging from the various individual cases, also extracting key lessons on common success factors and challenges encountered. Many of the ten detailed case studies focus on new initiatives targeting large buildings in the commercial sector. Some have identified programme impacts on energy consumption and greenhouse gas emissions, the retrofit or energy efficient building market, or on awareness or capacity building, but most cities note that it is too early to see definitive programme results. Based on experience to date, the key conclusions are as follows:

Success factors reported

The most widely reported key success factor is (1) stakeholder engagement, which was cited by almost all cities. Other important factors include (2) partner support, from key industry groups or utilities, for example; (3) buy-in and recognition from mayors and elected officials; (4) flexibility in the implementation timeframe; (5) uptake of targeted strategies for different segments; and (6) well-designed linkages between regulatory and voluntary programmes and financial incentives or capacity building efforts.

As for stakeholder engagement, the participation of industry, civil society, academia and other government bodies during programme design and implementation was crucial for the success of virtually all initiatives. Stakeholder engagement allows for early identification of the needs and concerns of affected communities, which can be incorporated into programme design. This also allows for an early assessment of a proposed programme's feasibility, in addition to forging cooperative relationships with key industry players that can drive general acceptance of programmes and compliance with regulations during implementation.

Key challenges being faced

Major difficulties noted by cities in the development and implementation of their energy efficiency programmes include: (1) moving from a focus on compliance with reporting regulations to an understanding of programme outputs such as energy use data; (2) data management in terms of accuracy and access to aggregated data for reporting programmes; (3) limited city staff capacity to implement programmes; (4) outreach and marketing of programmes; and (5) tenant engagement.

There is consensus that efforts are needed to shift building owners from merely complying with reporting requirements to appreciating the value of energy efficiency data and action, although the high levels of compliance with regulatory programmes generated by marketing and outreach efforts should not be dismissed. Continued stakeholder and public education is key to increasing broader public awareness about the benefits of improving building energy efficiency in order to influence broader market trends. Auditing and retro-commissioning, reporting, benchmarking, and public or partial disclosure of benchmarking results can play key roles here, while voluntary efforts such as competitions, private leadership programmes or awareness raising programmes serve as excellent opportunities for increasing stakeholder knowledge of the benefits of building energy efficiency.

Future perspectives

The wealth of experiences outlined in the ten case studies offer important insights into forthcoming challenges and opportunities for building energy efficiency. For example, cities with reporting and benchmarking programmes are considering how and if to publicly disclose this data to help influence the market. Experience suggests that a phased approach to public disclosure is key. Further efforts are needed to raise awareness amongst building owners and industry groups of the value of benchmarking data and audit results.

Cities have noted that different strategies are required for targeting smaller buildings and many have developed specific programmes for this sector. One approach is to provide financial incentives and support to facilitate energy use reporting and retrofits of small and medium enterprises. Another approach is to encourage voluntary action through friendly competitions. Regulatory measures have also been successful, particularly those focused on gaining recognition for energy efficiency efforts through public disclosure.

Tenant engagement is one of the largest challenges that cities are facing and a number of cities have developed innovative strategies for overcoming the split incentive problem. City initiatives include development of an energy efficiency master plan, financial incentives, promotion of green leases, award programmes, and obligations for large tenants to report their energy use data and to cooperate with building owners.

Chapter 5, 'Conclusions', reflects on the original objectives of the research. Initial feedback suggests that this research will be a valuable resource and the policy maps and hyperlinked matrix of programmes in **Appendix 2** – which synthesise vast amounts of information about policies in 16 cities – will be helpful tools for cities. *Urban Efficiency* is certainly not an exhaustive study and the selection of cities was limited. Data on programme inputs such as budgets and on evaluated impacts in general were difficult to capture. However, this report provides a foundation for future investigations, both in terms of the theoretical framework it sets out (the policy maps) and also in the policies it has documented (the case studies). Future research could build on this by increasing the number of cities, the range of policy elements, and the geographic scope of cities studied, which would build up a database of policies and also allow the theoretical framework of policy elements to be tested and refined. In particular, this piece of research could be extended and enhanced by a more detailed investigation into how cities identify and calculate the impacts of their building energy efficiency policies.

There is still work to be done to recognise and analyse the building energy efficiency policies that cities are implementing all around the world. *Urban Efficiency* makes an important contribution to this effort, showcasing the building energy efficiency programmes of leading global cities.

November 2014

1. A macro view of city-level policies

Since 2011, C40 has been tracking the climate actions of its cities and now holds a unique dataset that demonstrates the sheer scale and variety of city action in its landmark report *Climate Action in Megacities 2.0 (CAM 2.0)*. Covering the fields of transport, energy efficiency, energy supply, adaptation and water, waste management, finance and economic development, and sustainable communities, CAM 2.0 provides an overview of the global climate action landscape across sectors, including building energy efficiency. This chapter draws out some of the relevant highlights from the report.

Building energy efficiency is one of the most prominent sectors in terms of reported activity within C40 cities, and accounts for more than 20% of all actions reported across all sectors¹. Moreover, the buildings sector has shown the most progression of actions from the proposal and pilot stages in 2011 to the transformative and significant level in 2013².

¹ C40 Climate Leadership Group and Arup (2014) *Climate Action in Megacities 2.0* [figure 2.1].

² Ibid., [figure 3.6].

Space conditioning is the most common way energy is used in buildings, accounting for 38% (see **Figure 1.1**). Therefore it makes sense that cities report insulation and heating/cooling efficiency amongst their top five buildings actions. The other three most reported actions are directed towards measuring building performance; namely, audits and advice, energy performance certification, and benchmarking. These data-gathering measures are often the precursor to implementing changes to the building fabric or operation³.

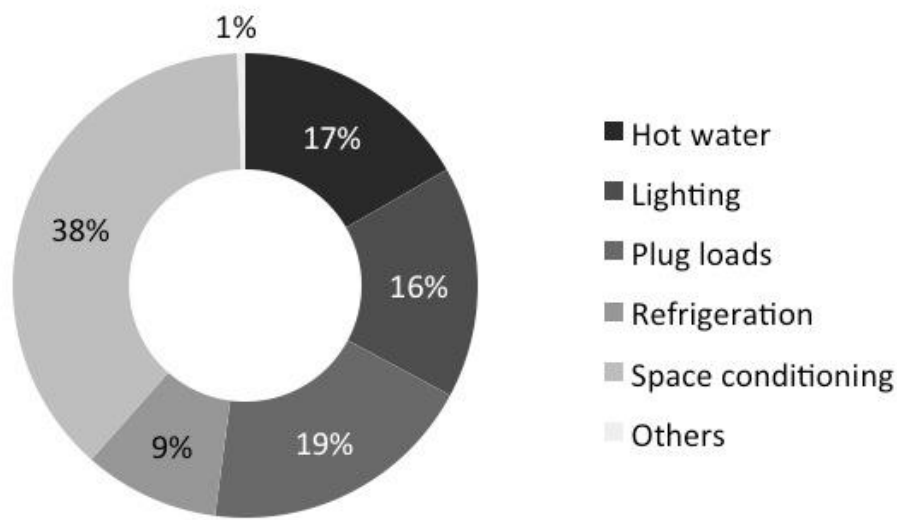


Figure 1.1 Percentage Building Energy Use, by Usage Type

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³ Ibid., [figure 5.13].

C40 complements its analysis of city actions in CAM 2.0 with an analysis of mayoral powers, or how action relates to the degree of influence mayors or city leaders exert over city functions compared to other levels of government and the private sector. In building energy efficiency as a whole, C40 cities have relatively strong power, but this breaks down into a diverse picture (see **Figure 1.2**). Cities have the strongest and broadest powers over existing and municipal buildings, with at least 70% of cities having strong powers of ownership or operational control, policy-setting and enforcement, and budgetary control. This is significantly different from city powers over private buildings, where ownership is naturally non-existent, and budgetary control is minimal. However, cities often do have partial or even strong powers to set policies and vision for private sector buildings.

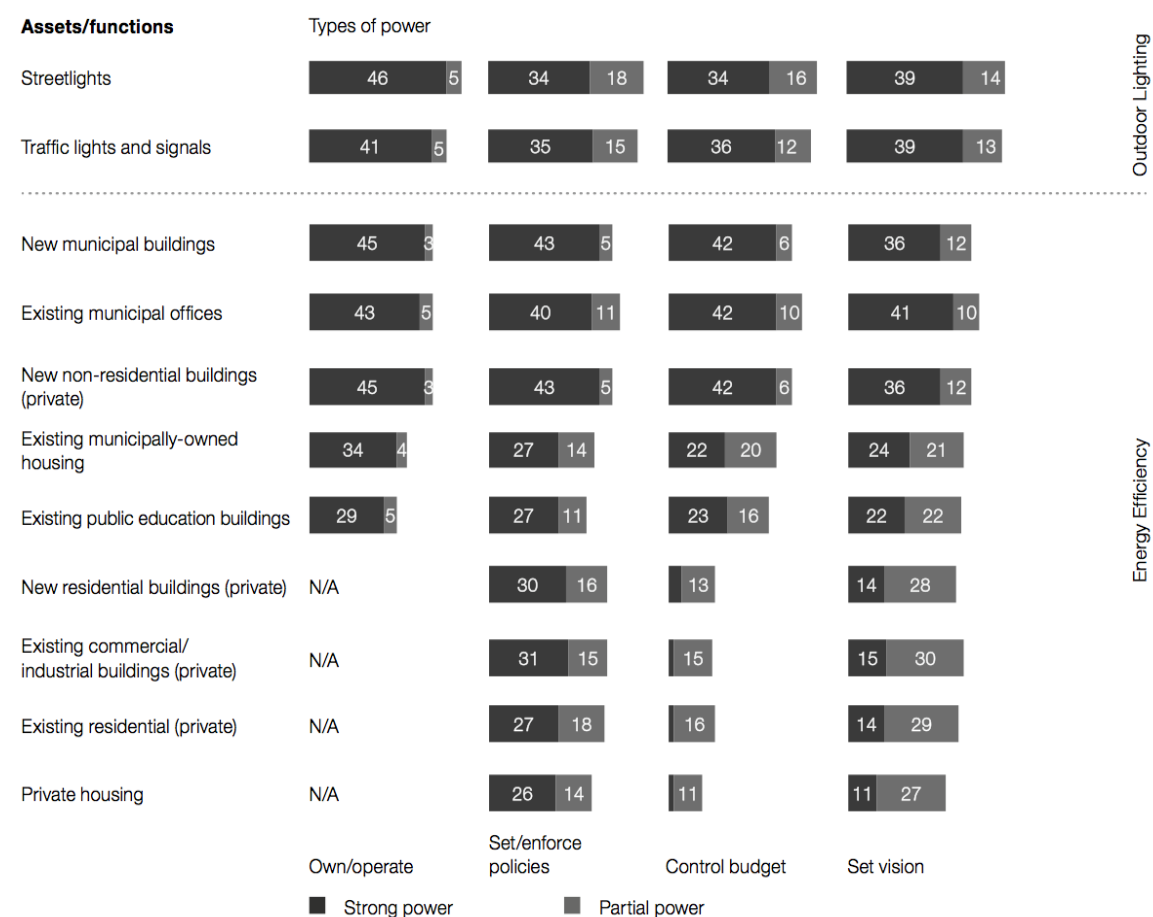


Figure 1.2 Number of Cities (Out Of 57 Responding) with Strong or Partial Powers over Assets/Functions, by Types of Power
(Copyright C40/Arup 2014, reprinted from CAM 2.0 with kind permission)

Turning to the future, we see that cities have significant plans to address energy consumption in their buildings, mainly through energy efficiency (see **Figure 1.3**). It is

notable that the top five actions cities prioritise for the buildings sector in the future are the same five actions they are currently pursuing. This suggests that scaling-up is a greater priority than exploring new actions. Overall, CAM 2.0 paints a picture of cities taking considerable action in the buildings sector, and using a range of mechanisms to do so. *Urban Efficiency* hopes to make a valuable contribution to C40 cities around the world by taking the analysis to the next level – documenting the range of approaches taken by individual cities and illuminating how these approaches are being implemented.

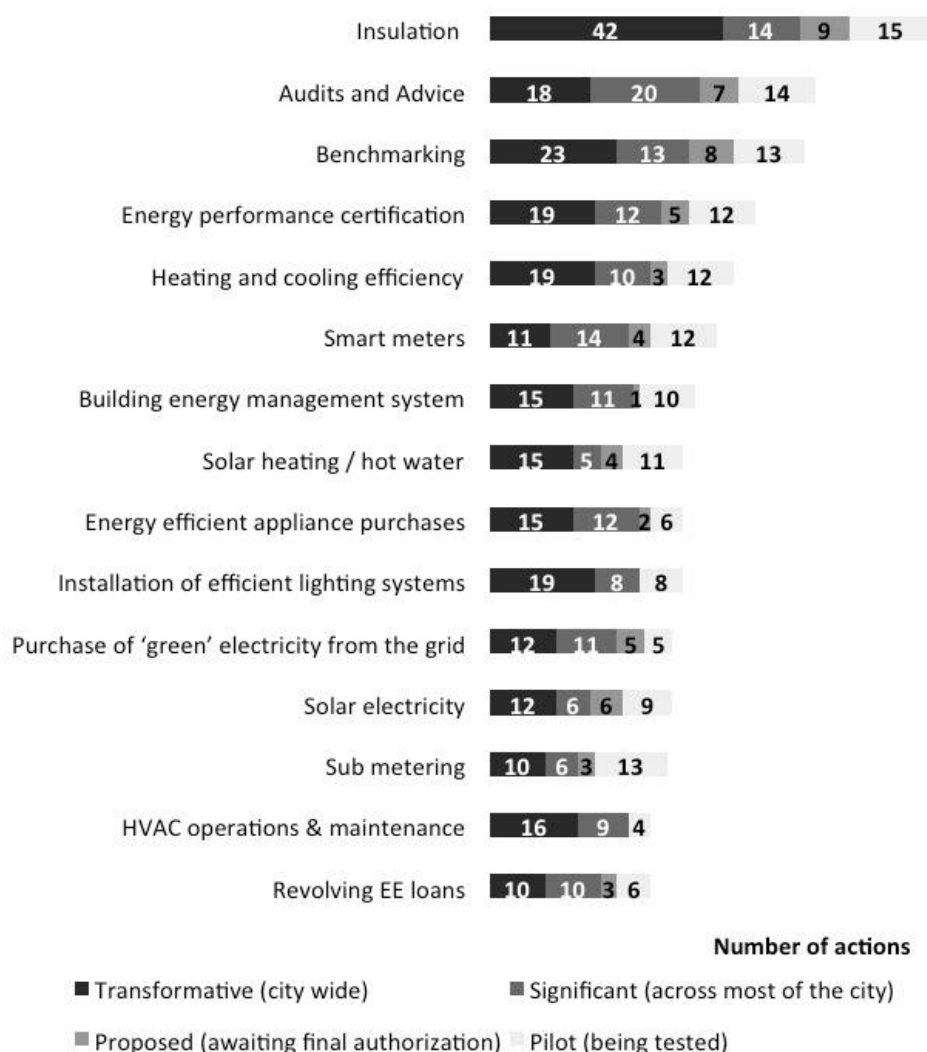


Figure 1.3 Top 15 most common actions for future expansion in the buildings sector, by scale

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2. Objectives and Methodology

2.1 Objectives

Large cities play an increasingly important role in addressing climate change in general, and in tackling building energy efficiency in particular. The aim of this research is to document city building energy efficiency programmes in order to produce a useful resource for officials in other cities, whether they are planning for new initiatives or considering enhancing current ones.

The *Urban Efficiency* report's specific objectives are:

- to begin to capture the range of different policies being implemented in cities around the world;
- to obtain detailed information on the necessary conditions, opportunities and potential challenges when introducing and implementing such initiatives; and
- to analyse what approaches have been successful in which context and why.

The scope of the research includes:

- new and existing buildings
- non-residential and multi-family residential buildings (i.e. excluding single-family housing)
- privately and municipally owned buildings, and
- energy efficiency policies and programmes (i.e. excluding renewable energy policies).

2.2 Outputs

The outputs of the research include:

- '**policy maps**', which provide a high-level overview of the different policies being employed by cities around the world for promoting energy efficiency in (A) new buildings and (B) existing buildings, accompanied by the description of the different types of policy instruments; and
- a series of **case studies** which provide detailed information about city experiences of implementing a specific programme to promote building energy efficiency of private sector buildings, accompanied by analysis of the key characteristics, trends, success factors and challenges.

2.3 Methods

Data sampling

The surveyed cities were chosen from amongst the active members of the C40 Private Building Efficiency Network. C40 is a unique coalition of global megacities committed to tackling climate change, and within it are smaller working groups – or Networks – of cities focused on specific aspects of climate change. The members of the Private Building Efficiency Network focus on energy efficiency in existing commercial and residential buildings and they collaborate through knowledge sharing and joint projects. These cities, as members of this C40 Network, have consciously chosen to prioritise energy efficiency to tackle climate change. Therefore, studying cities from this Network is an effective way of identifying pioneering cities. Although the C40 Private Building Efficiency Network focuses on existing private buildings, most of the cities have chosen to prioritise building energy efficiency in general. Therefore, programmes for municipal buildings and new buildings are also covered in the scope of this research.

Data collection: policy maps

To complete the policy maps, all active member cities of the C40 Private Building Efficiency Network, namely Chicago, Hong Kong, Houston, Johannesburg, London, Melbourne, New York, Philadelphia, Portland, San Francisco, Seattle, Singapore, Stockholm, Sydney, Tokyo and Toronto, were surveyed. As such, the resulting policy maps largely reflect the experience of Asia-Pacific and North American cities and advanced economies.

A **literature review** was the chosen method because it allowed for a wide (across all sectors) and deep (covering the detail of policy documents) scope of research. This review was conducted from January to September 2014 using data from online resources, such as official websites for city/state/national governments, news articles and electronic databases (see **Appendix 1**, 'List of web-based databases on energy efficiency policies worldwide').

After the initial step of listing programmes for each city, a categorisation method was developed to identify 12 policy elements (see in **Table 3.1** for details). A **mapping exercise** was then conducted for city-led programmes to create **Appendix 2** ('Policy map - City-led programmes'), accompanied by efforts to classify the programmes as relevant for either new or existing buildings and either for the residential or non-residential sectors. The policy maps were then divided into separate documents, with one for new buildings and the other for existing buildings. In those cases where no specific city government programmes were identified, national or state government programmes or collaborative initiatives with industry associations, private coalitions and utilities, were featured if they were

complementary to city efforts. *Information contained in the policy maps was collected solely through desk research and has not been verified by surveyed cities.*

Data collection: case studies

The active members of C40 Private Building Efficiency Network were contacted and invited to participate in the research, resulting in 10 contributors: Hong Kong, Houston, Melbourne, New York City, Philadelphia, San Francisco, Seattle, Singapore, Sydney and Tokyo. The case studies that resulted are not, therefore, a representative selection of global cities. Nonetheless, they do represent some of the most advanced city programmes around the world and provide lessons for other cities wishing to follow their example. Moreover, the level of detail offered by these case studies allows for new insights into their specific programmes and for meaningful comparisons to be made amongst the programmes highlighted in the report.

A combination of methods was used to create a comprehensive account of the city programme based on published material (document analysis) and on personal accounts of city officials (through questionnaires and interviews).

A **written questionnaire** (see **Appendix 3**) was sent electronically to the active Network member cities in March 2014. Respondents were invited to choose one key programme dealing with existing private sector building energy efficiency and enter detailed written information on the following points:

- (1) *Background information*: Including target sector (e.g. commercial, residential etc.), scope (building sizes), objectives and progress or impacts attained so far;
- (2) *Inputs during design phase*: Including timeframes, resources (staffing and budgets), research commissioned/used, stakeholder engagement or consultation process, and links to other city policies or programmes;
- (3) *Inputs during implementation phase*: Including timeframes, resources (staffing and both overall and marketing/communications budgets), monitoring/reporting/verification procedures, partner support and tenant engagement;
- (4) *Data collection*: Procedures and key metrics used;
- (5) *Small to medium buildings*: Other policies or a part of the highlighted programme aimed at promoting energy efficiency in small to medium sized buildings;
- (6) *Outcomes*: Effects on the building and retrofitting market and demand for energy efficient buildings;
- (7) *Drivers of success; and*
- (8) *Key challenges.*

Data from these questionnaires was supplemented by **semi-structured telephone interviews** with each city. Conducted between March and April 2014, these interviews consisted of a 90-minute teleconference between one or two government representatives from the city concerned, the CSR Design Green Investment Advisory research team in Tokyo, officials from Tokyo Metropolitan Government, and C40. Interviewees were invited to elaborate on key success drivers and challenges encountered, programme impacts, and respond to various questions emerging throughout the interview. The interviews were recorded, transcribed into minutes and then analysed.

The third process used to obtain information on each city programme was the **collection and analysis of key documents**, including those accessed via official websites, such as programme reports, policy documents and press releases from each city. Third-party research such as reports and press materials was also reviewed where relevant.

Using the data and information obtained via the methods outlined above, preliminary case study drafts were developed during May and June 2014. The drafts were sent for approval to interviewees in each city to ensure the accuracy of information and obtain additional details as needed. Attendees of the Private Building Efficiency Network workshop in Tokyo in June 2014 provided feedback on the first draft of the case studies and analysis. Some case studies were subsequently updated in July and August 2014.

3. Policy maps and global trends

3.1 Overview

This chapter documents the significant city efforts made to date and illustrates global trends regarding city-led policies or programmes for building energy efficiency. The wide range of programmes are classified into separate policy maps for new buildings and existing buildings. The policy maps cover the cities of Chicago, Hong Kong¹, Houston, Johannesburg, London, Melbourne, New York City, Philadelphia, Portland, San Francisco, Seattle, Singapore², Stockholm, Sydney, Tokyo, and Toronto.

The focus of the mapping exercise is primarily on programmes run by city governments. In those cases where no specific city government level programmes were identified, national or state government programmes, or collaborations with industry associations, private coalitions and utilities are featured instead.

The major areas covered by policy maps include:

- New buildings and existing buildings (measures concerning major renovations are categorised under 'new buildings');
- Energy efficiency (excluding renewables/energy supply); and
- All building sectors (commercial, industrial, multi-family residential and government etc.) except single-family residential dwellings.

The various policies and programmes are classified into 12 categories of policy elements as outlined in **Table 3.1**.

¹ Under the Basic Law, building energy efficiency policies of the People's Republic of China are not applicable to the Hong Kong Special Administrative Region. Therefore, Chinese policies are not cited in the policy maps.

² Singapore is a city-state and as such the programmes featured in the policy maps are from the national government.

Table 3.1 Definition of policy elements

1.	Building energy codes	Any building codes containing energy efficiency requirements for a whole building, part of a building, or equipment embedded in a building, or other regulations, laws and ordinances based on such codes.
2.	Reporting and benchmarking of energy performance data	Any policy or programme requiring reporting (to the government), benchmarking or disclosing data for building energy consumption and GHG emissions, etc.
3.	Mandatory auditing and retro-commissioning	Any policy or programme mandating auditing and/or retro-commissioning of buildings.
4.	Emissions trading schemes	City-led emissions trading schemes that covers emissions from the building sector.
5.	Green building rating and energy performance labelling	Any scheme run by a city government to rate or certify levels of building environmental performance or energy performance. Alternatively, any regulatory policy or programme based on existing green building certification/rating schemes or energy performance certification/labelling schemes.
6.	Financial incentives	Any financial incentive (e.g. tax incentives, rebates, etc.) offered to offset costs associated with the implementation of one or more specific energy efficiency retrofits to building envelopes or equipment.
7.	Non-financial incentives	Any non-financial incentive (e.g. accelerated permitting, floor area bonus) to encourage implementation of one or more specific energy efficiency measures for building envelopes or equipment.
8.	Awareness raising programmes	Awareness raising programmes for building owners, tenants or the wider public, such as free or subsidised energy efficiency advice, weatherisation programmes, open online sources for energy efficiency tips, educational programmes and public campaigns, etc.
9.	Promoting green leases	Programmes to promote green lease contracts between building owners and tenants.
10.	Voluntary leadership programmes	Voluntary leadership programmes such as voluntary private sector programmes, friendly competitions, flagship projects and voluntary design guidelines.
11.	Government leadership	Any initiative to demonstrate governmental leadership in building energy efficiency and sustainability through implementation measures in government owned or occupied buildings or government operations.
12.	Other	Any other initiatives that contribute to building energy efficiency.

Table 3.2 Policy map of new buildings³

Country	China	Japan	Singapore	Australia	Canada	United States								United Kingdom	Sweden	South Africa
Cities	Hong Kong	Tokyo	Singapore	Melbourne	Sydney	Toronto	Chicago	Houston	Philadelphia	Portland	New York	San Francisco	Seattle	London	Stockholm	Johannesburg
Policy elements⁴																
1. Building Energy Codes*																
2. Reporting and Benchmarking																
3. Mandatory Auditing and Retro-commissioning																
4. Emissions Trading Schemes																
5. Green Building and Energy Ratings*																
6. Financial Incentives*																
7. Non-financial Incentives																
8. Awareness Raising Programmes																
9. Promoting Green Leases																
10. Voluntary Leadership Programmes																
11. Government Leadership*																
12. Other																

	City-led programmes ⁵		Regional, national or state government-led programmes ⁶		Partner-led programmes ⁷
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³ It should be noted that this information was collected through desk research and has not been verified by surveyed cities.

⁴ See definitions in **Table 3.1**. Policy elements 2. and 5. are named in short form. Originally they are '2. Reporting and Benchmarking of Energy Performance Data', and '5. Green Building Rating and Energy Performance Labelling'. Stars(*) indicate 'Regional, national or state government-led programmes' are considered (also see footnote below).

⁵ See **Appendix 2** for the list of city-led programmes in each cell.

⁶ Regional, national or state government programmes are highlighted only when no city-led programmes were identified in that category, and also they are complementary to city efforts, i.e. only 1., 5., 6., and 11. are considered for new buildings.

⁷ Partner-led programmes are coloured only when no city-led or higher-tier government-led programmes were found in that category, and also they are identified during the online research.

Table 3.3 Policy map of existing buildings⁸

Country	China	Japan	Singapore	Australia	Canada	United States								United Kingdom	Sweden	South Africa
Cities	Hong Kong	Tokyo	Singapore	Melbourne	Sydney	Toronto	Chicago	Houston	Philadelphia	Portland	New York	San Francisco	Seattle	London	Stockholm	Johannesburg
Policy elements^{9, 10}																
1. Building Energy Codes*																
2. Reporting and Benchmarking*																
3. Mandatory Auditing and Retro-commissioning*																
4. Emissions Trading Schemes*																
5. Green Building and Energy Ratings*																
6. Financial Incentives*																
7. Non-financial Incentives																
8. Awareness Raising Programmes																
9. Promoting Green Leases*																
10. Voluntary Leadership Programmes																
11. Government Leadership*																
12. Other																

 City-led programmes¹¹
 Regional, national or state government-led programmes¹²
 Partner-led programmes¹³

⁸ It should be noted that this information was collected through desk research and has not been verified by surveyed cities.

⁹ See definitions in **Table 3.1**. Policy elements 2. and 5. are named in short form. Originally they are '2. Reporting and Benchmarking of Energy Performance Data', and '5. Green Building Rating and Energy Performance Labelling'. Stars(*) indicate 'Regional, national or state government-led programmes' are considered (also see footnote below).

¹⁰ Major renovation or alterations are classified in 'New buildings' in this research, as they are most likely to legislate together.

¹¹ See **Appendix 2** for the list of city-led programmes in each cell.

¹² Regional, national or state government programmes are highlighted only when no city-led programmes were identified in that category, and also they are complementary to city efforts, i.e. only 1., 2., 3., 4., 5., 6., 9., and 11. are considered for new buildings.

¹³ Partner-led programmes are coloured only when no city-led or higher-tier government-led programmes were found in that category, and also they are identified during the online research.

3.2 Global trends illustrated by policy maps

3.2.1 Building energy codes

(1) Programmes for new buildings

Many cities around the world develop their own codes for new buildings and major renovations that are broader or more stringent than national or state codes. It should be noted that major renovations and new construction are covered under 'new buildings,' as they are most likely to be regulated together.

In the US, most state governments have adopted a certain level of national model codes¹⁴. However, some cities are operating codes that are stricter or wider in scope, as indicated above. For example, the City of Houston set the residential energy conservation standard 15% higher than the Texas state code requires. Also, San Francisco Building Code 13C under the Green Building Ordinance, which is another mandatory code for both new residential and non-residential sectors buildings, requires a level 15% stricter than the state code. With the Californian code being one of the strictest in the US, this additional city modification could be seen as one of the most advanced codes in the country. Local Law 85 of New York City is a mandatory energy conservation code covering both new residential and non-residential buildings. The scope of this code has been widened to encompass any renovation or alteration project, in addition to new development.

In European countries, cities tend not to have their own building energy codes. This is probably because of the existence of stringent national codes required by European Union (EU) directives. The Energy Performance of Buildings Directive (EPBD) has required each national government to facilitate minimum performance requirements since 2002 and in 2009 tightened the obligation to a building energy code targeting nearly Zero Energy Buildings.

¹⁴ The International Energy Conservation Code (IECC) and American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1 act as US national model codes, with the IECC covering both the residential and commercial sectors and the ASHRAE Standard 90.1 being referred in IECC for the commercial sector. Both codes are updated once in every three years, and US Department of Energy (DOE) issues a 'determination' for the latest code (as to whether it achieves greater energy efficiency in buildings) within one year of its publication to recommend State governments to adopt them. States have two years to revise their codes or decide not to meet the new code (and submit an explanation to the Secretary of Energy in this case).

In Japan, where the national building energy code is still not strictly enforced¹⁵, the Tokyo Metropolitan Government mandates compliance with the Green Building Program for large residential and non-residential buildings (and allows voluntary submissions from smaller buildings). This requires the submission of a Building Environment Plan in the event of new construction or major renovations, with these plans disclosed online. Although this programme originally intended to foster the voluntary introduction of greener measures into new buildings, since 2010, adherence to minimum energy efficiency performance specifications has been required for certain non-residential buildings larger than 10,000 m².

Apart from directly setting the building energy codes, some cities incorporate energy performance criteria into their building permission processes. For instance, Toronto mandates all new planning applications to be met with Tier 1 of Toronto Green Standard. The Standard requires energy performance that is 15% higher than the Ontario Building Code, and not only targets energy efficiency but also covers comprehensive environmental criteria such as air quality, water and waste. The City of Melbourne also endeavours to set energy performance requirements, as well as water and waste efficiency, in its Planning Scheme by citing external standards such as NABERS, Green Star and the Building Code of Australia (BCA). This may be partly because codes are implemented by the state government in accordance with the BCA and therefore cities usually do not have the authority to impose their own energy codes.

Another strategy is to set codes focused on specific parts of buildings. For example, Toronto developed the Green Roof Bylaw in 2009 for new commercial, industrial, institutional and residential buildings larger than 2,000 m² and Philadelphia adopted the Cool Roof Law in 2010 to mandate reflective roofing for all new commercial and residential buildings with no or low roof angles.

(2) Programmes for existing buildings

City-level building energy codes focused on existing buildings are rare given that major renovations are categorised into new buildings in this analysis. The building codes of cities like Houston and San Francisco tend to apply only to new buildings. Even at the national or state level, where it is more common to set building energy codes, the main target tends to be new

¹⁵ Due to the general attitude of Japanese laws towards private assets, compliance to codes set by the Energy Conservation Law, i.e. Building Energy Standard, is still voluntary; however, they have started the process of making it mandatory for all buildings and housing over 300m² by 2020. Currently, building owners are required to make efforts to meet the codes, and are additionally mandated to submit energy efficiency plans for new buildings and major renovation of residential and non-residential buildings larger than 300 m². In cases where energy efficiency levels in a submitted plan are significantly sub-standard, the government can issue recommendations, publicise the offense, or give them an order to amend their plan (if not followed, a fine is imposed).

buildings and major renovations. One exception, however, is the New York City Energy Conservation Code (NYCECC) scheme. As described above, compliance with the NYCECC is required even for renovations or alterations affecting less than half of the building and/or its systems.

Alternatively, as another form of regulating energy efficiency in existing buildings, some cities have set minimum performance standards for equipment embedded in a building. Again in New York City, Local Law 88 mandates that by 2025 covered buildings must replace or install all lighting to meet the NYCECC standard, and introduce sub-meters and provide a monthly statement based on sub-metered electricity consumption to tenants. In Singapore, building owners are required to meet a standard equivalent to the Green Mark Certified level when replacing or installing new cooling systems.

3.2.2 Reporting and benchmarking of energy performance data

(1) Programmes for new buildings

No examples of reporting and benchmarking schemes for new buildings were identified for city or national government programmes, mainly because the reporting of energy performance requires actual energy use data.

(2) Programmes for existing buildings

Requiring energy performance data reporting appears to be a major trend by which surveyed cities are seeking to spur action on building energy efficiency. The majority of reporting and benchmarking programmes target large buildings and mandate annual reporting of energy performance and GHG emissions data, with differing policies regarding disclosure of the data. Some policies simply require disclosure between building owners and potential buyers or tenants, whilst others require public disclosure of the data online via city websites.

The US in particular is home to an array of benchmarking schemes. As many as five out of seven US cities surveyed (and 13 cities nationwide) have enacted their own building energy reporting and benchmarking policies (see case studies for Seattle, Philadelphia, New York City and San Francisco in **Chapter 4** with the rest being Chicago). Such measures sometimes exist on top of statewide benchmarking programmes, the scope of which may be modified at the city level. There are even cases where a city government took the lead in introducing a benchmarking scheme, which was then followed by the state government.

In addition to energy benchmarking, Chicago has started requiring homeowners to issue a

Home Energy Performance Report when listing their home for sale. The report includes monthly gas and electricity use and cost for a one-year period and is disclosed via the online Multiple Listing Service. This is the first attempt in the US to disclose residential energy cost and is expected to allow for more informed decision-making by home buyers.

In Europe, neither London nor Stockholm operates reporting or benchmarking schemes as noted below. This seems to be due to the stricter requirement by the EU for Energy Performance Certificates (EPCs). Both in the UK and Sweden, an EPC, based on the projected performance, is needed when a building is sold or rented (as well as built), and obliges the building owner to obtain a certificate from an accredited assessor to disclose to potential buyers and tenants. Additionally, a Display Energy Certificate (DEC), based on the actual energy performance, is required for public buildings in the UK.

Cities may also provide simple tools to facilitate benchmarking without any mandates. Hong Kong has a programme called the Energy Consumption Indicators and Benchmarks for Residential, Commercial and Transport Sectors. This programme offers online benchmarking tools for residential and commercial buildings without requiring reporting or disclosure of the energy performance data. Additionally, the Tokyo Metropolitan Government operates the Carbon Reduction Reporting Program for Small and Medium Facilities. Based on data submitted under this scheme¹⁶, benchmarks are provided for small to medium facilities in accord with building usage. In June 2014, the city used this benchmark to launch a new scheme, Carbon Report, a self-rated energy performance labelling for small to medium sized buildings.

Tokyo has also taken a slightly different approach to the reporting of energy performance data for larger non-residential buildings. Under the emissions trading scheme, large facilities are subject to reporting obligations (also see **3.2.4**). The report is used to set the amount of emissions, as owners must procure emission credits in the event that an establishment exceeds its emissions cap. For this reason, building owners are required to assess data through a government registered verification agency before submission.

3.2.3 Mandatory auditing and retro-commissioning

(1) Programmes for new buildings

As auditing and retro-commissioning apply to existing buildings, no programme was identified under new buildings.

¹⁶ Reporting is mandated for facilities above a certain level of annual energy consumption. For facilities with lower consumption levels, the reporting is encouraged on a voluntary basis.

(2) Programmes for existing buildings

Energy auditing and retro-commissioning have emerged as a key policy trend around the world to promote greater energy efficiency in buildings. In some cities such as Hong Kong, Singapore, New York City and San Francisco, either or both auditing and retro-commissioning¹⁷ are mandated. They are required periodically (every three years in the case of Singapore, five in San Francisco, and ten in Hong Kong and New York City), while also being conducted by registered or qualified professionals such as assessors or auditors. The targeted buildings are mainly large buildings (Hong Kong covering almost all buildings except small buildings) in the non-residential sector (except New York City which targets all sectors). While Singapore, Hong Kong and New York City are focusing on basic building components (building cooling systems in Singapore; four key building service installations, i.e. air-conditioning, electrical, lifts and escalators and lighting in Hong Kong, and base buildings in the case of New York City), San Francisco targets the entire building including both tenants and common areas. It is noteworthy that these are often implemented along with reporting and benchmarking schemes (this is the case for Singapore, New York City and San Francisco with the exception of Hong Kong). This is because it can be highly effective to identify energy efficiency improvement opportunities (i.e. via audits and retro-commissioning) together with reporting of current energy performance. Also, free or subsidised audits are provided by several cities to building owners, which will be explored in **3.2.8 Awareness Raising Programme** section.

3.2.4 Emissions trading schemes

(1) Programmes for new buildings

Emission trading schemes are based on emissions from building operations and therefore do not apply to new buildings.

(2) Programmes for existing buildings

The mandatory emissions trading scheme in Tokyo is highly unique in that it was developed by a city, is being managed by a city and is focused on buildings (see also **3.2.2** and a case study in **4.2**). The emissions trading scheme was developed based on the then Carbon Reduction Reporting Program introduced in 2000 and has been in implementation since 2010. Although some Chinese cities that were not surveyed for this report (namely Beijing, Shanghai and Shenzhen) have been targeting building sectors through pilot emissions trading schemes since 2013, it can be said that Tokyo has pioneered this approach.

¹⁷ Retro-commissioning refers to the act of testing and adjusting building systems and equipment to ensure their functioning in an energy efficient manner. Auditing, on the other hand, refers to the inspection and measuring of overall energy performance in a building and the identification of opportunities to increase energy efficiency.

3.2.5 Green building rating and energy performance labelling

(1) Programmes for new buildings

Results suggest that it is uncommon for a green building certification or rating scheme to be run by a city government. This is partly because in most cases, including those from the US, Australia, UK and Japan, comprehensive building certification systems are developed and managed by a national non-governmental organisation.

As an exception however, Tokyo Metropolitan Government has developed its own scheme, the Green Labelling Program for Condominiums, which started in 2005. The scheme consists of a simple star rating that covers areas such as thermal performance and use of renewables, and is based on information submitted under the Green Building Program. It is mandated that this rating is displayed on any advertisement upon sale or lease of the building. Some US cities, e.g. Portland, have developed their own green building ratings that were based on LEED (Leadership in Energy & Environmental Design) but adapted to local circumstances.

A popular way to promote the uptake of green building certifications and rating schemes is to utilise them as standards that must be met to qualify for financial or non-financial incentives. For example, to encourage the adoption of green building technologies and practices, Singapore provided cash incentives through its Green Mark Incentive Scheme for New Buildings (GMIS-NB) for projects that made efforts to achieve a Green Mark Gold rating or higher. To encourage higher standards such as Green Mark Gold^{Plus} and Platinum, additional gross floor area can be granted to developments that achieve these ratings as a bonus under the Green Mark Gross Floor Area Incentive Scheme (GM-GFA). BEAM Plus in Hong Kong also acts as a criteria for the city's Gross Floor Area Concessions. In Chicago, under the Green Permit Program, the City allows an expedited permit process and a reduction of permit fees for green buildings. In terms of criteria, commercial buildings require LEED certification, and for smaller residential buildings, either LEED for Homes or another certification developed by the city is needed.

Many city governments also use existing certifications as a requirement for municipal buildings or city-funded projects. Philadelphia has mandated LEED Silver or above for all new construction or major renovations of governmental buildings since 2009. Similar requirements are found in quite a few cities including Houston, Philadelphia, Portland and New York City. Many, like Portland, have even gradually strengthened the standards. Whilst Portland's first Green Building Resolution of 2001 required the 'Certified' level of the local Portland LEED Green Building Rating System for new construction and major retrofit projects by the city, in

2005 it was updated to mandate USGBC LEED Gold certification with specific additional requirements, and again in 2009 to require even stricter performance (also see examples of other requirements under Portland Green Building Resolution in existing buildings section below and **3.2.11 Government Leadership**).

Similar to green building rating and certifications, it is unusual for a city to develop its own energy performance labelling scheme. The reason appears to be that existing major labelling schemes, such as ENERGY STAR in the US, NABERS in Australia and Energy Performance Certificate (EPC) in the EU, operate nationally or regionally.

Tokyo appears to be unique in implementing its own labelling scheme, called the Energy Performance Certificate Program, aimed at new and large commercial buildings. The programme requires owners to issue an Energy Performance Certificate to potential buyers and tenants during the mandated period (from 21 days before commencement of construction to 180 days after completion). Although this programme relies on self-reporting, data is based on documentation submitted to the Tokyo Metropolitan Government under the Green Building Program. In addition, the Energy Performance Certificate itself must also be reported to the city government after the mandated period.

Another type of programme in this category is one utilises existing labelling schemes as a tool or standard. For example, the Melbourne Planning Scheme cites the NABERS rating as the standard for energy efficiency requirements. For new construction, alterations and additions, an office building larger than 2,000 m² must provide a statement from a qualified professional assuring that it has the preliminary design potential to achieve NABERS Energy 5 Stars or equivalent.

(2) Programmes for existing buildings

There were fewer cases where green building rating or certifications systems were applied to existing buildings. In Singapore, in addition to the Green Mark Scheme (which applies to existing buildings, existing office interior or existing data centres), the Existing Buildings Legislation requires compliance with the minimum Green Mark standard at the time of replacement or installation of a new cooling system. Under the Portland Green Building Resolution of 2009, all interior upgrade projects for city-owned or leased buildings must either obtain LEED Silver or higher certification from LEED for Commercial Interiors (CI), or follow the local Green Tenant Improvement Guide, and all city-owned existing buildings are required to be certified as LEED Silver or higher with LEED for Existing Buildings Operation and Maintenance

(EBOM). It should be noted that while many cities use green building certification as a requirement for the major renovation of governmental buildings, such measures are discussed under the 'new buildings' section in this analysis.

Cities have not typically developed energy performance labelling schemes for existing buildings, potentially because these labelling systems are often run by national level organisations. Tokyo Metropolitan Government, however, is an exception. As noted in **3.2.2**, the Carbon Report programme (for existing and small to medium sized commercial buildings) was introduced in June 2014 to label the actual energy performance using benchmarks created under the Carbon Reduction Reporting Program for Small and Medium Facilities. This unusual case of a city implementing its own labelling scheme can be explained by the fact that prior to the launch of the national 'Building Energy-efficiency Labeling System (BELS)' in April 2014, there were no such schemes in the Japanese market.

A few cases of using existing energy ratings as a standard for other programmes were documented in US cities. For example, the Green Building Resolution of Portland requires an Energy Star-rated roof or material for replacement works in city-owned existing buildings.

3.2.6 Financial incentives

(1) Programmes for new buildings

It is currently uncommon for the surveyed cities to use financial incentives to drive energy efficiency improvements in new buildings. At a national level, however, governments often offer financial incentives for new residential or non-residential buildings and innovative building technologies (see **3.2.4** regarding the Singaporean Green Mark Incentive Scheme for New Buildings as an example). One exception is in Toronto, where a refund of the 20% Development Charge is provided to new buildings that meet the comprehensive Tier 2 of the Toronto Green Standard. The standard covers not only energy efficiency but also other aspects such as site and water, requiring alignment with LEED for New Construction (NC) and supporting the city's argument that meeting the Toronto standard facilitates achievement of LEED Gold certification. The energy efficiency standard of Tier 2 is 25% higher than that required in the Ontario Building Code. Another example in this category is the Portland Energy Efficient Home Pilot (PEEHP). This grant was awarded to builders to cover the cost of two housing projects which substantially exceeded the state code. This pilot programme was started in order to identify the cost and feasibility of such housing projects, as well as providing builders with technical assistance to achieve the high performance standard.

(2) Programmes for existing buildings

In the case of existing buildings, many cities offer one or more financial incentives. For example, Retrofit Chicago Residential Partnership provides free energy efficient fixtures, such as programmable thermostats and showerheads, as well as rebates on larger appliances, like qualifying air conditioners, to homeowners while helping them identify trusted energy efficiency assessment contractors. In Stockholm, a Conversion Loan is available for property owners to replace oil-fired boilers and other equipment. The Singapore government offers financing for the purchase of energy efficiency equipment and renewable energy systems through its pilot Building Retrofit Energy Efficiency Financing Scheme. In Tokyo, tax incentives have been made available through the Energy Saving Promotion scheme targeting small to medium enterprises. These incentives exempt individuals and corporations from the enterprise tax when they introduce energy efficient equipment and renewable energy facilities. In some cases, cities focus on financial incentives for a certain type of building or certain parts of a building, as in the High-Rise Retrofit Improvement Support Program and Eco-Roof Incentive Program, for example, in Toronto. Innovative financial schemes are also being trialled in leading cities. These initiatives include the Energy Service Agreement in NYC, the PACE (Property Assessed Clean Energy) programme in San Francisco (i.e. GreenFinance SF) and Environmental Upgrade Finance in Melbourne and Sydney.

Additionally, national or state governments offer a wide variety of financial incentives, including tax incentives, grants and rebates. In many cases they ask local authorities to manage the schemes and distribute incentives to households and businesses.

Finally, partners such as utilities offer financial assistance to building owners. These incentives are sometimes offered in the form of mandated grants or rebates, as in the case of London (by Energy Company Obligation) and other US cities. For instance, Philadelphia Gas Works (PGW) and Philadelphia Electric Company (PECO) offer a wide variety of incentives to homeowners and businesses throughout the city for energy efficiency improvements.

Many city governments provide a list of the financial incentives available in their jurisdiction, including ones offered by partners or national or state governments, via their websites. In some cases, the city provides further assistance by advising the building owner on the relevant incentives, as part of major regulatory or voluntary programmes run by the city.

3.2.7 Non-financial incentives

(1) Programmes for new buildings

Expedited building permits are a common type of non-financial incentive offered by cities. Seattle delivers programmes such as Priority Green Expedited and Priority Green Facilitated, whereas San Francisco allows Priority Permitting to new developments with a formal commitment to achieve an advanced green building certification such as LEED Platinum. As mentioned earlier, the Green Permit Program in Chicago thoroughly incorporates green building practices into the permitting process. By applying for this programme at the beginning of the permitting process, developers are able to qualify for expedited processing and a reduction of permit fees.

Another form of non-financial incentive is an allowance for extra height or floor area for new buildings that meet a certain green building or energy efficiency standard. For example, in the case of Singapore, the Green Mark Gross Floor Area Incentive Scheme permits extra floor area for new buildings committed to achieving Gold^{Plus} or Platinum ratings for Green Mark. In the case of a Platinum rating, gross floor area allowances can be twice as high as in Gold^{Plus}. In Tokyo, an energy efficiency performance requirement was introduced as a prerequisite for four urban planning criteria, which include existing floor area ratio bonus schemes. Many large buildings in the city are eager to meet the standard and earn the valuable floor area bonus. Hong Kong employs BEAM Plus certifications as a criteria for granting a maximum of 10% Gross Floor Area Concessions (see also 3.2.5).

(2) Programmes for existing buildings

Non-financial incentives, which, as discussed, tend to offer expedited permitting or additional floor area bonuses, are less common for existing buildings. Nonetheless, the Green Mark Gross Floor Area Incentive Scheme in Singapore grants owners of existing buildings extra floor area in the event that “substantial energy efficiency (EE) enhancements” have been made to achieve a Gold^{Plus} or Platinum rating for Green Mark.

3.2.8 Awareness raising programmes

(1) Programmes for new buildings

Apart from making information on green buildings and energy efficiency available online, few cases of city-led public awareness raising programmes to support energy efficiency in new buildings were encountered. This may reflect the greater focus on operation and retrofit of existing buildings among the surveyed cities.

(2) Programmes for existing buildings

The most basic example in this category is the provision of web-based resources detailing ways to save energy in the course of building operation. For example, Stockholm offers online brochures on how to be 'climate smart' at the office and at home. US cities often provide a 'weatherization' programme¹⁸ mainly targeting low-income households. In Chicago, the Low-Cost Education and Weatherization Program offers residents training opportunities for low-cost weatherproofing techniques and a tool kit including weatherstripping (double edge seals for door and window openings), a caulk gun to seal small gaps, and Compact Fluorescent Light bulbs (CFLs).

Another way cities deliver advice and raise public awareness is via free or subsidised energy audits. For example, the Tokyo Metropolitan Government has been offering free audits for small and medium businesses since 2009. The Greenovate Challenge Programme in Singapore, a friendly competition amongst secondary schools, provides a free audit by ESCOs. Students are requested to work together with ESCOs to create action plans based on their audit result.

The Tokyo Metropolitan Government has also been offering energy efficiency textbooks for various sectors with small to medium sized businesses and free seminars based on the textbook. Since 2006, 28 textbooks for more than 20 business sectors, including hotels, cleaning businesses, public bathhouses and confectionary factories, have been made available online through the Tokyo Metropolitan Center for Climate Change Actions (known as Cool Net Tokyo). Industry associations can apply for the scheme so that Cool Net Tokyo analyses typical facilities and develops a comprehensive textbook focusing on energy saving measures for that sector.

3.2.9 Promoting green leases

(1) Programmes for new buildings

As a green lease contract is between owners and tenants for buildings in operation, no green leasing programmes were identified for new buildings.

(2) Programmes for existing buildings

Some cities endeavour to promote green leases to tackle the split incentive problems between building owners and tenants. In New York City, the Energy Aligned Clause was enacted in 2011 to initiate and disseminate model lease language for Green Leases between commercial

¹⁸ This refers to the implementation of low-cost improvements like adding weather stripping to doors and windows to eliminate air leaks and save energy.

owners and tenants. Most recently, the Building Construction Authority of Singapore published a Green Lease Toolkit for office and retail buildings, containing specific provisions for improving environmental performance. Other cities such as Sydney, Melbourne and London have released Green Lease Guides or Toolkits in cooperation with industry partners such as the Better Buildings Partnership as early as 2007.

3.2.10 Voluntary leadership programmes

(1) Programmes for new buildings

This category includes guidelines and flagship development projects from city governments. Guidelines in this sense are different from building energy codes in that they are promulgated on a voluntary basis, with the goal of showcasing exemplary ideas. For example, Johannesburg demonstrates leadership to its residents and the building industry with Design Guidelines for Energy Efficient Buildings, which are designed to guide energy efficient building practices in new government developments. Flagship development projects, such as the Stockholm Royal Seaport and the Melbourne Docklands, may also be observed in several cities. Such zones provide excellent opportunities for the City to try innovative policy measures such as stricter or more comprehensive codes, the implementation of new technologies, financial initiatives and knowledge sharing programmes.

(2) Programmes for existing buildings

Some cities endeavour to implement voluntary leadership programmes for energy efficiency efforts and/or retrofits in the commercial sector. For instance, the 1200 Buildings programme in Melbourne helps commercial building owners to understand the current performance of their buildings and to make improvements by offering advice and financial solutions (see a case study in **4.2**). Retrofit Chicago's Commercial Buildings Initiative asks for participating buildings to commit to start energy efficiency improvements within six months and to reduce energy consumption by at least 20% in five years. Houston launched the Green Office Challenge (also see a case study in **4.2**) to encourage owners, managers and tenants alike to better manage their energy and water use alongside other key topics such as waste and transport. The City holds an annual competition and provides training and resources to tenants and building owners. The Seattle 2030 district focuses on a downtown area to create "a groundbreaking high-performance building district" by engaging owners, managers and tenants of the medium to large existing buildings in the area. The City also supports this challenge by developing district energy, e.g. district heat recovery and distributed generation, to serve the buildings. Often these programmes are coupled with energy assessments or recommendations and advice on available financial incentives. Participants in these programmes are also expected to

serve as leaders and share their experience with the wider public.

3.2.11 Government leadership

(1) Programmes for new buildings

Almost all cities have shown a willingness to lead by example. In London, all new buildings for the Greater London Authority are required to meet the London Development Agency's Sustainable Design and Construction Standards or exceed targets in the London Plan. Also, as described in **3.2.5**, some cities aim to achieve green building certification when developing new governmental buildings. For example, the Singapore government has committed to obtaining Green Mark Platinum for new and existing public sector buildings that have undergone major retrofitting and with more than 5,000m² of air-conditioned floor area. In the same way, all new government buildings larger than 10,000 m² of gross floor area in Hong Kong¹⁹ are requested to pursue the second highest grade or above of locally or internationally recognised certifications such as BEAM Plus or LEED. Many US cities, including Houston, Philadelphia, Portland and New York City, require a certain level of LEED certification for all new municipal or government-funded development.

(2) Programmes for existing buildings

The most common government-leading-by-example programme for existing buildings involves the retrofitting of city-owned buildings. For example, the City of Johannesburg has identified opportunities for energy efficiency upgrades in 104 municipal buildings, with five of these already having undergone lighting upgrades and achieved significant reductions in GHG emissions. New York City has been promoting municipal GHG emissions reduction through its 30x17 programme (meaning 30% reduction by 2017). Although the focus of this programme is comprehensive and addresses other operations such as street lighting and waste management, it aims to foster retrofitting as a way of reducing a major portion of GHG emissions from municipal operations. To this end, the City utilises benchmarking results to identify target buildings and subsequently carry out audits to detect opportunities for reducing energy consumption at low or no cost. Also as described in **3.2.5**, Portland requires LEED CI certification (Silver or above) for tenant improvements in city-owned or leased buildings, in addition to pursuing LEED EBOM certification for city-owned existing buildings.

Other measures include policies mandating the disclosure of energy performance for government buildings. The Tokyo Metropolitan Government publicly discloses GHG emissions

¹⁹ In Hong Kong, new government buildings with floor area of more than 10,000 m² are also required to surpass the Building Energy Codes by, for instance, 10% for office buildings and 5% for schools and hospitals.

from as many as several thousand municipal facilities online, with New York City and Seattle also disclosing the energy performance of municipal buildings via its benchmarking scheme.

Additionally, governments are endeavouring to showcase innovative measures in sustainable building practices. For instance, the City of Chicago is leading the way by building a rooftop garden in City Hall. Another interesting example is the Municipal Entrepreneurial Testing Systems of New York City. This initiative provides opportunities for entrepreneurs to test new green building technologies in municipal buildings before they are released to the market. In this manner, New York is also hoping to attract new businesses and green jobs to the city.

3.2.12 Others

This category covers a wide variety of schemes that have grouped together in their own category because they were only recently developed, are rare, have a scope broader than the building scale, and/or represent more of a coordination role rather than active implementation role for cities. Examples of these initiatives include RE:CONNECT in London with the goal of setting 10 low carbon zones, and energy management schemes like those seen in Seattle and Tokyo. Promotion or utilisation of ESCOs is another type of programme, for example, by the 'Zero Initial Investment Cost Business Model for Energy Saving' in Tokyo. Other efforts include launching Better Buildings Partnerships in the city (in the case of Sydney, Toronto and London) and participating actively in national programmes, such as the City Energy Project in the US.

Reference List

Chicago

i) Addressed in this Chapter

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²⁰ Also see **Appendix 1** for web-based databases on building energy efficiency policies.

4. Experiences from frontrunner cities

4.1 Overview

This chapter presents detailed case studies from ten pioneering C40 cities that are implementing various programmes¹ to drive energy efficiency and sustainability in existing commercial and residential buildings. The cities are Hong Kong, Houston, Melbourne, New York City, Philadelphia, San Francisco, Seattle, Singapore, Sydney and Tokyo. The list of programmes surveyed appears in **Table 4.1**.

Each case study focuses on one key programme from each city and provides details on these specific elements:

- Programme context: key components of the programme and its relevance to local challenges, existing climate and building targets, and other initiatives.
- Inputs for the programme: the process by which it was designed and implemented including timeframes, resources, background research and stakeholder engagement.
- Programme results: impacts on the building retrofit market, GHG emissions, capacity building, etc.
- Lessons learned: success drivers and barriers encountered in the design and implementation phases.
- Reference list.

Section **4.2** contains the case studies and Section **4.3** offers an overall analysis of key characteristics and trends emerging throughout the individual case studies, extracting key lessons on common success factors and challenges.

¹ The term ‘programme’ is used to describe the overall ‘package’ consisting of various policies, laws, regulations, financial incentives or activities to drive energy efficiency and sustainability in a particular sector of buildings.

Table 4.1 List of programmes surveyed

City	Programme name	Policy elements from policy map (Chapter 3, Table 3.1)	Further explanation	Year took effect ²
Hong Kong	Buildings Energy Efficiency Ordinance	1. <i>Building Energy Codes</i> 3. <i>Mandatory Auditing and Retro-commissioning</i>	<i>Regulatory</i> • Energy efficiency codes • Auditing and retrofitting requirements	2012
Houston	Houston Green Office Challenge	10. <i>Voluntary Leadership Programmes</i>	<i>Voluntary</i> • Annual competition	2011
Melbourne	1200 Buildings	8. <i>Awareness Raising Programmes</i> 10. <i>Voluntary Leadership Programmes</i>	<i>Voluntary</i> • Advice and financial solutions	2010
New York City	Mandatory benchmarking scheme	2. <i>Reporting and Benchmarking of Energy Performance Data</i>	<i>Regulatory</i> • Benchmarking	2011
Philadelphia	Building Energy Benchmarking Ordinance	2. <i>Reporting and Benchmarking of Energy Performance Data</i>	<i>Regulatory</i> • Benchmarking	2013
San Francisco	Existing Commercial Buildings Energy Performance Ordinance	2. <i>Reporting and Benchmarking of Energy Performance Data</i> 3. <i>Mandatory Auditing and Retro-commissioning</i>	<i>Regulatory</i> • Benchmarking • Auditing and retro-commissioning requirements	2011
Singapore	Existing Buildings Legislation	1. <i>Building Energy Codes</i> 2. <i>Reporting and Benchmarking of Energy Performance Data</i> 3. <i>Mandatory Auditing and Retro-commissioning</i>	<i>Regulatory</i> • Benchmarking • Energy efficiency codes • Auditing and retrofitting requirements	2013
Seattle	Building Energy Benchmarking and Reporting	2. <i>Reporting and Benchmarking of Energy Performance Data</i>	<i>Regulatory</i> • Benchmarking	2012
Sydney	Smart Green Apartments	8. <i>Awareness Raising Programmes</i> 10. <i>Voluntary Leadership Programmes</i>	<i>Voluntary</i> • Pilot programme • Free audit and information on rebates	2011
Tokyo	Tokyo Cap-and-Trade	4. <i>Emissions Trading Schemes</i>	<i>Regulatory</i> • Mandatory emissions reductions (or trading)	2010

² This refers to the year the programme came into effect and not the year of adoption (i.e. for ordinances).

4.2 Case Studies

The ten case studies outlined in **Table 4.1** are presented in alphabetical order as follows:

- 4.2.1 HONG KONG – *Buildings Energy Efficiency Ordinance (BEEO)*
- 4.2.2 HOUSTON – *Houston Green Office Challenge (HGOC)*
- 4.2.3 MELBOURNE – *1200 Buildings programme*
- 4.2.4 NEW YORK CITY – *Mandatory benchmarking scheme
in the Greener, Greater Buildings Plan*
- 4.2.5 PHILADELPHIA – *Building Energy Benchmarking Ordinance*
- 4.2.6 SAN FRANCISCO – *Existing Commercial Buildings Energy Performance Ordinance*
- 4.2.7 SEATTLE – *The Seattle Building Energy Benchmarking and Reporting Program*
- 4.2.8 SINGAPORE – *Existing Buildings Legislation*
- 4.2.9 SYDNEY – *Smart Green Apartments programme*
- 4.2.10 TOKYO – *Tokyo Cap-and-Trade Program*

4.2.1

HONG KONG – *Buildings Energy Efficiency Ordinance (BEEO)*

Abstract: The Buildings Energy Efficiency Ordinance of Hong Kong acts as an effective and legislative means to improve the energy efficiency of buildings. As a side benefit, it also helps to tackle the split-incentive problem in the market for building energy improvement works.

Citywide reduction target

Hong Kong supports the APEC's aspirational and yet ambitious target of reducing aggregate energy intensity by 45% by 2035 from 2005 levels.

Building-specific reduction target

Not specified.

I. Programme context

Key elements

The Buildings Energy Efficiency Ordinance (BEEO) covers new construction and major retrofits of existing commercial buildings. It seeks to drive energy efficiency through stringent codes of practice and energy audits. Registered Energy Assessors play an essential role in executing the ordinance by certifying compliance of building service design and conducting energy audits. The law was officially unveiled in December 2010 and fully implemented in September 2012 to enforce building energy efficiency as part of wider mitigation measures for climate change.

The BEEO consists of the following three central elements outlined below (see also **Figure 4.2.1**).

1. **Building Energy Code (BEC):** New construction and existing buildings undergoing major retrofits are required to comply with BEC minimum standards and requirements for four key building service installations: air-conditioning, electrical, lift and escalators and lighting (henceforth referred to as 'service installations').
2. **Energy Audit Code (EAC):** An energy audit must be conducted every ten years in accord with the EAC in regard to the above four key building service installations in commercial buildings and in commercial components of composite buildings such as shopping centres. Display of the energy audit report is then required for that building.
3. **Registered Energy Assessors (REA):** Certified REAs are required to process the BEC certification and energy audit works required under the ordinance. The Building Energy Efficiency Registered Energy Assessors Regulation (REA Regulation) specifies the detail of the registration and regulation of REA.

Enforcement

In cases of non-compliance, the Electrical and Mechanical Services Department (EMSD) will issue an improvement notice to the relevant building owner or person responsible. Details of non-compliant buildings are published on the webpage of the BEEO and are only removed following compliance. An offender is liable to fines ranging from HK\$ 2,000 to HK\$ 1 million, depending on

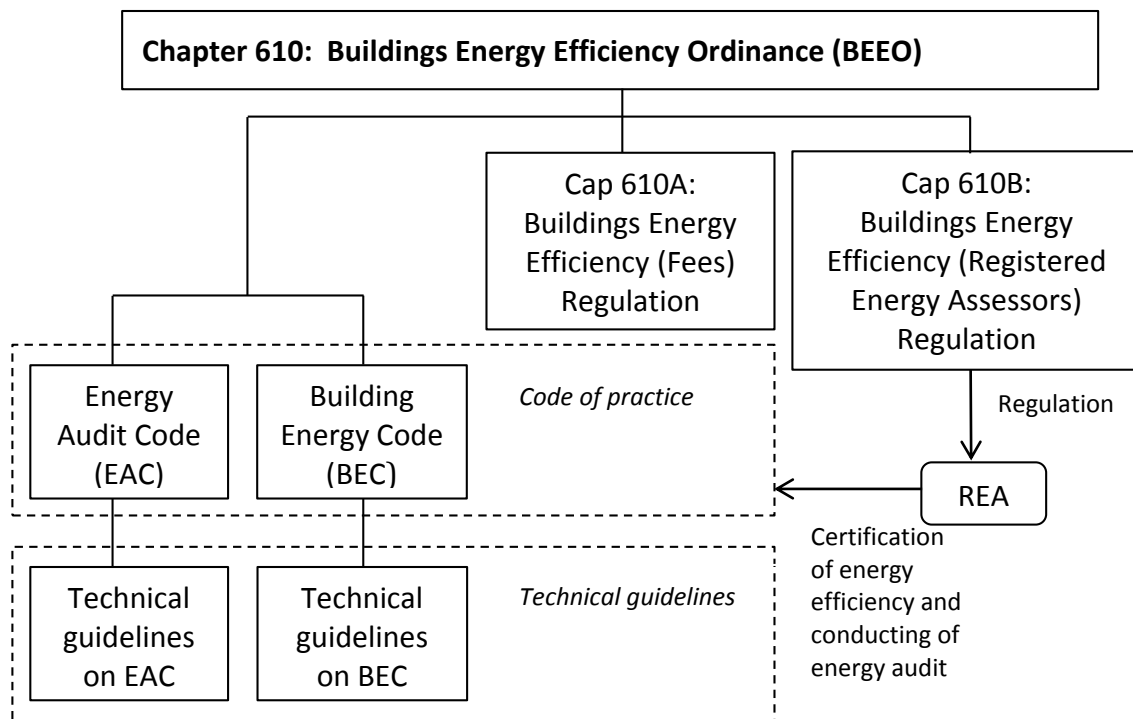
the offence committed. If any person provides false information or obstructs enforcement, they are liable for a fine and imprisonment.

Programme target and scope

The BEC component of the BEEO covers most public and private commercial buildings in Hong Kong. In addition to offices, this includes, for example, hotels, government, municipality, educational and transport related buildings, in addition to commercial portions shared with industrial and residential buildings. The EAC component focuses on the four central service installations of commercial buildings and the commercial portion of composite buildings.

The BEEO covers both new and existing buildings. New buildings are those having obtained consent for the commencement of building works for superstructure construction from the Building Authority after 21 September 2012 (i.e. after commencement of the BEEO). Existing buildings are those whose permits were obtained prior to this.

The major retrofitting works covered by the BEC are those involving addition or replacement of a services installation covering a total floor area of 500 m² or more. The BEEO also targets the addition or replacement of a main component of a services installation. This may include addition or replacement of a complete electrical circuit at a rating of 400A or above; a unitary air-conditioner or air-conditioning chiller of a cooling or heating rating at or exceeding 350 kW; or the motor drive and mechanical drive of a lift, an escalator or passenger conveyor.



(Adapted from EMSD Symposium 2011)

Figure 4.2.1 The structure of Buildings Energy Efficiency Ordinance (BEEO)

Small to medium sized buildings

The BEEO does not apply to smaller and historical buildings. More precisely, exempted historical buildings and smaller buildings refer to those with an electrical loading below 100A, less than three storeys, with a roofed-over area not more than 65.03 m², or a height inferior to 8.23 metres. Most of the small and medium buildings in Hong Kong are individual bungalow buildings between two and three storeys, with less than 70 m² per floor. Small buildings are not covered by the BEEO as their retrofitting is not justified in terms of cost efficiency. For these reasons, there are no present or planned initiatives for energy efficiency in such buildings.

Overall goals of the programme

The BEEO was enacted to enable the promotion of building energy efficiency under a regulatory framework. The requirement to carry out an energy audit was also designed to facilitate behaviour change in energy consumption. For the first decade of implementation it is estimated that the BEEO will lead to energy savings in the vicinity of 2.8 billion kWh for new buildings. As for reductions in CO₂ emissions, this is projected to attain 1.96 million tonnes within the first ten years of implementation.

Links to other City policies or programmes

During official policy addresses in 2008-09 and 2009-10, the Chief Executive of the Government of the Hong Kong Special Administrative Region announced the intentions of the Hong Kong government to promote a low carbon economy. The BEEO was legislated as a major government measure for achieving this goal.

II. Inputs for the programme

Inputs during the design and implementation phases

Staff resources for developing the BEEO consisted of a team of five administrative officers and professional engineers from the Environment Bureau (ENB) and the EMSD. Development took approximately five years from detailed inception to full implementation. Before the drafting of the ordinance, an external consultant was engaged to study overseas building energy efficiency practices. In addition, a technical committee of representatives from some 30 professional institutions, trade associations, universities and government departments, as well as a trade taskforce with representatives from approximately ten trade bodies, was formed to provide input on the ordinance's drafting. A public consultation was also conducted to solicit views from the public and various stakeholders before legislation.

As the BEEO is a regulation, there is no overall budget allocated for its development or implementation.

III. Programme results

Compliance rate

With the BEEO still in the early stages of implementation, no compliance rate has yet been established. At the beginning of implementation, a six months grace period was given to building owners to encourage higher compliance levels. The main focus of the BEEO at this stage is the prosecution and investigation of any non-compliance.



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Progress and evaluation

Data collected so far is insufficient for a significant assessment of progress by the BEEO towards national climate targets. This is principally because it only commenced in September 2012. Also, the collection of building energy performance data for benchmarking was not the purpose of the BEEO and there is no separate provision to mandate building owners to report such data. That said, data on energy consumption in the Hong Kong building sector is currently being accumulated from three various sources for future analysis, creation of baselines and possible utility for benchmarking.

The first source is the energy audit report mandated by the EAC. This document requires detailed information on the four key services installations. A second source of energy data is design stage data from buildings adhering to the BEC. A third source of energy performance data comes from a comprehensive energy use survey called the Hong Kong Energy End-use Data (HKEEUD). Not officially part of the BEEO, this survey is managed by the EMSD and is sent to companies to study energy consumption from various sectors including the building sector. The survey result is open to the public and provides consumption data of the different energy fuel types and the specific purposes for which these fuels are consumed (e.g. space-conditioning, lighting and cooking etc). The data provides a better understanding of energy consumption, and increases public awareness. The Hong Kong SAR Government also uses the information to formulate and evaluate its energy policies.

Regarding the accuracy and reliability of data acquired for the BEEO (design and energy audit data), this responsibility belongs to the REAs who are professionals and engineers. On the other hand, for the HKEEUD this relies on the quality of the information obtained in the survey. Meanwhile, there are provisions under the BEEO to regulate the qualification, knowledge, experience and other requirements for the registration of REAs.

Programme effects on retrofit market

The main purpose of the BEEO is to improve energy efficiency of buildings in Hong Kong. As such, it was not intended to drive market demand for retrofitting, although this has occurred indirectly to some extent. Two main impacts can be observed from the programme.

1. Overcoming split-incentives between building owners and tenants

The split-incentive problem between building owners and tenants has long existed in the real estate market of Hong Kong. It occurs where both the building owner and tenant are reluctant to make a large initial investment to improve building energy efficiency. This is because, on one hand, any outlay from the owner only results in long-term cost-savings on energy bills for the tenants. On the other hand, any investment from the tenant only results in improvements to a property they do not own. Before enactment of the BEEO legislation, this split-incentive dilemma was predicted to continue, with green leases and green premiums uncommon. The BEEO has overcome this problem to a large degree by mandating building owners to improve their buildings, thus freeing tenants from the responsibility of sharing the cost of retrofit works.

2. Increasing community expectations towards building energy efficiency

The BEEO sets minimum requirements for energy efficiency in four key building service installations. Initially, this is expected to foster the emergence of a new trend of increased energy efficiency in the building market. Then, with the regulatory nature of BEEO turning this trend into a norm, it is expected that the market will then demand buildings satisfying a minimum standard of energy efficiency.

IV Lessons learned for replication

IV-i Key drivers of success

Stakeholder engagement

During the design phase, the BEEO team consulted with building stakeholders such as developers, owners, tenants, property management companies, institutions, professionals and trade associations on design aspects. This enabled them to obtain feedback concerning ordinance requirements before drafting of the law was finalised. The involvement of as many stakeholders as possible was of crucial importance as stakeholders felt that they were involved and that their views would be adequately incorporated in the drafting of the final ordinance. The BEEO team understood that this engagement process might not be sufficient to collect all viewpoints and interests of the community. Therefore, the BEEO team has also met and obtained feedback from various stakeholders after implementation of the ordinance. This was driven by their awareness that, being a law requiring action from the building industry, the only way to ensure effective implementation would be to obtain the support of relevant stakeholders.

Not all stakeholders have the expertise to understand the requirement details of the BEEO. Promotion and promulgation efforts are required to foster community understanding and compliance. The BEEO team held more than 100 talks with the public and building industry representatives such as the Hong Kong Institution of Engineers and trade associations of various building services such as air-conditioning, electrical installation, and lift and escalator.

Concerted effort from the building trade

There are more than 40,000 existing buildings in Hong Kong, with this stock projected to increase at approximately 200 every year. It therefore requires substantial manpower to reach out to these building owners, which is not always possible with the existing resources of the BEEO enforcement team. The reliance on REAs to certify the energy efficiency of buildings and to conduct energy audits has been one of the solutions to deal with this shortfall. REAs are not necessarily third parties and may be direct staff of the developers, building owners or business tenants. Submissions from such REAs therefore function as a type of self-reporting mechanism. The BEEO team has also collaborated with other government agencies for assistance in implementation. For information about building's owners and the occupation permit of buildings, they have worked closely with The Land Registry and the Buildings Department of the HKSAR Government.

It has proven relatively easy for the BEEO enforcement team to reach out to new buildings by working with agencies managing various permits or licenses required previous to commencement of construction works. Conversely however, reaching out to existing buildings and tracking their records of energy audits or major renovation activities is difficult. As submission of energy audits is required by law, tracking of this compliance is relatively easier than monitoring the reporting of major renovation activities—a process relying on the involvement of REAs. Whenever non-compliance is identified, officers are sent out for investigation.

IV-ii Main challenges

Community resistance due to split-incentive problem

As mentioned in the previous section, the split-incentive problem has long constituted a huge hurdle to the improvement of building energy efficiency in Hong Kong. While building owners are mandated to take concrete actions to improve building energy efficiency since the BEEO has come into force, this has not been without community resistance, particularly from building owners. This resistance has usually manifested in the form of non-compliance with BEEO requirements. It therefore appears that although the BEEO has been enforced to upgrade building energy efficiency at the time of a major retrofit, several cases of non-compliance are indicating that it has not completely resolved the zero-sum issue of the split-incentive dilemma between building owners and tenants.

One of the measures taken to deal with such resistance is the introduction of the Buildings Energy Efficiency Funding Scheme (BEEFS, from April 2009 to April 2012). Under the BEEFS, HK\$ 450 million was allocated to subsidise building owners to conduct energy-cum-carbon audits (ECAs) and to carry out energy efficiency improvement works. Consequently, the BEEFS has largely contributed to the enhancement of community awareness in building energy efficiency. It has also aided mobilisation of property owners and managers to take concrete actions to reduce carbon emissions and increase the energy performance of their properties. Key outcomes include:

- Subsidisation of more than 6400 buildings (about 1/7 of total in Hong Kong)
- Stimulation of building retrofit market: from simple measures such as replacement of lightings to large-scale retrofits or replacement involving air-conditioners, lifts and escalators

- Fostering of cross-sector cooperation between property managers and engineers through opportunities presented by a low-carbon economy
- Over 20 training courses on energy and carbon audits have been offered for about 1,200 people by various training institutes and organisations
- Estimated savings by the approved projects equating to around 180 million kWh/year or 126,000 tonnes of CO₂

Publicity and human resource restraints

A key challenge remaining largely unsolved is the large amount of regulatory actions needed for effective enforcement of the BEEO. This barrier is even more significant when compounded with other challenges. These include the necessary publicity to facilitate compliance through education and outreach to various organisations and individuals, and existing manpower limitations for dealing with the large amount of building owners.

In addition, challenges encountered during enforcement of the ordinance include the prosecution and investigation of cases of non-compliance. This is because this ordinance is the first in Hong Kong directly regulating the energy efficiency of electrical and mechanical installations in buildings. Implementation of this legislation therefore represents a learning experience for both the community and the enforcement team.

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4.2.2

HOUSTON – *Houston Green Office Challenge (HGOC)*

Abstract: Instead of relying on the power of legislation, the voluntary Houston Green Office Challenge seeks to advance a holistic pursuit of office and building sustainability in energy and water consumption and waste. It also addresses employee behaviour such as modes of transport and engagement to green office practices.

Citywide reduction target

Not specified.

Building-specific reduction target

The City is participating as a community partner in the US Department of Energy's Better Buildings Challenge. It has a goal of engaging the community to lower energy consumption in 30 million square feet of buildings (including 7 million of City-owned buildings) by a minimum of 20% by 2020, from 2008 levels. In addition, the City is aiming to attain the highest number of ENERGY STAR and LEED-certified buildings in the US.

I. Programme context

Overview

The Houston Green Office Challenge (HGOC) is an annual, voluntary challenge initiated in the Autumn of 2010, officially beginning in January 2011. It consisted of a partnership between the Mayor's Office of Sustainability in Houston, ICLEI-Local Governments for Sustainability and the Clinton Climate Initiative.

This initiative seeks to engage commercial property managers, building owners and office tenants in a friendly, voluntary competition that guides participants towards sustainability and greener building management whilst recognising outstanding achievement. The areas targeted by the programme are: energy and water consumption, waste outputs, transportation, building management/tenant engagement and employee outreach. At present, the programme has mobilised 375 buildings and tenants—representative of approximately 75 million square feet (sq ft)—who disclose data and information to the City of Houston for appraisal. At the end of the first year, high achievements were acknowledged through awards, attracting high-levels of press and media attention and official mayoral recognition.

Key elements

This programme welcomes participation from both tenants and property managers/building owners, with differing tools and evaluation schemes employed for each. On one hand, property managers/building owners use the EPA's ENERGY STAR Portfolio Manager and ICLEI's Green Business Challenge reporting platform. Metrics evaluated by the combination of these two tools include energy and water consumption, waste, as well as tenant engagement. On the other hand, tenants are directed to monitor progress only through a specially developed Green Office Challenge Tenant Scorecard on ICLEI's Green Business Challenge platform. This facilitates the evaluation of green office strategies taken to influence employee behaviour in the areas of:

energy use, waste, transportation choices and outreach. This scorecard creates a baseline score and suggests various measures that can be taken to improve this performance. Scores are organised into four tiers of achievement: Tier 1-Platinum (76-100 points), Tier 2-Gold (51-75 points), Tier 3-Silver (26-50 points) and Tier 4-Bronze (15-25 points). With these areas of interest, the programme is focused equally on physical building performance as much as behavioural changes and work place policies pertaining to employee work and lifestyles. From this perspective, the programme should be understood as being more about the holistic pursuit of sustainability than mere energy efficiency.

Another key element of HGOC is a series of educational opportunities from the City to guide participants to improve their environmental performance in the above areas. These include the provision of free training and educational seminars, workshops and webinars for decreasing office energy and water consumption and fostering environmental behavioural changes in tenants and employees. Other support measures consist of easily implementable strategies for improving building and office sustainability, assistance in setting up Portfolio Manager accounts, referrals to free energy audits from HGOC sponsors, and lastly, financial incentives for energy efficiency retrofits from the City and local energy utilities.

Outstanding performance in the programme is recognised through an awards ceremony hosted by the Mayor and the City of Houston, in conjunction with coverage from the media.



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Overall goal of the programme

The overall objective of HGOC is to engage the private sector to reduce energy and water usage and increase waste diversion by fostering leadership from commercial building managers and office tenants in regard to environmental performance and sustainability. Specific goals of the programme are to: i) foster green building practices by providing sustainability knowledge and tools, educational opportunities and funding for building owners, property managers and tenants and ii) contribute to ambitions to attain the highest number of ENERGY STAR and LEED certified buildings in the nation. Through such objectives, the City is seeking to change its image from just an oil- and gas-centric economy to one where energy diversity is celebrated and renewables and efficiency are embraced.

Programme target and scope

HGOC targets building owners, property managers and tenants. All building tenants or property managers located within the city limits are eligible to participate. The focus on commercial buildings comes from the awareness that it is this sector making the most significant contribution to community-wide GHG emissions. For the upcoming 2014 Challenge year, considerations are being made to focus explicitly on Class A, with a special emphasis also on Class B and C commercial properties, for which there is no operative definition:

- Class A:
Large and centrally-located, premium office buildings. Usually with more than 500,000 m² of total flooring and a super hard finish on ground floor, which typically has a clear height of more than 30 feet.
- Class B:
Smaller buildings, typically around 10-15 years old. Usually located closer to the suburbs.
- Class C:
Lower market range of buildings, typically located in suburbs. Includes strip malls and light industrial buildings less than 50,000 m².

II. Inputs for the programme

Inputs for the design phase

Overall, design and development of the HGOC spanned from between three to six months and involved two to three FTEs. The programme received sponsorship to the amount of US\$ 210,000 from 12 companies and in-kind sponsorship amounting to approximately US \$35,000 from three others. Except for the allocation of staff hours, no funds from the City were contributed.

During development, Houston officials were able to draw upon the experiences of several other US cities previously incorporating an ICLEI model for a green office challenge. In particular, the City of Chicago proved a valuable point of reference. Outside of the US, Houston officials also gained valuable knowledge regarding case studies and potential bottlenecks from the City of London. A key lesson gained from these other cities was that top-down approaches with programmes designed single-handedly and without stakeholder engagement tend to prove less successful.

Inputs for the implementation phase

Resources allocated for implementation of the programme include one FTE and an additional \$5,000 for a marketing and communications budget. At the end of the first challenge year, two staff were involved with data analysis.

Engagement with stakeholders was central to the strategy of designing the programme in a way best reflecting participant needs and interest areas. This took place through several meetings aiming to gather feedback for the proposed challenge, gain support and encourage participation. Some of the various stakeholders involved include private sponsors such as the utility, Shell, Siemens and other corporations, NPOS, professional associations such as local chapter of the US Green Building Council and other government agencies.

Various forms of input were also procured from many of the financial sponsors and supporting partners for the programme. Contributions included assistance with outreach by local NPOs, the provision of free energy audits by Siemens, information sessions by CenterPoint Energy on incentive programmes available and the free collection and recycling of e-waste. In addition, a broad coalition of stakeholders from industry, government and civic societies also assisted with recruitment of participation on both the building and tenant level.

In May 2014, the City succeeded in winning a US \$20,000 award from ICLEI USA and its national programme sponsor Office Depot. The support is called the Green Business Challenge Implementation Pack valued at \$20,000, which includes in-kind contributions, software, and technical assistance and guidance. The funding also requires the City to facilitate three relating events (e.g. a local programme launch, training sessions and an award ceremony) and enhanced website for the programme.

Key metrics and reporting platform of energy data collection

Key metrics used in the data collection for property managers and building owners were electricity, natural gas and water consumption figures, and the amount of waste and recycling. This data was collected in ICLEI's Green Business Challenge platform and EPA's ENERGY STAR Portfolio Manager. In contrast, tenants are not required to directly report energy data. Instead, they provide information relating to a certain policy or initiative launched in their office during the reporting year. This information is also reported through ICLEI's Green Business Challenge platform.

III. Programme results

For the first Challenge year, the programme has mobilised a total of 375 buildings and tenants, which together accounts for approximately 75 million sq ft of building flooring space. As for sustainability impacts, City officials have reported the following:

- Reductions in energy consumption by 28 million kilowatt hours
- Reductions in water consumption by 280 million litres

- 90% of participating tenants recycled in the office, achieving a 40% diversion from the landfill

In addition, during the same period well in excess of half the participants adopted various sustainability measures such as flextime and telecommuting policies, bicycle parking and policies to reduce paper consumption.

Programme effects on retrofit market

City officials report that the programme is playing a role in stimulating the retrofit market. This said, other factors must be considered as core drivers of the transformative activities taking place in the Houston building sector. For example, there has been a recent and dramatic increase in the amount of LEED certified existing buildings. As an indicator, over 8.5 million m² have been certified over the last two years. Currently, Houston has the fifth highest amount of LEED buildings in the US and is ranked tenth in terms of ENERGY STAR Buildings. One of the drivers of this market shift has been the realisation that non-LEED certified buildings are becoming less competitive in the market place. As part of this increase in LEED-certification for existing buildings, retrofitting activities have naturally expanded. In the context of this greater market transformation, HGOC has contributed to an increase in LEED and ENERGY STAR certified buildings. This is largely by demonstrating that smaller Class B and C buildings can obtain LEED or Energy Star status.

Another key outcome of the programme is knowledge sharing amongst participants, who otherwise, may not have had the opportunity to share success stories with other building or business owners. The City believes that this information sharing is assisting the implementation of retrofitting activities and achievement of higher energy efficiency in the network. Also of note, not all success stories are from Class A buildings as many have come from smaller Class B or C types.

IV. Lessons learned for replication

IV-i Key drivers of success

Stakeholder engagement

The City demonstrated a strong willingness to listen to those segments of the building sector it wished to target, incorporate their concerns and desires, and ensure a large degree of flexibility for the design of the programme. Of importance was a strong engagement with building tenants, in addition to building owners and managers. This period of stakeholder consultation also allowed the identification of non-critical areas, which were later discarded from the focus of the programme.

This early stakeholder engagement meant that the City had achieved a strong network of advocates for the programme when it was launched. Officials also sought to capitalise the Houston spirit of preferring market-based solutions as opposed to policy mandates.

Engagement of tenants in addition to building owners and managers

With half of programme participants being tenants, another key attribute and driver is the resolve to create opportunities for tenant involvement. Efforts to spur tenant engagement have included, for example, education sessions and networking events where participants share

experiences on how green office practices were implemented. In the second year, an environmental behaviour change workshop was organised for HGOC participants. As an additional measure, the property managers and owners category also includes a section on tenant engagement, in addition to energy use, waste and water.

Holistic focus on sustainability as opposed to energy efficiency per se

A defining characteristic of the HGOC programme is a holistic pursuit of sustainability (inclusive of social and lifestyle dimensions) as opposed to a narrow focus on energy efficiency. This can be observed from its simultaneous targeting of building owners/managers and tenants, as well as the inclusion of indicators pertaining to transport policy, waste and recycling, outreach and employee behavioural changes. The design of this broader approach to building sustainability is also a result of the above stakeholder consultation process. Through such comprehensiveness, the programme has been able to maximise overall sustainability impacts in the commercial building sector by allowing a wider range of approaches to green office practices than a programme focused purely on energy efficiency.

Targeting diverse building types and expertise levels

A diversity of buildings and sustainability expertise has proved a key driver for increasing the impacts of the programme. As already mentioned, by targeting class A, B and C buildings, HGOC was designed to address a highly diverse array of building performance. Some segments of this population were already frontrunners and examples of best practices that had emerged from significant investments being made previously by building owners. Consultations with stakeholders during the design phase revealed that a programme focused upon energy performance against a base year for the physical building alone would risk losing the participation of many building owners unable to make necessary investments for retrofitting. At the same time, it would also potentially lose the participation of frontrunner buildings and models of best practice, who had already attained a high level of energy efficiency. To overcome these potential limitations, the programme was designed to target a broad range of sustainability areas, in addition to energy efficiency, that would be of relevance to a diverse array of building types and expertise levels.

The City Mayor as a 'marketing tool'

Another tactic employed was the use of the City Mayor as the official recogniser of excellence at the awards ceremony. Awards were handed out by the Mayor, who posed for photographs with the winners at the official ceremony. The prospect of being directly recognised by the City Mayor was in a sense used as a marketing tool and communicated to all participants during implementation. This demonstrated that the programme had top-level support from the City. The prospect of receiving formal recognition from the Mayor served as a major boost to competition and participation levels.

Communication and relationship building

Much of the success achieved by the programme has been attributed to relationship building and constant communication with participants via channels such as email, telephone and face-to-face meetings. Although this was challenging for the office when considering the limited staff available and the large participant base, stakeholder engagement in the early stages of programme design served to lay the foundations for the forging of strong relationships with various participants.

Recruiting of key staff

Success of the programme has also been attributed to the securing of staff whose competencies were aligned with the goals and activities of the programme. For example, strong communication skills and a background in green building practices by core staff members have proved critical in winning support and participation of stakeholders. Consequently, City officials have made efforts to employ knowledgeable staff with effective and outgoing communication skills to assist with engagement activities.

IV-ii Main challenges

Communication

While constant communication with the participants was cited as a key driver, there were several cases where the City was not able to build close relationships with participants due to staff and time restraints. This inability to devote more staff and resources for outreach proved a challenge during the latter stages of data reporting.

Data verification

A major limitation of HGOC is the incapacity of the City to clean or verify data submitted to the ENERGY STAR Portfolio Manager and ICLEI Green Business Challenge reporting platform. Only in those cases where data was found to be inaccurate (e.g. different energy units were chosen) were participants contacted and instructed to select the correct units by the two staff allocated to the role of analysing responses.

Financial incentives

In order to boost participation, the City initially attempted to establish an incentive scheme (also involving subsidised loans) through the Energy Efficiency Incentive Program. This provided up to 20% of capital costs (labour and materials) for energy upgrades meeting certain criteria. However this programme met with limited success. This was principally due to the short-term availability of the funds and a highly complex and time-consuming application process, due to utilisation of federal grant funding. In addition, the stipulation of strict conditions regarding retrofitting caused, in many cases, additional costs for the applicant and nullified the benefits of the programme (e.g. use of independent energy contractors and adherence to union wage conditions). Incidentally, the fixing of such rigid conditions came from the donor of the funding incentive.

Despite such complications, some building owners were able to successfully utilise the Energy Efficiency Incentive Program. However for the majority, the greatest incentive and driver of engagement was the prospect of receiving good publicity and being recognised as a top-performer by the Mayor and peers in the industry. This was particularly so for large and centrally located buildings (i.e. class A) competing for tenants in the market place.

Regarding potential lessons for future financial incentive programmes, an essential component would be the securing of a long-term funding base. As the case of Houston has shown, short-term funding incentives, which quickly expire, are not highly effective. Long-term funding would be particularly important in securing the participation of many public sector buildings and higher education institutions with long-term horizons and planning protocols. Another potential solution would be a revolving fund with firm stipulations regarding the time period for financing and a competitive interest rate. Projects would also need to involve a certified energy engineer and involve a simple repayment plan (i.e. once per year as opposed to once per month) as this

would cut administrative costs for both parties. There would also have to be some sort of reserve for bad debt as repayments would be potentially affected by bankruptcies from some building owners.

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4.2.3

MELBOURNE – 1200 Buildings programme

Abstract: The 1200 Buildings programme aims to catalyse the retrofit of 1200 commercial buildings by helping owners assess current environmental performance, recommending improvements and providing innovative financing solutions to deliver results

Citywide reduction target

The City of Melbourne has a highly ambitious strategy, *Zero Net Emissions by 2020*, to attain climate neutrality by the year 2020, as articulated in a 2014 update.

Building-specific reduction target

The 1200 Buildings programme aims to increase the energy efficiency of 1200 existing commercial buildings by 38% by 2020. This equates to an estimated reduction of 383,000 tonnes of CO₂ per year. Also, the City has an interim target to achieve an average four-star National Australian Built Environmental Rating System (NABERS) rating of existing commercial buildings by 2015.

I. Programme context

Key elements and overview

The 1200 Buildings programme was launched in 2010 as a ten-year strategy to trigger dramatic improvements in energy and water consumption of 1200 commercial properties in Melbourne, as well as reduce waste to landfill. It is a core strategy to decarbonise the building sector. This voluntary programme was also conceived to hasten Melbourne's transition to a green economy by creating employment and business opportunities through driving demand for environmentally efficient buildings.

The programme contains a range of elements designed to:

- educate owners and managers on the benefits of energy efficient buildings
- develop industry capacity to retrofit buildings and to monitor building environmental performance
- provide attractive and easily accessible finance options
- enable knowledge sharing and showcasing of best practices and new technologies

The programme seeks to showcase leadership and catalyse behaviour change. Building owners are offered different opportunities to participate depending on their level of commitment, capacity and need for promotion. Research undertaken early in the programme's development identified two key ownership segments and influenced the development of two key engagement approaches:

1. Leadership group – institutional building owners

A number of corporate building owners participated in an earlier programme, the Building Improvement Partnership, and have since developed sophisticated approaches to retrofitting their assets. These owners have joined to take advantage of the

opportunity to profile the superior performance of their building and display good corporate social responsibility. Leadership services are developed with these building owners and are available depending on the capacity of staff and resources available. Services include: precinct or energy grid projects, waste solutions, arts commissions that catalyse behaviour change, climate adaptation, staff training, building campaigns, specialised finance projects (Environmental Upgrade Agreements – EUAs) and joint advocacy projects.

2. Under-performing buildings —the ‘mid-tier’

The programme focuses mostly on this group. The majority of buildings owned by the private segment have a moderate to extensive capacity to improve their energy efficiency performance. The owners of these buildings generally have low levels of awareness on the benefits of retrofitting and motivation to improve their buildings efficiency. Base services offered to these owners include: access to resources, facility management training, facilitating access to funding, tenant assessments, base building assessments, tools to assist interaction between building owners and tenants, precinct campaigns, awards, reporting, promotion and support through education partnerships.

Overall goals of the program

The specific target of the programme is to contribute to the City’s goal of climate neutrality by raising the energy efficiency of 1200 buildings by 38%. With the commercial sector currently responsible for emitting just over half of citywide GHG emissions, it is expected that a 38% increase in efficiency by 2020 for the commercial building sector will lead to an overall reduction of 383,000 tonnes of CO₂ per year.

Other related goals of the programme are to:

- Heavily reduce water consumption
- Drive local economic development by increasing demand for green products and services
- Achieve healthier buildings for both tenants and the city by decreasing heat and pollution inside and outside buildings

Programme target and scope

The programme is principally aimed at engaging the owners and property/facilities managers of existing commercial buildings with office space. Yet other building types such as hotels, universities, light manufacturing and recreation facilities are also included. *Office* buildings are defined as containing 70-100% of floor space for office use. *Mixed use buildings* contain 1-69% office space and are characterised by a combination of office use and parking, retail and/or residential use.

The *Zero Net Emissions by 2020 – 2008 Update* strategy established that 1200 commercial buildings accounted for a total floor area of 5.6 million m². By fostering retrofits in 1200 properties, the programme is in effect targeting approximately two thirds of the commercial building stock containing office space in the city.

Whilst the 1200 Buildings Program itself is operated citywide, the incentives offered through the programme are targeted to certain ownership groups within a specific area of the city as a result of market research.



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Private owners: 'The mid-tier'

There are relatively few, large-scale office buildings and skyscrapers in Melbourne's central business district compared to megacities. A large portion of commercial buildings are 'mid-tier' defined as B, C or D by the Property Council of Australia. This grading system takes into consideration a diverse range of indicators such as building size, design, location, environmental performance, security and building installations such as lifts, air-conditioning and other amenities. This means that the majority of the 1200 buildings targeted by the programme are smaller to medium size property owners. Such owners are very often individual investors, families or small businesses.

Innovative funding mechanisms

A key component of the 1200 Buildings programme involves financing packages designed to overcome the hurdle of owners lacking credit to finance retrofitting. The Environmental Upgrade Finance is a flagship product developed for the programme and administered by the Sustainable Melbourne Fund (a trust set up by the City to finance sustainability projects). This product consists of a tripartite agreement between the building owner, the City of Melbourne and a financial institution. Once a loan is negotiated, the lender transfers the funds to the owner for the financing of a retrofit. Loan repayments are then collected by the City of Melbourne through rates (i.e. municipal taxes) and passed back to the lender on behalf of the borrower. Special features of this loan system include competitive fixed interest rates and up to 15 year repayment periods. Importantly the charge is fixed to the building and can be passed onto next

owner if the building is sold. As a further option, retrofitting costs (i.e. the loan) can be shared between the owner and the tenant as a way of overcoming the split-incentive dilemma, whereby the owner pays for an upgrade and the tenants gain the benefit of lower energy expenses.

Links to other City policies or programmes

Other initiatives conducted in parallel by the City to reduce emissions and increase sustainability performance in the building sector include Smart Blocks (targeting multi-unit residential buildings); City Switch (reducing emissions in commercial tenancies); Positive Charge (supporting both commercial and residential buildings to improve environmental performance) and the Solar Program (aiming to increase the uptake of renewable energy to 25% of the City's total electricity use by 2018).

Links to other government policies

In 2011, the introduction of mandatory reporting of energy efficiency status by commercial buildings with over 2000 m² of net lettable area (Commercial Building Disclosure) has been leveraged by the City of Melbourne and industry partners to drive an increase in tenants demanding to work in better performing buildings. In some cases this has worked to incentivise building owners to take measures to improve building performance. However, because the legislation is only triggered at point of lease or sale (which in most cases occur only once every several years) the policy alone will not influence a significant number of owners to investigate their building's performance.

II. Inputs for the programme

Inputs during the design phase

AU\$ 750,000 was allocated by the City to establish the programme and Environmental Upgrade Agreements, as well as cover associated legal costs. Development of the program took place over two years, beginning in 2008. Three City officers were charged with this task, with additional support received from a director and external partners and consultants. In 2009, a steering committee of members of government, industry and academia representatives was set up to guide implementation efforts over the next decade.

Extensive research was commissioned by the City, utilising engineering and marketing consulting firms prior to the design of the programme. Although not published, these reports have been shared with industry and government stakeholders. One study analysed the Melbourne City building stock based on physical characteristics such as age, size and owner category as proxies to retrofitability. A major finding was that a relatively small number of properties (132 or 10%) in the CBD made up 42% of net lettable area (NLA). A key feature of this segment is that many buildings are owned by corporate or institutional investors, who are generally committed to retrofitting to improve building efficiency and obtaining higher NABERS Energy ratings. The study also identified another key segment: *private* (including owners or strata corporations). This group collectively owns 1078 buildings or the equivalent to 64% of total NLA. These owners are of key interest to the programme as such buildings tend to be older, with owners not typically engaged in improving building performance.

A second study analysed potential economic benefits from the programme. It concluded that a successful programme could drive around AU\$ 1.3 billion of additional retrofitting construction activities, create as much as from 5,800 to 11,800 in FTE employment, and decrease current energy expenditures in the City of Melbourne by up to 25% annually.

Inputs during the implementation phase

The programme was designed as a ten-year initiative, with implementation in three stages:

- 2011 – 2013
Efforts to understand the commercial building market and its drivers for change; awareness raising and capacity building for owners; securing of commitment from building owners; the provision of support to mid-tier owners to undertake retrofitting work; and setting targets.
- 2014 – 2017
Implementation of initiatives to increase retrofitting activity, with a particular focus on mid-tier owners, in addition to tracking emission reductions and driving local economic development.
- 2017 – 2020
Accelerated retrofitting action; transformative change.

Three officers were assigned to implementation of the programme, including a manager and director. In addition, two officers from the Sustainable Melbourne Fund were charged with the delivery of energy efficiency services.

A budget of AU\$ 250,000 was allocated, with a further AU\$ 250,000 for renewable energy projects for commercial buildings. In addition, the Sustainable Melbourne Fund (of which the City is the sole shareholder) has AU\$ 5 million available for low interest loans for commercial buildings. Private finance through Australian financial institutions is also available to building owners through the above-mentioned Environmental Upgrade Agreements.

III. Programme results

Effects on the retrofit market

Citywide progress in the retrofit market is monitored through the publication of the *1200 Buildings Retrofit Survey*. These surveys measure the volume and type of retrofitting activity and qualitative information on drivers and perceived obstacles to retrofitting the 2,256 buildings with portions of office space in Melbourne.

The latest report (2013) concluded that retrofitting activity in this sector is increasing. Key conclusions were:

- Since 2008, around 450 buildings (20% of the 2,256 buildings) have undertaken a retrofit.
- For the two five-year periods 2006-2011 (seen in the last biennial report) and 2008-2013, retrofitting activity accelerated, with more activity in the latter period.
- In 2013, 5% of the 589 buildings surveyed were currently retrofitting.
- 16% of buildings intended to retrofit within the next five years. 55% of respondents wanted to receive further information from the City regarding financial assistance and retrofitting advice.
- The majority of retrofitting was being implemented by corporate owners.

- At the time the second survey was undertaken in 2013, the most common type of retrofitting activities were lighting upgrades (83%), followed by installation or upgrade to Building Mechanical Systems (59%), metering/sub-metering (57%) and chiller upgrades (54%). Other activities included boiler upgrades, installation of Variable-Speed Drives and other heating, ventilation and air conditioning (HVAC) improvements.
- Buildings undergoing retrofits were more commonly owned by the corporate segment (21%) and less commonly by private owners (4%). As the private segment own a much greater number of buildings, they accrued a greater total number of retrofits.

In addition, five buildings to date have signed an Environmental Upgrade Agreement (see *Innovative funding mechanisms* above) for financing retrofits.

In terms of other efforts to monitor citywide energy use reductions in buildings, this occurs through voluntary reporting and analysis of data from local energy maps and the Australian Government Commercial Building Disclosure programme.

IV. Lessons learned for replication

IV-i Key drivers of success

Time spent researching target audience

City officials attribute the allocation of sufficient time to the designing of the program as an important success factor. They highlight that during this period much effort was made to understand the nature and characteristics of the commercial building sector through stakeholder engagement and research. They focused on identifying key decision makers and understanding their motivations, capacity to finance retrofits and make decisions.

Different strategies for different building owners

Officials adopted different communication and incentive strategies for different sectors of commercial buildings. For example, corporate building owners typically have a large investment portfolio of buildings and a greater capacity to self-fund retrofits. They are motivated by the potential to gain publicity and showcase corporate social responsibility. Therefore, the City offered them a leadership programme to create opportunities for increased recognition.

By contrast, the mid-tier buildings owned by the private owner segment are not driven by corporate social responsibility and do not attract blue chip and government tenants choosing green buildings. They also lack the financial and human resources to take advantage of government grants and subsidies. The team therefore decided to play a major role in supporting this sector. Engagement with this segment includes the delivery of training and seminars, development of case studies and fact sheets, linking of owners with state and federal government subsidies, and provision of finance via Environmental Upgrade Agreements.

Drivers of retrofitting behaviour

The *1200 Buildings Retrofit Survey* (2013) shed some light on the key drivers behind owner decisions to retrofit buildings and equipment. The most common reason to retrofit was to replace a broken asset (39%) followed by a desire to minimise energy consumption (31%) and attract tenants (21%). The latter reason, in particular, indicates market demand for energy efficient buildings in central Melbourne, especially by government and blue chip tenants.

IV-ii Main challenges

Overcoming financing barriers

At the programme planning stage, lack of access to suitable financing was one of the most significant barriers preventing building owners from retrofitting. To overcome this, the City used its statutory power to establish Environmental Upgrade Finance to provide long-term financing to building owners. Despite its attractiveness compared to conventional loans, it has been found that 81% of owners retrofitting at the time of the 2013 survey funded their own projects. This may indicate that since recovery from the global financial crisis, access to finance is not proving a major barrier to retrofitting for Melbourne building owners. However, significant work is still required to engage with difficult to reach owners. As one strategy, the programme advocates ongoing and proactive building management as a low cost technique for improving environmental performance. For example, improved access to operational budgets for undertaking modest works to improve efficiency can be more attractive to owners not willing to borrow.

Engagement and marketing

Mid-tier owners are beginning to understand the opportunities represented by retrofitting and improving the environmental performance of buildings. However it has taken to three years to garner interest from these hard to reach owners. A new and ongoing challenge is the fact that a large number of building owners reside overseas, which limits the ability of City officials to contact or meet with them. It has also proved time consuming and challenging to secure the cooperation of building management services companies who are time poor and generally not committed to identifying opportunities for improving environmental performance. Officials devoted a large amount of time to understanding the market and creating tailor-made assistance packages for different segments and precincts. Officers are also collaborating with cultural associations, accountants, lawyers and consultants who advise building owners, and are experimenting with different messages. One approach was to utilise data obtained from recent heat waves and the social and economic impact of extreme temperatures. Other approaches include the provision of support and advice to building owners and managers with case studies, information kits, networking opportunities, seminars and training. Working with tenants through the City's CitySwitch program is proving effective to influence owners from the bottom-up.

Limitations of voluntary participation

The 1200 Buildings programme is a voluntary initiative seeking to trigger behavioural change. As such it is difficult to secure the participation of many building owners and managers in the absence of regulations. A secondary obstacle related to this absence of a legal framework is the acquisition of consistent information regarding energy and water consumption from both the entire building and individual tenants. City officials have attempted to overcome this by stipulating that tenants provide data to owners or managers as a condition of participation. Other channels are being pursued to facilitate data gathering, such as directly accessing data through utilities and using building owner reports. Officials are investigating the feasibility of proposing for legislative reform at the state government level, and are also seeking to learn from other cities in regard to the processes by which regulations are put in place and used to drive change in the building sector.

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4.2.4

NEW YORK CITY – *Mandatory benchmarking scheme in the Greener, Greater Buildings Plan*

Abstract: A benchmarking programme for energy and water consumption in large buildings, formed as one of four tenets in a comprehensive series of green building laws. After successfully achieving high compliance rates, the City is now focused on addressing data accuracy challenges.

Citywide reduction target

The PlaNYC sets a target of reducing citywide GHG emissions by 30% below 2005 levels by the year 2030.

Building-specific reduction target

The Greener, Greater Buildings Plan (GGBP) is expected to contribute 5% of the 30% target.

I. Programme context

Key elements

The Greener, Greater Buildings Plan (GGBP) is one of the most comprehensive building energy efficiency policies in the world. It consists of four Local Laws (LL) rendering mandatory the following: (1) adherence to strict energy local codes for both new construction and retrofitting, regardless of building size (LL85); (2) annual benchmarking of energy and water use with public disclosure (LL84); (3) audit and retro-commissioning every ten years (LL87); and (4) lighting upgrades and installation of electric sub-meters for large tenant spaces in commercial buildings to facilitate compliance with the current energy code (LL88). These four components are designed to complement each other. This case study focuses on the benchmarking programme.

Annual benchmarking

The benchmarking programme requires owners of large buildings to report energy and water use data to the City by May 1 every year. The NYC Department of Finance (DOF) generates an annual list of buildings required to comply. A free benchmarking tool, ENERGY STAR Portfolio Manager provided by US Environmental Protection Agency (EPA), is used by building owners to submit the data to the NYC Mayor's Office of Long-Term Planning and Sustainability (OLTPS). As this energy usage data must cover the whole building, owners must collect this directly from tenants (in the case of commercial buildings), or by requesting aggregated data from utilities. The City strongly recommends the latter method to reduce unnecessary burdens on owners and tenants. As for water usage data, the mandate is applicable only to those buildings equipped with automatic meter readings provided by the Department of Environmental Protection (DEP) for the entire period of the previous year. Upon the building owner's request, this data is automatically uploaded to ENERGY STAR Portfolio Manager by DEP.

Enforcement

Currently fines are only applicable to cases of non-compliance. A US\$ 500 fine is imposed on those failing to submit benchmarking data by each of the four quarterly deadlines, in addition to the main deadline on May 1 each year, totalling to US\$ 2000 per year. Also, as benchmarking

results are disclosed on the City website by DOF, owners failing to comply are publically listed. Implementation of the legislation was phased in, with disclosure requirements required only for City buildings in the first year, commercial buildings for the second, and residential buildings in the third. As of September 2013, all reported data has been made publicly available.

Programme target and scope

The programme targets owners of the following large buildings (see **Table 4.2.4**). Although it affects only approximately 2% of total buildings in NYC (roughly 24,000 private buildings and 2600 public buildings), it covers about half of the gross square footage, which is responsible for 45% of citywide energy consumption. In this way, the City has maximised its limited resources to impact a significant share of energy consumption in the building sector.

Table 4.2.4 Thresholds for targeted building sizes

City building (owned or operated)	Single building	Two or more buildings on the same tax lot	Two or more buildings with the same condominium ownership
More than 10,000 gross square feet (sq ft)	More than 50,000 gross sq ft	More than 100,000 gross sq ft	More than 100,000 gross sq ft

With thresholds being the same for most GGBP programmes—namely Audits & Retro-commissioning (LL87), Lighting upgrades & Sub-metering (LL88) and Benchmarking (LL84) —this results in less confusion for owners.

Overall goals of the programme

Goals for the programme are organised into the following three levels.

1. Overall goal: Reduction of total energy consumption in buildings throughout New York City, contributing to a reduction in citywide GHG emissions.
2. Operational goal: High compliance rate and data accuracy.
3. Outcome goal: Market transformation, retrofit implementation, and information transparency by monitoring energy and water use data as a key metric for the real estate industry.

The City has evaluated and compiled the data into a series of annual benchmarking reports for the first three years. Each of these analyses compliance levels and data quality in addition to energy and water consumption trends and characteristics of covered (i.e. mandated to comply) buildings.

Linkages to other City policies or programmes

The New York City Energy Efficiency Corporation (NYCEEC) provides financial assistance to support compliance with GGBP. This body was originally set up by NYC to facilitate GGBP implementation and it provides varying assistance to building owners to obtain easily accessible financing for energy efficiency retrofits. Options include direct loans provided by NYCEEC, Energy Services Agreements (ESA) offered by ESA providers via contract, and a multifamily programme offered by a local utility, Consolidated Edison (Con Ed).



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II. Inputs for the programme

Inputs during the design phase

Preparations for GGBP took place over a total of approximately 15 months in a process consisting of extensive in-house research, stakeholder meetings and public consultation (elaborated in *4.1 Key drivers of success* below). Research into characteristics of the New York building stock, benchmarking measures in other cities and potential impacts was conducted with support of the PlaNYC Sustainability Advisory Board. Throughout this preparation phase, staff from the Mayor's Office of Long-Term Planning and Sustainability (OLTPS) led by coordinating both the overall conception and detailed design of the programme design. This role was supported by assistance from the Department of Finance (DOF), the Department of Buildings (DOB), the Department of Environmental Protection (DEP) and the Department of Citywide Administrative Services (DCAS). Technical support for the ENERGY STAR Portfolio Manager was also provided by the US Environmental Protection Agency (EPA). GGBP was officially enacted in December 2009.

Inputs during the implementation phase

Annual benchmarking for covered buildings has been mandatory since May 2011. The implementation phase is also coordinated by OLTPS, with technical and financial support from DOF, DOB, DEP and other City departments. Resources consist of three full-time staff in OLTPS (one dedicated full-time, with two others providing support) in addition to personnel engagement from other City departments such as DOF, DOB, DEP and DCAS. Outreach efforts from other parties are discussed in a later section (*Partner support*). Monitoring of programme implementation for the first three years is facilitated through publication of an annual benchmarking report. Regarding verification measures, currently no third-party is used. However academic partners do assist in data analysis. Also, basic internal verification is conducted for service providers that assist the majority of building owners with benchmarking

(see *Feedback to service providers*). At present no specific budget is in place regarding funds required for marketing, communication, monitoring or verification. Many agents such as professional bodies, universities and utilities act as City partners to support the programme implementation (see *Lessons learned for replication*).

III. Programme results

Compliance rate

In September 2013, the City of New York published the second annual report for the benchmarking programme. According to the report, a 75% compliance rate on a property number basis was achieved in both 2010 and 2011, with the second year seeing a significantly faster reporting of results. In 2012, compliance rose to 84%. Benchmarking reports indicate that a combination of five factors have contributed to these relatively high compliance rates. Namely, enforcement, outreach and training, focus on large buildings, communications and technical support, and consultants.

Programme effects on retrofit market

The benchmarking scheme was enacted in late 2009 and implemented by the private sector in 2011 for data from the calendar year 2010. Being so recent, the City of New York has not yet taken formal measures to gauge progress towards energy efficiency and GHG reduction targets. As such, it is too early to assess the impact of the programme on the retrofit market or demand for energy efficient buildings. In terms of other market impacts, however, the Institute for Market Transformation (IMT) reports that a growing number of companies appear to be offering services related to benchmarking and auditing. For example, entrepreneurs such as service providers and ESCOs are launching businesses in the city, with several coinciding with the inauguration of the benchmarking scheme. As the programme continues and building owners are further informed of their benchmarking results and energy saving opportunities, it is expected that the City will see significant progress towards GHG emissions reduction and higher energy efficiency of buildings in New York.

Overall improvements in ENERGY STAR scores

Other evidence of positive impacts for GHG emissions and energy efficiency across New York emerge when comparing benchmarking results from the first and second year. Compared to year one, median ENERGY STAR scores for year two have increased from 64 to 67, with 25% of submittals qualifying for an ENERGY STAR score compared to 20% in year one. This equates to an increase of 284 buildings for the second year. The accumulation of experience across the building sector and implementation of improvement measures and upgrades in response to the GGBP appear as likely contributors to this improvement.

IV. Lessons learned for replication

IV-i Key drivers of success

Stakeholder engagement

A core driver of success was a strong stakeholder engagement process. This involved key players such as the real estate community, large property owners and tenants, engineering and architecture firms, environmental organizations, non-profit groups, labour unions, and other industry experts. This process started as early as 2006, just after the creation of New York City

Office of Long-Term Planning and Sustainability (OLTPS). Diverse stakeholders from civil society, industry and government were mobilised into the Sustainability Advisory Board (SAB) where they provided input for the design of GGBP concerning requirements for mandatory retrofits (later removed) and use of ENERGY STAR Portfolio Manager (ultimately approved). The process of stakeholder recruitment was facilitated by prior and solid connections from the City of New York. Interaction with stakeholders was particularly important when considering that compliance with the new laws of GGBP require a substantial amount of effort from building owners. Additionally, this allowed the sharing of viewpoints between the City and building owners, the identification of areas of concern or tension, and then a degree of compromise from both sides in order to make the programme feasible.

During implementation, it was particularly useful to build and maintain a list of stakeholder email addresses voluntarily submitted by individuals interested in receiving up to date information via email. This permitted the City to contact stakeholders directly through periodic email digests and maintain close contact to obtain feedback or support.

Additionally, green workforce development and training was significant in gaining support from stakeholders. A study conducted during the early stages indicated that numerous jobs would be created by GGBP. A knowledge centre for lighting efficiency, Green Light New York, was also established to help building owners comply with LL88, obtain training in lighting efficiency, and test out new lighting technology.

Partner support

Of the various stakeholders involved, a substantial number of organisations became strategic partners for the programme. The various roles assumed included assistance with outreach or training and the provision of expert knowledge and techniques for data cleaning and enhancing reliability (see 4.2 *Main challenges*). Energy utilities have also played a critical role in data collection. Further, the US Environmental Protection Agency (EPA) acts as a partner by providing technical assistance regarding Portfolio Manager.

The Urban Green Council—the New York Chapter of the US Green Building Council (USGBC)—has played a key role by disseminating green building practices in the region. They have published the *LL84 Compliance Checklist & User's Guide* to assist building owners submitting benchmarking data to the City and conducted GGBP presentations to the public. Also, they actively contributed to the City by making proposals for building related policies via the Green Codes Task Force and the Building Resiliency Task Force.

During the implementation phase, City University New York Building Performance Lab contributed through the establishment of a Benchmarking Help Centre to assist with data collection issues. Beginning as a call centre managed by graduate students, it continues via a call-back service for voicemail requests. OLTPS and DOB also assist the centre with financial support from IMT.

Competitive nature of the New York City real estate industry

From anecdotal observations, the competitive nature of the New York real estate industry seems to have had a positive impact on the success of the programme. Owners of large buildings in particular are acutely aware of competition in the real estate market and committed to maintaining the greenest and most efficient buildings possible. The disclosure of

benchmarking data has therefore had the effect of stimulating competition.

Focus on large buildings

Another key driver was the decision to focus on large rather than small buildings. As a defining characteristic of the New York programme, buildings larger than 50,000 gross sq ft are targeted. This threshold is relatively larger than that of other similar benchmarking schemes.

Consequently, the programme affects a small number of owners (about 13,000 properties) which together cover about half of total floor area in New York City. (That said, GGBP also requires benchmarking for about 2600 City government buildings over 10,000 sq ft). The reason behind this focus on larger buildings comes from the resolve to focus on properties that can potentially achieve the greatest impact with the smallest allocation of public resources. Also, owners of large buildings tend to be more consolidated, have more capital for compliance, and possess a greater array of measures available to enhance the energy efficiency of their real estate.

Flexibility to ensure high compliance rate

The New York City benchmarking scheme allowed a degree of flexibility to assist building owners in compliance, especially during the first year of implementation. For example, the reporting deadline was extended twice in the first year, first from May 1 to August 31, then to December 31. This leniency was afforded mainly to give building owners of various sectors enough time to report. While many owners were unfamiliar with Portfolio Manager, some also lacked energy efficiency and benchmarking expertise, and were less likely than commercial building owners to employ building managers.

The City was also flexible regarding the disclosure of data in special circumstances. Some commercial tenants operate in energy-intensive ways and do not wish to publish their ENERGY STAR scores because these may not accurately portray energy use intensity across different sectors. While all building owners must disclose energy intensity data relative to floor area, the City provides an option to omit 0-100 ENERGY STAR scores for properties demonstrating that data centres, television studios and trading floors occupy more than 10 percent of the total gross floor area.

IV-ii Main challenges

Coordination between multiple agencies

Different City agencies are in charge of different aspect of the programme, which is complex to implement. It is therefore crucial that multiple agencies communicate frequently and fully understand each other's role to ensure efficient implementation and reduce risks of miscommunication. To briefly summarise the various departments and roles performed, the Department of Finance (DOF) creates the list of buildings required to comply. While benchmarking results are reported to the Mayor's Office of Long-Term Planning & Sustainability (OLTPS), they have previously been disclosed online via DOF (since 2013, OLTPS and DOF both disclose on respective websites). The Department of Buildings (DOB) is in charge of legal enforcement and the imposing of fines. OLTPS analyses energy usage results, with the Department of Environmental Protection (DEP) overseeing water use and providing automatic data uploads to ENERGY STAR Portfolio Manager on behalf of owners. OLTPS is the overall coordinator of GGBP and leads stakeholder outreach with the help of DOF, DOB, and DEP.

Building identification

Building identification is an on-going challenge for the City. This is because the programme requires the identification of a building in a particular lot. On one hand a 'lot' is identified by the DOF system of BBL ('Borough, Block, and Lot') which is used for taxation. On the other a 'building' is identified by the Department of City Planning (DCP) system of BIN ('Building Identification Number'), which is used by the DOB to check the compliance of each building. Since neither a BBL nor BIN is sufficient on its own to identify a certain building in a certain lot, both systems are presently necessary. To enable this, the City asks building owners to provide both numbers when they submit data via Portfolio Manager. However the presence and need for these two identification numbers is currently proving confusing and time consuming as reports often include only one or the other.

Verification and data cleaning

Although there is presently no third-party verification process, the City does conduct data cleaning with cooperation of academic partners to improve data accuracy and suitability for analysis. New York University and University of Pennsylvania have separately developed individual data cleaning methods and successfully identified common errors such as under-reporting for gross square footage, in addition to omitting outliers (for more details see p.42 of the *2013 Benchmarking Report*).

Feedback to service providers

With around 80% of benchmarking reports submitted via 100 service providers (and as much as two thirds conducted by 30 firms) the data cleaning processes were able to identify the unique error tendencies of each service provider. Although mostly unintentional, these errors signalled potential flaws in reporting methodologies. With specific information on data accuracy levels for each firm, the City was able to contact the 35 largest service providers directly and provide them with feedback and individual 'report cards.' The City is confident that such efforts will continue to increase the reporting accuracy in the coming years.

Utility engagement and automatic uploading

Utility engagement is another key challenge facing the City, which has multiple utilities operating throughout its jurisdictions. Consolidated Edison (Con Ed) and National Grid provide electricity and gas, with PSEG Long Island in charge of electricity for Long Island, all of which are private firms. The City's Department of Environmental Protection (DEP) manages the citywide water supply. To comply with benchmarking requirements, building owners need aggregated, whole building data that includes tenant energy consumption information.

Prior to the launch of the benchmarking programme, private energy utilities did not offer aggregated whole building data. To obtain such data (which may include non-residential tenant energy consumption information) building owners were required to provide each tenant with a tenant energy request form, with limited means to ensure that this data would be provided. Fortunately, the law encouraged utilities to make aggregated whole building data available, making the form unnecessary. In 2014, the City notified building owners that due to the availability of aggregated data requests, forms were no longer required.

The City recognises that manual data entry is a short-term approach, with direct uploading being the end goal. Present limitations require manual data entry of aggregated data requested from utilities. This creates possibilities for errors and burdens building owners with the task of having

to contact multiple entities. The City has taken efforts to automate reporting, and has seen success with water data, with DEP providing direct and automatic uploads since 2011. Additionally, the City is actively exploring partnerships with utilities and the federal government to make automatic energy data uploading feasible in the near future.

Other measures to tackle data inaccuracy

Additional measures are being investigated by the City to address data quality issues. One option includes the hiring of specialist staff to verify data accuracy, investigate outliers and inform building owners of quality issues. The City is also exploring the possibility of imposing a penalty for inaccurate data entries, in addition to existing fines for non-compliance.

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4.2.5

PHILADELPHIA – *Building Energy Benchmarking Ordinance*

Abstract: This case study focuses on a benchmarking and disclosure programme from Philadelphia, supporting its goal to become “the greenest city in America” by 2015.

Citywide reduction target

The City of Philadelphia aims to reduce GHG emissions by 20% from 1990 levels, and municipal energy use by 30% from 2008 levels, both by 2015.

Building-specific reduction target

The City is aiming to reduce citywide building energy use by 10% by 2015 from 2006 levels.

I. Programme context

Key elements

The origins of the Building Energy Benchmarking Program lie in *Greenworks Philadelphia*, a comprehensive and ambitious sustainability plan announced by the Mayor of Philadelphia in 2009 to make Philadelphia “the greenest city in America” by 2015. *Greenworks*, as it is known, is comprised of 15 measurable targets and 164 initiatives encompassing five specific areas: energy, environment, equity, economy and engagement. Tackling commercial buildings was among the highest priorities, as approximately 62% of all GHG emissions in Philadelphia come from the building sector, with 60% of building energy used by commercial properties.

In June of 2012, the City Council unanimously passed the Building Energy Benchmarking Ordinance to amend Chapter 9-3400 of the Philadelphia Code. The new ordinance, which amends the Energy Conservation Code, mandates benchmarking, reporting and public disclosure of energy and water efficiency for non-residential buildings. Owners of covered buildings are required to submit data through EPA ENERGY STAR Portfolio Manager by June 30 each year. Data is required for energy and water consumption for the previous calendar year. Owners must disclose the recent benchmarking data to prospective purchasers or tenants upon request. The ordinance also includes provisions to safeguard privacy regarding the sharing of utility data. Starting with the second round of reporting in 2014, the information reported by building owners to the City will be publicly disclosed.

Programme target and scope

As stated in the Building Energy Benchmarking Ordinance, a qualifying building can be either of the following:

- Any commercial building with indoor floor space of 50,000 square feet (sq ft) or more.
- All commercial portions of any mixed-use building where a total of 50,000 sq ft or more of indoor floor space is devoted to any commercial use.

Results from the first year of benchmarking show that the buildings targeted by the ordinance represent approximately 20% of citywide energy use in the building sector.

The responsibility of compliance falls on building owners, who must obtain energy and water consumption data even when tenants are separately metered by a utility supplier. Once requested by the building owner, a tenant is required by the ordinance to provide information so that the owner can fulfil the benchmarking requirement. Because the majority of the covered buildings are served by 'master' energy and water meters, obtaining tenant data has not been a major barrier to compliance.

Overall goals of the programme

The programme aims to increase transparency in the commercial marketplace with regard to energy efficiency, advance energy efficiency building practices and reduce energy related expenditures for owners and tenants alike.

Enforcement

In cases of non-compliance, the building owner can be fined US\$ 300 for the first 30 days, and US\$ 100 each day thereafter. Based on a compliance rate of 86% in year one, the Mayor's Office of Sustainability (MOS) did not pursue fines for non-compliant buildings. With year two reporting now substantially complete, MOS has observed slightly higher compliance rates in the second year. However the final 10-12% of covered buildings are proving virtually impossible to reach.

II. Inputs for the programme

Manpower

The planning and design of the Building Energy Benchmarking Ordinance was undertaken by one full-time equivalent (FTE) from the Mayor's Office of Sustainability (MOS) who also managed other responsibilities. Staff support increased to 1.5 FTE going into implementation.

Input from diverse resources

There is no specific City budget for implementation and monitoring of the ordinance. However, inputs have been secured from diverse external sources to decrease reliance on internal resources. For example, the design of the benchmarking programme received technical assistance from academic partners in the Energy Efficient Buildings Hub, a regional innovation cluster funded by the Department of Energy. These partners also assisted by sharing costs or donating funds, in addition to other activities such as developing the programme website in the first year. The City also used approximately US\$ 50,000 of a grant funds to support advertising and public outreach activities.

A further US\$ 75,000 was spent on outreach programmes, mailing building owners and website development in efforts to boost compliance rates. In 2014 the City received funds for outreach activities from the City Energy Project, a US national initiative led by the Natural Resource Defense Council (NRDC) and the Institute for Market Transformation (IMT) that supports ten cities in their commercial energy efficiency efforts.

Learning from other cities

Philadelphia is the sixth city in the US to legislate a benchmarking law after New York, Washington, Seattle, San Francisco and Austin. Experiences from these cities, particularly with

regard to programme design and potential implementation issues, served as important points of reference for officials in Philadelphia. Knowledge was also gained about these cities from IMT. In particular, benchmarking experiences from New York have also proved highly insightful. For example, officials learnt that in New York most large buildings are owned by real estate corporations, who may own dozens of buildings. In Philadelphia, by contrast, many buildings are owned by individuals with single or small portfolios. Such market characteristics encouraged building management companies with large portfolios to voluntarily hire consultants to facilitate compliance in New York, but much less so in Philadelphia.

Energy data collection

The EPA Portfolio Manager tool serves as the standard reporting and data entry platform in all nine US cities implementing energy benchmarking programmes. Key metrics collected through Portfolio Manager are the ENERGY STAR score, source energy use intensity (EUI), site EUI, GHG, and water use. Philadelphia's benchmarking programme relies on self-reporting by building owners and does not require appointment of registered professionals to verify data. A data quality checker is used by the City to assist in the identification of any data problems which, once located, must be corrected by building owners. In contrast to other cities where many buildings in publicly disclosed benchmarking datasets lack EUI information, submissions to the City of Philadelphia missing such essential data are considered as incomplete.

III. Programme results

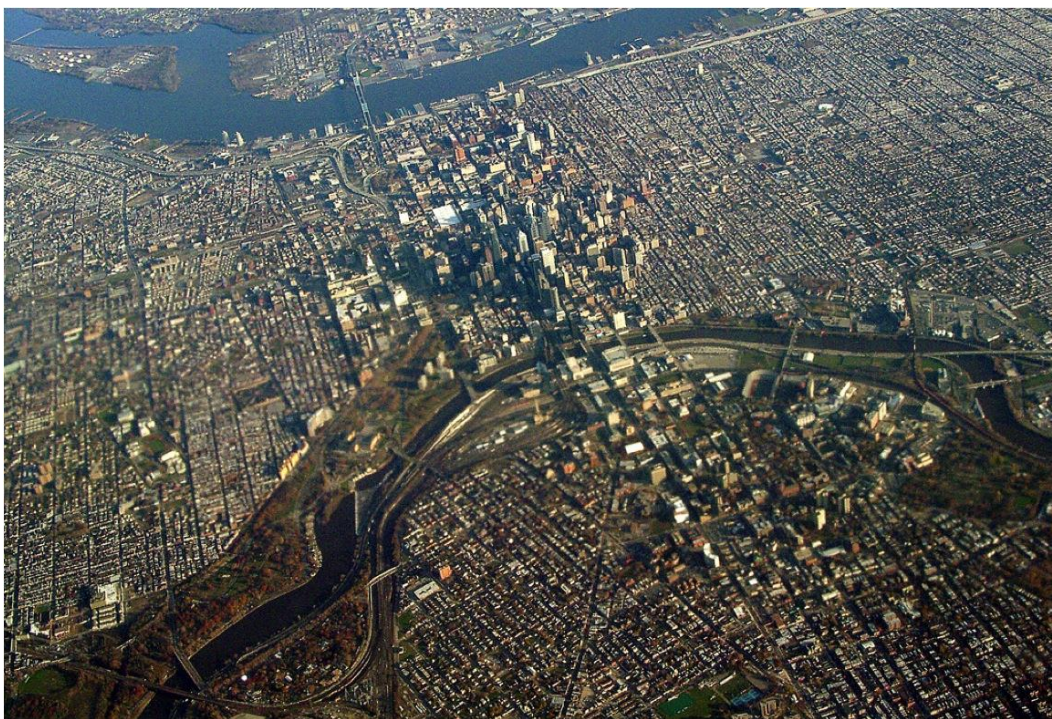
Compliance rate

Reporting for the first compliance period for the calendar year 2012 officially closed on 15 November, 2013. This initial deadline was pushed back from June to accommodate the major upgrades that the EPA introduced to the Portfolio Manager in the summer of 2013. In May 2014, the City released aggregate programme results for this first year of the programme (i.e. the calendar year 2012). Public disclosure of individual building-level results is scheduled for summer 2014.

Results from 2012 indicate that 1,762 buildings submitted benchmarking data, representing 253 million sq ft. On a square footage basis, this equated to a compliance rate of 86.6%; 79.0% by number of properties and 85.4% by number of buildings. City officials are satisfied with this compliance rate, which has been affected by a number of vacant or soon to be demolished buildings that will be exempted from the ordinance anyway. Taking such building owners into account, compliance rate for the first year could reach nearly 90%.

GHG reductions

According to the *Greenworks 2012 Progress Report*, the City saw an overall GHG emissions reduction of 3.7% from 2006 to 2010. This is largely due to fuel switching in power generation away from coal to natural gas. It is still too early to assess the contribution of the Building Energy Benchmarking Program. The reasons are that firstly the programme did not take effect until 2013 and secondly that citywide GHG inventories are conducted on two year cycles on at least a 12 month delay. There still remains a large gap between the City's initial target of a 20% reduction by 2015. Despite increased adoption of energy efficiency practices in building construction and retrofits of existing buildings, citywide building energy consumption increased between 2006 and 2012. To some extent this can be attributed to new development, extreme



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weather, a slow economy and historically low energy prices during the period. Notwithstanding this setback, the benchmarking programme is still regarded as a key tool in the City's numerous strategies to slash GHG emissions.

Programme effects on retrofit market

One anecdotal indicator of the benchmarking legislation's success is a growing awareness in organisations such as the Building Owners and Managers Association (BOMA) on the role that retrofitting can play in boosting building energy efficiency and cutting energy expenditures for building owners. City officials predict that for the second compliance year—and especially after public disclosure of results in the summer of 2014—many consultants will start offering services to building owners with low energy performance. Conversely, it is also expected that owners of poorly performing buildings will start seeking technical assistance from service providers.

Programme effects on other initiatives for small and medium buildings

The Building Energy Benchmarking programme exempts buildings smaller than 50,000 square feet. However, the City recognises the importance of driving improvements in energy efficiency in this sector. Separate programmes have been designed and implemented for these buildings such as the EnergyWorks and Greenworks Rebate programmes. Such initiatives usually come in the form of energy audits, low-interest financing, grants, and technical consultations at low or no cost. In addition, advertisements on radio and public transportation are used to reach out to small and medium building owners.

Future plans

Although the current programme focuses on commercial buildings, there is a plan to extend the coverage to residential buildings in response to a recent announcement made by the EPA that

residential buildings are now eligible for ENERGY STAR ratings. The City also intends to develop methods for tracking activities in the private retrofit market and to encourage the sharing of experiences between active service providers in the private sector.

IV. Lessons learned for replication

IV-i Key drivers of success

Stakeholder engagement

In 2011, the Mayor's Office of Sustainability (MOS) started meeting various stakeholders to gauge opinions about the benchmarking and disclosure programme. These stakeholders included building owners, organisations such as the BOMA, utilities, city council members and other City agencies and departments. This process proved an important means of gaining the support of such groups by incorporating their feedback into the programme design as much as possible.

Another highly effective means of fostering stakeholder engagement and support for the legislation came through the Coalition for an Energy Efficient Philadelphia (CEEP). The CEEP is a broad coalition of businesses, institutions, citizens, and organisations working together to increase energy efficiency in Philadelphia's buildings to stimulate economic growth and employment, cut energy expenditures for residents and businesses, and increase neighbourhood sustainability. City officials received assistance in building stakeholder support from the founding members of CEEP several months before the introduction of the ordinance. CEEP asked their fellow members to sign a pledge recognising the environmental and economic benefits of building energy efficiency, the 10% citywide energy reduction goal and new energy benchmarking requirements.

Cooperation from professional bodies

Relations with various professional bodies and organisations such as BOMA (Building Owners and Managers Association) were important drivers. BOMA had anticipated the enactment of this legislation, with both the international and local chapter supportive of benchmarking, yet opposed to public disclosure. Despite this, the City succeeded in building a good relationship with the BOMA local office and gained their cooperation in reaching out to key stakeholders, once the legislation was passed.

Cooperation and automated data transfer from utilities

In Philadelphia, the water and gas utilities (Philadelphia Water Department and Philadelphia Gas Works) are municipally controlled, whereas the electricity and steam utilities are privately owned (PECO and Veolia Energy, respectively). All four of these providers are regulated through a Public Utility Commissions (PUC), as elsewhere in the US. The City gained the cooperation of the utilities by working closely with this regulator, which was receptive to using benchmarking to make utility data more transparent to customers. The utilities agreed to participate in public consultations concerning the technical aspects of the Building Energy Benchmarking Ordinance. More recently, the two private privately-owned utilities for electricity and steam have begun automatic transfer of data to EPA Portfolio Manager. At present, automation of data reporting to Energy Star Portfolio Manager is playing a great role in reducing the burden on building owners. This also extends to the City itself, which owns several hundred municipal buildings captured by the legislation.

Partnership with other agencies

The City has delegated the responsibility of administering the ordinance to MOS. Duties include convening stakeholder meetings, development of a plan for distributing benchmarking information online and the implementation of regulations to address privacy issues. The ability of the MOS to perform these tasks is greatly influenced by various constraints on manpower and financial resources. Consequently, the MOS has sought cooperation with other governmental agencies. For example, the Department of Licenses + Inspections is a well-known body in the City that monitors any violation of regulations. As such, they have enhanced enforcement efforts by sending non-compliance notices. The Office of Property Assessment has also assisted by providing data to determine the coverage and scope of policy targets during the programme design.

IV-ii Main challenges

Ensuring data quality

The assurance of data accuracy is one of the largest challenges in Philadelphia. Data submission relies on self-reporting and third-party data verification is not required before submission. Although Portfolio Manager contains an inbuilt checker which automatically highlights outliers and common errors before data is submitted to the City, this alone is insufficient for assuring data reliability. Staff at MOS therefore verify each submission for errors.

Expertise gap among building managers

Expertise levels and responsibilities of building or energy managers appointed by large building owners vary greatly. Such managers range from planning and energy management professionals to administrative staff responsible for paying energy bills, often with little understanding of building energy efficiency. Although the latter group commonly experiences difficulties in compliance and often needs assistance, it nevertheless represents a large potential opportunity to reduce emissions.

As a means of assisting inexperienced building owners and managers, MOS officers have adopted measures such as providing a helpline, free information sessions and walkthrough assistance, as well as fixing specific time slots for receiving visits from building owners with enquiries. Instead of using third parties, the City of Philadelphia has chosen to provide in-house help beyond that required solely for benchmarking purposes as a way of creating maximum opportunities to advance energy efficiency in buildings, and sustainability more broadly.

Outreach to non-BOMA buildings

BOMA possesses sophisticated expertise in energy use issues as most of its members have been using Portfolio Manager prior to the launch of the benchmarking programme. Yet building owners belonging to the BOMA represent only a small number of targeted properties in the City; although these include some of the largest. It has so far proven relatively easy to reach out to this audience through the BOMA organisation. The real challenge remains how to reach out and provide various forms of assistance to non-BOMA individual buildings when MOS staff and funding resources are limited.

Moving from compliance to understanding

Many building owners are complying with the Building Energy Benchmarking programme simply because they are mandated to do so by law. Many do not realise or appreciate the importance

of monitoring or improving energy performance other than to avoid non-compliance and fines. A key challenge for the second year of benchmarking legislation is therefore to communicate, educate and raise awareness about the importance of building energy efficiency. Towards this end, the benchmarking report for the first compliance year will provide information regarding the significance of energy efficiency improvement measures in buildings and will illustrate their potential benefits to the environment and economy.

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4.2.6

SAN FRANCISCO – *Existing Commercial Buildings Energy Performance Ordinance*

Abstract: A comprehensive policy initiative aimed at existing commercial buildings. Consists of benchmarking, auditing and measures to foster retro-commissioning and retrofitting by complementing other finance and incentive programmes from the City.

Citywide reduction target

The City and County of San Francisco has set a goal of reducing GHG emissions to 40% below 1990 levels by 2025.

Building-specific reduction target

The Existing Commercial Buildings Task Force and San Francisco’s 2013 Climate Action Strategy Update recognised the goal of reducing by 2.5% per year the total energy consumption in commercial and non-residential buildings. This will result in a total reduction of 50% by 2030 below 1990 levels.

I. Programme context

Key elements

The Existing Commercial Buildings Energy Performance Ordinance (ECB ordinance)—or the Environment Code Chapter 20—came in to force in 2011, targeting all non-residential buildings with more than 10,000 square feet (sq ft) of conditioned space (i.e. heated and/or air-conditioned). The ordinance was adopted in response to a set of recommendations proposed by the Mayor’s Task Force on Existing Commercial Buildings.

Targeted buildings must abide by the following requirements: (1) annual submission of a limited set of statistical information, also involving public disclosure of total energy consumption and 1-100 ENERGY STAR score for each affected building, and (2) conducting of either an energy audit or retro-commissioning of the entire building (including both tenant and common areas) at least every five years. The aim of these requirements is to ensure that decision makers such as owners, managers, tenants and investors etc. are able to (i) determine the energy performance of the building concerned, both over time and in comparison to similar buildings across the City and (ii) have clear and actionable reports from qualified auditors identifying cost effective opportunities for enhancing building energy efficiency.

Benchmarking

Building owners or managers are required to annually submit a brief report of key benchmarking results to the San Francisco Department of Environment (SF Environment) by April 1. This is called an ‘Annual Energy Benchmark Summary’ and consists of the following points:

- Contact information and square footage
- Energy intensity (the amount of energy used per square foot)
- 1-100 ENERGY STAR score from Portfolio Manager (where applicable)
- GHG emissions from energy usage

This report is based on data from the previous calendar year. The local electricity and natural gas provider Pacific Gas & Electric Company (PG&E) provides automated data upload of energy data into ENERGY STAR Portfolio Manager for free. Owners or managers are required to submit the Annual Energy Benchmark Summary to tenants upon request. In addition, the City will disclose each Annual Energy Benchmark Summary publically through 'DataSF' the City's open data portal, which is scheduled to begin in October 2014. It should be noted that the reports for the first reporting year are being held confidential. In addition, data obtained is shared with the US Department of Energy Building Performance Database.

Audit and retro-commissioning

As mentioned above, requirements for the auditing procedure vary in accord with building size. For buildings greater than 50,000 sq ft, stricter requirements apply. An audit must at least satisfy Level 2 from ASHRAE and consist of an 'intermediate' survey and energy analysis. This will involve a detailed building survey and energy analysis, in addition to the recommendation of capital-intensive energy saving opportunities in alignment with owner constraints and economic capacity. Buildings between 10,000 and 49,999 sq ft require a less strict ASHRAE Level 1 'basic energy analysis'. This will involve a brief walk through visit and inspection of energy bills to identify low cost/no cost energy saving measures. In both cases, qualified auditors are then required to submit a Confirmation of Energy Audit to the City.

A noteworthy aspect of this requirement is that owners can select retro-commissioning as an alternative to energy auditing. The ordinance defines *retro-commissioning* as "non-capital work" such as repairs, maintenance and adjustment to optimise energy performance. This is opposed to *retrofit measures* involving "capital alterations" on the building such as the installation of new, energy efficient technology. This flexibility regarding either auditing or retro-commissioning is based on the implicit assumption that building owners would alternate between these two options as recommendations from energy audits were implemented to improve energy efficiency for every second fifth year. Note that the difference between an energy audit and retro-commissioning is a matter of emphasis; it is common practice for an engineer to document operational savings opportunities in the course of an energy audit, and to identify items entailing capital investment in the course of retro-commissioning.

Support system

The City offers free in-person presentations and webinars on the benefits of complying with the benchmarking ordinance, and provides a helpdesk reachable via email, phone, and troubleshooting via screen-sharing. The utility PG&E also provides free classes on benchmarking and how results can be used to generate cost and energy savings. Those who attend these PG&E sponsored classes are also eligible for free technical support with benchmarking.

Overall goals of the programme

The ECB ordinance aims to enable market decision-makers to compare the energy performance of their building to others, and gain actionable insight into cost-effective strategies for enhancing the energy efficiency of their property. Its wider goal is to reduce energy costs in the City of San Francisco, support the economy, reduce GHG emissions and enhance the competitiveness of the building stock. Specific targets of the programme are to reduce total energy consumption in non-residential buildings by 2.5% per year, achieving a total reduction of 50% by 2030 below 1990 levels. This target has come from the Existing Commercial Buildings

Task Force set up by the City and San Francisco's 2013 Climate Action Strategy Update. It was also formed in response to the State of California's goal of achieving zero net energy in 50% of existing commercial buildings by 2030.

Enforcement

In comparison to other cities, San Francisco has taken a relatively lenient stance to compliance thus far. The Department of Environment is required to: 1) issue a written notice of violation, 2) publicly post those buildings not complying after 30 days from the deadline, and 3) has the authority to levy fines 45 days after the written notice. With fines yet to be issued, the stance of the City is to encourage compliance by communicating the benefits of complying with the ordinance, assist those in need of technical assistance such as acquiring the necessary data, and to provide incentives and financing resources to those that comply. For the time being, the financial penalty for inaction is the opportunity cost of foregone energy cost savings.

Programme target and scope

The ECB ordinance targets all existing commercial buildings larger than 10,000 sq ft. As a result, approximately 19,000 private sector buildings and 450 public buildings are affected by the ordinance. This equates to a total of approximately 151 million sq ft of private sector buildings (around 80% of conditioned commercial floor area in the city) and approximately 38 million sq ft of municipal buildings and schools. This focus on commercial buildings has come from the realisation that buildings account for 53% of citywide carbon emissions, with commercial buildings making up 31.8% of emissions for this sector.

In regards to exempted buildings, ECB differs from policies of other cities by only targeting non-residential buildings with conditioned space. Consequently, any unconditioned building such as a warehouse, for instance, is exempted from the ordinance. In addition, other types of buildings are outside the focus of the ordinance. An Annual Energy Benchmark Summary is not required for new buildings less than two years old. Unoccupied buildings are also exempt. As for the auditing requirement, buildings are exempt when any of the following apply: an energy audit has been conducted within the past five years, an ENERGY STAR certification has been obtained for three of the last five years or LEED for Existing Buildings operational certification in the past five years. Other exempted buildings are those less than five years old, unoccupied, or under financial distress.

The ordinance does not target residential buildings. This is because it was shaped largely by a series of consultations with commercial real estate stakeholders (i.e. the Mayor's Task Force on Existing Commercial Buildings) and thus the focus was on commercial buildings rather than residential. The principle reason for focusing on commercial buildings was that in California, cities lack the authority to directly regulate energy usage data, and residential buildings tend to have very large numbers of individually metered tenants. As a result, residential energy benchmarking in San Francisco would require the consent of each individual tenant. Given the large number of residences in an apartment building, the inclusion of the residential sector for benchmarking and auditing would prove impractical at this point in time. In commercial buildings, the same issue applies. However it is less common for tenants to purchase energy directly for individual portions of the building, with the total number of tenants also tending to be much less. Although the programme has proved more feasible to implement on the commercial sector, significant friction remains. As this is a recurring problem across the country, at the invitation of the Obama Administration and US Department of Energy, the City and utility

have entered into an agreement (the White House Data Accelerator) to find a better solution to the tenant data sharing problem within two years, beginning in December 2013.

Interestingly, the Mayor's taskforce initially recommended targeting buildings from 5,000 sq ft in order to ensure that the broadest spectrum of stakeholders possible were involved and provided with data on energy performance. However this was raised to 10,000 sq ft to make the policy easier to administer. As a result, it has been estimated that there are at present approximately 11,000 commercial buildings under 10,000 sq ft falling outside of the law. However this tranche of buildings comprises only 17% of aggregate commercial floor area in the City.

Linkage to the other city policies and programmes

The City of San Francisco has implemented various other measures to improve energy efficiency in buildings. These including policy for existing and new buildings, incentives, and financing:

Policy

A strict State energy code (CA Title 24 2013 Energy Standards) applies to all new construction and alterations to existing buildings. In addition, San Francisco requires LEED Gold for all new commercial construction larger than 25,000 sq ft. By targeting existing buildings, the ECB ordinance hence compliments this code.

Incentive programmes

The ECB ordinance also complements San Francisco Energy Watch (SFEW). Launched in 2006, this programme targets hard-to-reach small businesses, medium sized commercial buildings and multifamily buildings by providing free audits and project management of retrofit projects, whilst also supporting retro-commissioning. Rebates and quality assurance assistance help motivate building owners to implement energy efficiency measures recommended through the mandatory audits.

Financing

The City also offers the GreenFinanceSF Property Assessed Clean Energy (PACE) finance programme, which finances energy efficiency, renewable energy, water efficiency, and seismic retrofit projects. Capital is provided by investors selected by the property owner and repaid through an increase to annual property tax assessments, with terms up to 20 years.

California State benchmarking programme

The ECB ordinance also compliments the Commercial Building Energy Use Disclosure Programme (AB 1103) by the State of California, effective from January 2014. This requires disclosure of a detailed set of energy efficiency data to the two parties involved in a major real estate transaction (i.e. sale, lease or refinance), in addition to the state regulating body. In contrast, the City of San Francisco requires public, annual disclosure of a very limited set of data. The view in San Francisco is that annual disclosure is a mechanism to encourage current occupants to improve energy efficiency in operation. On the other hand, transactional disclosure helps the buyer, future tenant or investor gauge opportunities for further improvement.



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II. Inputs for the programme

Inputs for the design and implementation phase

Whereas initial administration of the ordinance is funded by a combination of the city and foundation support, related programmes are funded separately. SFEW currently receives approximately US\$ 7 million per year from contracts with utilities to provide efficiency and outreach services to commercial and multifamily customers in need. This funding is in turn derived from nearly US\$ 1 billion in energy efficiency funds paid by California ratepayers under the auspices of the California Public Utilities Commission.

The ordinance was designed in 2009 by the Mayor's Task Force on Existing Commercial Buildings, with stakeholder engagement and drafting of the legislation stretching out over approximately 18 months. Implementation of the ordinance was designed to be phased in as follows:

- April 2011: Ordinance becomes effective
- October 2011: First benchmark reporting deadline for large buildings (50,000 sq ft or more)
- January 2013: First submission deadline for energy audits or retro-commissioning reports for large buildings
- April 2013: First benchmark reporting deadline for small buildings (10,000 to 25,000 sq ft)
- End of 2014: 95% of audits for smaller buildings expected to be complete

For staffing resources, the City supplies approximately 1.5 FTE, and various support roles are provided by the private sector. In addition, extra staff are mobilised before and after reporting deadlines.

Stakeholder engagement during the design phase

Stakeholder engagement and consultation took place through the above mentioned Mayor's Existing Commercial Buildings Task Force. This consisted of approximately 20 stakeholders with diverse experience and expertise in commercial real estate (ownership, management, operations, engineering, construction, law and finance), engineering firms, the local energy utility PG&E, the State Energy Commission and the US Environmental Protection Agency (EPA). This task force was originally convened by the Mayor to identify the policies, partnerships and measures for maximising energy efficiency in commercial buildings, reducing GHG emissions and improving the competitiveness of commercial buildings in the city. As mentioned already, one of the main driving forces behind the emergence of ECB ordinance was the formal recommendation (in the form of a report) for a benchmarking system. Stakeholder consultation then continued after drafting of the ordinance, itself based on recommendations of the task force.

A preliminary version of the ordinance was then formed, also based on research from the City Department of Environment, City data and literature reviews. The draft was presented to no less than 50 trade groups and commissions (many from the task force) as well as community members. It was revised based upon feedback from these groups. Once adopted in February 2011, outreach about the new requirements of the ordinance commenced. This took place through presentations to trade groups, utility-sponsored training, media coverage and letters of notification to affected property owners.

Partnerships with other cities

Officials in San Francisco Department of the Environment are part of the Local Government Sustainable Energy Coalition (LGSEC). This group of 26 local governments engages in knowledge sharing around issues such as energy data access, improvement to state policy and regulations, and how cities can team with utilities to promote energy efficiency. San Francisco also shares best practices and policy models with the US DOE. At the same time, the City is participating alongside other US cities implementing energy benchmarking programmes to contribute to the development of the Standard Energy Efficiency Data (SEED) platform. This is intended as a common database to standardise management of similar energy efficiency programs, among other uses. The open source software platform is in beta testing, with release expected in the latter half of 2014.

III. Programme results

Impacts

The 2013 update to the Climate Action Strategy reports that as of Spring in the same year in excess of more than US\$ 6 million in annual energy savings opportunities and US\$ 10.7 million in energy efficiency investments have been identified in the first 195 audits submitted. It is also reaffirmed that full compliance with the ECB ordinance will lead to a 2.5% annual improvement in efficiency for the commercial building sector, with projected annual GHG reductions being 176,638 metric tonnes per year.

Compliance

Benchmarking compliance has been established at currently 80% for the two year period of 2011-2012. Compliance rates are significantly higher for large buildings, with smaller buildings between 25,000 and 50,000 sq ft presently attaining only around 50-60%. This sector therefore

represents the main area of focus for City efforts to boost compliance. For small buildings between 10,000-25,000 sq ft, compliance only just became compulsory last year, and at present, compliance rates are extremely low. Yet this can mainly be attributed to technical problems related to the upgrade of the EPA ENERGY STAR website which caused technical issues with data uploading from the energy utility. Audit compliance for 2013 was 78%.

Programme effects on retrofit market

City officials are confident that the law is helping drive the retrofit market. To cite some anecdotal evidence, the City-run SFEW programme is observing that a high proportion (around 40-70%) of small commercial and multi-family building customers are implementing the energy saving opportunities identified in free audits provided by SFEW. So while audits do not entail mandatory upgrades, the retrofit market is regarded as robust. In addition, the State of California's ambitious Title 24 Energy Standards apply to all commercial and residential additions and alterations. In addition, San Francisco has instituted various amendments to these standards such as time-of-sale mandatory upgrades for residential properties, and greater performance standards for fluorescent lighting. Therefore, it is important to bear in mind that the benchmarking system has only been in operation for three years whereas 'low hanging fruit' such as energy efficiency codes and incentive packages have been in existence for much longer.

IV. Lessons learned for replication

IV-i Key drivers of success

Support from both elected officials and local stakeholders

As local stakeholders were involved in the design period, implementation of the ordinance has been fuelled by support from various stakeholder communities who felt that their interests had been adequately incorporated. Conversely, there was no substantial resistance from owners, who comprised a large part of the Mayor's task force. In the legislative process, the local Building Owners and Managers Association (BOMA), the Chamber of Commerce, and the Small Business Commission were strong supporters. Support from these bodies is representative of a large range of building sizes and uses. The critical mass of the above described support granted the City some freedom to learn through trial and error when implementing the new act.

Differing messages for different audiences

City officials have made efforts to adjust the message and medium used to communicate about the ordinance depending on the market segment targeted. This is also appears to be a key factor in fostering stakeholder support or understanding for the audience. In the case of written communications to building owners, the amount of content is kept brief, with the main focus being on financial savings rather than climate change mitigation. In verbal communications, references are made to the Mayor's task force and political support, again with the emphasis on potential financial savings and opportunities for competitive advantage. Climate change risks and mitigation is positioned as a secondary driver. In web communications or presentations, key messages focus on cross-referencing benchmarking initiatives in other cities, financial benefits and the importance of reducing GHG emissions for the real estate industry.

Compatibility with existing efficiency measures

When designing the ordinance, substantial efforts have been made to ensure compatibility with other City and State incentives for energy efficiency. The policy was designed so that once data

required for compliance was assembled, owners would be well positioned to take advantage of other programmes and financial incentives to implement upgrade measures and capitalise on savings opportunities identified in audits. As other measures to ensure compatibility with other programmes, workshops provided by the City on data reporting and energy efficiency were designed to contain additional information to that already available through existing educational initiatives, such as energy efficiency training programmes from PG&E.

Securing of high quality data

The City has observed that data reported so far is on the whole of high quality, with no evidence of systematic falsification of data. A key driver for this appears to be the awareness that the falsification of data could potentially jeopardise a future transaction (i.e. sale etc.) of a building. This is because State law requires benchmarking reports to be disclosed to concerned parties at the time of a real estate transaction. To ensure data quality, the City recommends the validation of benchmarking information by professional engineering services.

IV-ii Main challenges

Balancing priority and resources

The City's legislative body, the Board of Supervisors, being motivated by concerns about climate change, sought a more aggressive approach. As a result, the originally envisioned time period allocated for conducting the first round of audits was shortened from five to three years. The need to strike a balance between calls for an aggressive timeline, programme efficiency and feasibility, in addition to data quality challenges (explained below), have all contributed to the relatively lenient enforcement approach taken to date.

Lack of quality data for the local built environment

In designing and implementing the ordinance, a major obstacle has been a lack of quality data describing the local built environment. There were multiple existing datasets in the City with some relevance to the ordinance, in particular those by the tax assessors and local building inspection department. However this data was organised according to each particular agency's function and was not entirely suitable for implementation of the ordinance. Much effort was therefore required to clean and re-organise the data, including cross-referencing with data from Co-Star (a comprehensive database of commercial real estate data). Now that data quality has improved substantially, the City is poised to utilise the US DOE's SEED platform mentioned above. It is envisioned that this tool will generate significant cost savings for the City for data management whilst standardising this process across other cities.

Owner access to whole-building energy use data

While it is a straightforward matter for owner-occupied buildings and single-tenant buildings to track energy use, this is proving much more challenging for owners of buildings with numerous separately metered tenants. In the other eight US cities where energy benchmarking is required, utilities solve this problem by providing whole-building monthly total energy consumption upon request. By automating data access, the utility PG&E has reduced but not yet solved this problem. Tenants must still consent to share data with building owners, with this procedure being facilitated through a free online process on the PG&E website.

Institutional complications for data management

Two state agencies regulate energy consumption data in the state: the California Public Utilities Commission and the California Energy Commission. Lack of a single regulatory authority

complicates the City of San Francisco's efforts to streamline the data procurement and management process. As one means of overcoming this barrier, the City is currently involved with the US DOE and PG&E in the White House Data Accelerator project mentioned above.

Communicating the value of benchmarking data

Communication and education remain as key future challenges for the City. A core task and eventual metric of success for the programme is to ensure that the wider public is aware of the value of benchmarking information, which it is hoped, will trigger a shift in market trends.

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4.2.7

SEATTLE – *The Seattle Building Energy Benchmarking and Reporting Program*

Abstract: Although achieving a high compliance rate, maintaining outreach efforts to educate stakeholders on the value of benchmarking data is an ongoing challenge.

Citywide reduction target:

The City of Seattle aims to attain carbon neutrality by the year 2050.

Building-specific reduction target:

The City has set the goal of reducing by the year 2030 energy use in commercial buildings by 10% and 20% in residential buildings.

I. Programme context

Key elements

The Seattle Building Energy Benchmarking and Reporting Program requires all residential and commercial buildings of 20,000 square feet sq ft or larger to track energy performance annually, report to the City and disclose upon request this information to current and prospective tenants, buyers or lenders. This regulation has been developed in support of the Climate Action Plan (CAP), updated in 2013, as a step toward the City's 2050 carbon neutrality goal.

The benchmarking programme was adopted in January 2010 as Ordinance 123226 (updated in 2012 as Ordinance 123993). Implementation of the law included a phase-in period beginning with large commercial buildings greater than 50,000 sq ft, which were first required to report by April 2012. Multifamily buildings were first required to report by October 2012. For buildings greater than 20,000 sq ft (and less than 50,000 sq ft) reporting was first required in April 2013. The programme is now in full implementation, covering approximately 3250 properties (totalling more than 280 million sq ft).

Annual benchmarking structure

The benchmarking programme requires buildings owners to collect building use details and actual energy use data for each individual building and report to the City by April 1 each year. Reporting is carried out through the ENERGY STAR Portfolio Manager from the US Environmental Protection Agency (EPA).

While submitted data is not currently verified by a third party, the City provides a free help desk to support owners with reporting performance data via telephone and email, in addition to weekly drop-in sessions and workshops. The City also uses third-party technical assistance to identify outlier data and contact building owners to correct inaccuracies.

Enforcement

Programme outreach includes annual mailing of a notification letter informing or reminding building owners of the April 1 reporting requirement. In cases of non-compliance, the City

notifies owners with a warning letter. After the provision of grace periods and assistance if required in creating the data, a Notice of Violation with penalties is eventually sent to those failing to submit within 90 days of the deadline. For buildings greater than 50,000 sq ft, a fine of US\$ 1,000 applies per quarter of non-compliance, with this amount being US\$ 500 for those between 20,000 to 49,999 sq ft. Last year, approximately 2% of 3250 buildings were issued a fine. Fines continue to accrue every ninety days if a building owner fails to correct the violation and bring the building into compliance.

Programme target and scope

The programme targets all residential and commercial buildings 20,000 sq ft or larger, with requirements directed toward building owners and managers. The logic behind this focus on large buildings was the resolve to capture the majority of flooring surface area in Seattle. Another decisive factor was that this class of buildings is more likely than smaller buildings to employ a facility manager or building management firm and, therefore, to have greater capacity to conduct energy benchmarking and act upon the results.

The initial ordinance was targeted at commercial buildings above 10,000 sq ft and multi-family buildings of five units or more. This was revised when it became clear that this would affect 9000 buildings, many of which were small buildings whose owners lacked knowledge of benchmarking systems and the resources to report energy consumption. This led to a reform of the ordinance to target larger buildings of 20,000 sq ft or more in the commercial and residential sector.

Overall goals of the programme

The ultimate goal is to help building owners lower energy consumption and costs and thus contribute to the Climate Action Plan goals for reducing carbon emissions in Seattle's existing buildings. The City has also placed a great deal of emphasis on educational aspects of the programme. It hopes that by educating tenants and owners in energy efficiency performance and benchmarking, the programme will contribute to an informed market which considers energy efficiency when making financial decisions. In addition, annual reports of building energy performance are also planned to help guide the City's future policies and incentive programmes. As an operational goal, the City aims to attain close to 100% compliance annually.

II. Inputs for the programme

Inputs during the design phase

The design phase took place over two years. From 2008 to 2009 a Mayor's Green Building Task Force (elaborated below) was convened and charged with the mission of providing guidance on suitable policy mechanisms for reducing energy consumption in existing buildings by 20%. A benchmarking policy was one of the energy efficiency policies recommended during this stakeholder engagement process. Policy legislation was designed and proposed during 2009, and eventually passed in 2010. Starting with the design process, personnel has ranged from portions of existing staff, growing to 2.75 FTE in 2013 during the implementation period. In addition, staff for technical assistance began at 0.5 FTE, then expanded to 3 FTE in the second year of phased implementation. This technical assistance staffing level has recently been reduced to 1.75 FTE now that all buildings are reporting for their second and third year.

In terms of overall budget, the policy proposal phase (2007-08) relied on part-time contributions from several existing staff members in other departments. After the policy was recommended by the Green Building Task Force in 2009, 0.25 FTE staff was committed to its design. Federal grant resources were also used to create infrastructure for the programme, such as for instance database development.

Stakeholder consultation took place around a year before the passing of the ordinance. This was mainly assured through the above-mentioned Mayor's Green Building Task Force consisting of 50 individuals from the private sector, energy utilities, government authorities and the civic sector. This task force was eventually divided into two groups—one focusing on new buildings and the other on existing buildings—and met monthly during the period of June 2008 to January 2009. In addition, approximately 18 months later a series of community discussions were held to inform about implementation requirements of the ordinance. These consisted of both informal and formal meetings with the Building Owners and Managers Association (BOMA), rental housing associations and other public stakeholders. Feedback from these meetings was used to refine the adopted ordinance's rule mailing guidance known as the 'Director's Rule'. After adoption, stakeholder consultations continued. These involved working with training providers to educate building owners on the uploading of data to ENERGY STAR Portfolio Manager, as well as outreach efforts to the building sector to inform them about the new reporting requirement. Additionally, officials launched a multifamily pilot programme in the early implementation stages to verify the effectiveness of educational materials and support compliance of multifamily building owners.



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Inputs during the implementation phase

Although shifting over time, the overall budget composition for the implementation phase roughly consisted of 75% in grant funds, 15% in city funding and 10% in penalty revenue. In regard to staffing resources, the programme currently has 2.75 FTEs. This includes 1.0 for programme management and planning, 1.0 for outreach, education and data management, and 0.75 for compliance and enforcement.

The latest marketing and communication budget was approximately US\$ 20,000. This was to cover costs associated with producing notification letters, educational materials, and warning letters. The latest budget for Information Technology upgrades to maintain the web services reporting process was approximately US\$ 15,000.

The City has also continually invested in the stakeholder engagement process. This has encompassed measures such as free educational workshops to facilitate compliance, media outreach through monthly e-newsletters and contributions to industry publications, and also by sharing lessons learned from data analysis.

III. Programme results

In January 2014, the first comprehensive analysis report of data submitted in 2011 and 2012 was released. This provided the first ever means for building owners and managers to gauge their building's energy efficiency against similar buildings in the city. So far, the programme has achieved a remarkably high compliance rate (elaborated below). In addition, it is also seeking to spur green building practices by referring owners and managers to other utility incentive programmes regarding energy efficiency and so on.

High compliance rate

According to the report, the programme has achieved a 93% compliance rate on average (89% for non-residential and 97% for multifamily buildings). This rate is one of the highest recorded of US cities implementing similar benchmarking programmes.

Programme effects on retrofit market

With energy savings usually requiring a number of years to manifest, it is hard to assess the impact of the programme at this early stage of implementation. However, there is anecdotal evidence of several buildings undertaking energy efficiency upgrades in response to the ordinance. As a further measure to drive retrofitting, the City is partnering with the publicly-owned electric utility Seattle City Light. This utility is currently comparing benchmarking results with internal data and using findings to improve and inform existing and future efficiency rebate programmes.

Another source of anecdotal evidence comes from the Seattle 2030 District. This coalition of private downtown buildings is seeking to, amongst other sustainability goals, attain carbon neutrality for new buildings and a 50% reduction in energy usage for existing buildings by the year 2030. The benchmarking initiative of the City has been credited by the Executive Director of the Seattle 2030 District as being one of the key drivers behind the self-initiated formation of this alliance.

IV. Lessons learned for replication

IV-i Key drivers of success

Political and stakeholder support

A key driver of success has been political support from the City's Mayor, Council members, and department directors. Buy-in from the Mayor and other representatives, due to existing City

commitments to implement new measures to meet climate targets, proved particularly important in forming the programme.

Stakeholder support was also key in driving the formation of the programme. The main group involved was the above-described Mayor's Green Building Task Force, which recommended the creation of a benchmarking programme in their findings. Working collaboratively with stakeholder groups (such as BOMA), the ordinance was created with a unique disclosure provision aimed at entities engaged with a building, rather than allowing broad public access. Annually reported metrics were also limited to basic building energy performance and not operational characteristics. This responsive policy proposal enabled the City to overcome the bottleneck of building industry concern regarding the disclosure of building level energy data. In addition, support came from the Institute for Market Transformation (IMT), EPA and the US Department of Energy (DOE).

Funding

Another core driver was the securing of funding from the Federal Government, local energy efficiency organisations and private foundations.

Existing knowledge base

The existence of a knowledge base on the residential and commercial stock in the City helped the identification of the most suitable buildings to target. This consisted of a City-created database utilising data from the local tax assessor's office.

Drivers of high compliance

Officials attribute Seattle's remarkably high compliance rate to outreach and stakeholder engagement efforts involving free information and training sessions and establishment of a help-desk, now in operation for over two and a half years. Other important factors include revision of the ordinance to focus on the type of buildings that would most benefit from benchmarking. The City relaxed some of the initial reporting deadlines deemed as too ambitious for many building owners, and modified some of the rules and details in the ordinance during the design phase. The City also spends time following up dubious reports or helping resolve errors in the reporting process. Another reason behind high compliance levels appears to be the commitment to enforcement, when necessary.

Closer examination of compliance rates reveals that the residential sector (97%) outperforms the non-residential sector (89%). Commercial and residential buildings make up roughly 50% each of the 3250 properties required to benchmark. Contrary to expectations, interest and compliance from the smaller commercial building market is lowest, with, in contrast, small multi-family property owners proving much more receptive and easier to reach out to. One of the key drivers for the higher compliance rate in this category appears to be that residential owners were easier to contact, with many being members of local housing rental associations and users of property managers.

Citywide energy reduction targets

The success of the programme has also been driven by the wider City resolve since 2005 to decrease carbon emissions. Officials cite the presence of the Climate Action Plan (CAP) as being helpful when reaching out to stakeholder groups who may otherwise have felt that the new ordinance was an unnecessary and additional burden. This is because the CAP illustrates that

simultaneous efforts are being made to tackle sectors such as transport, in addition to buildings. The CAP also shows stakeholders that the City of Seattle is itself subject to benchmarking and carbon reduction requirements.

Inter-city exchanges

Sharing of best practices and mutual testing of various approaches with other municipalities pursuing similar policies was highly valuable. Such cities include New York City, San Francisco and Washington DC. Officials in Seattle were able to draw upon this outside experience and research which demonstrated the importance of benchmarking in driving energy efficiency and carbon reduction. Some of the meetings with these cities were realised with funding from external sources such as US Sustainability Directors Network and the Bloomberg Foundation.

Utility support

Support from utilities in regard to data exchange has also been a significant contributor to the success of the programme. In Seattle, access to energy data requires the cooperation of three utilities: Seattle City Light (electricity, publicly-owned), Puget Sound Energy (LNG, privately-owned) and Seattle Steam (privately-owned). Each of these utilities has specially set up data access and reporting infrastructures. Direct access to utility data allows building owners to attain aggregate building level consumption data inclusive of all tenant energy use, whilst retaining tenant anonymity. Furthermore, utilities also offer automatic data upload to ENERGY STAR Portfolio Manager on behalf of customers as a data exchange service. The combination of these measures facilitates the reporting process by saving the manual task of, for example, referring to individual power bills for each tenant in a building. The establishment of access mechanisms between the utility and individual buildings was time consuming and cumbersome. Yet, once set up, it eased the task of continued reporting and reduced errors in data arising from manually input.

IV-ii Main challenges

Software and data management issues

City officials found that the software used for reporting (ENERGY STAR Portfolio Manager) was not user friendly as it was originally designed for energy efficiency engineers. This system has since been redesigned and made more user friendly, which appears to have helped building owners.

Creating the database and information technology system for data exchange was also challenging. This has required ongoing technical oversight to address problems and maintain compatibility. Utilities have been faced with the need to create individually an automated data processing programme for data exchange. Customer resistance and lack of technical expertise are large barriers that the City has continually needed to address through technical assistance.

In terms of measures to ensure data accuracy, the City mainly relies on self-reporting, although they have audited a sample. They have also separated results into building type, allowing the verification of data accuracy for cases falling outside category mean ranges. This verification of outliers has generated opportunities for property managers to consider increasing energy efficiency after being informed that their energy consumption falls well above the mean range. All data is managed in house, although the City attained assistance and verification support from the Department of Energy through the Buildings Performance Database and contracting with a private consultant to conduct data analysis.

Another strategy to boost data accuracy is by recommending the obtainment of EPA ENERGY STAR certifications to eligible building owners, who can use such energy efficiency ratings to promote the market appeal of their building. As the awarding of an ENERGY STAR certification requires verification of reported energy consumption via an engineer-led inspection of past energy bills, this strategy of promoting certification serves to enhance data accuracy of the self-reported benchmarking results. It also helps eliminate the perverse incentive of falsely reporting lower energy consumption figures to the City. At present, however, the Seattle Building Energy Benchmarking Analysis Report shows that only 69 out of 309 buildings eligible for certification have actually obtained certification.

Outreach efforts required to educate on the value of benchmarking data

Precise data on the number of buildings receiving requests for disclosure from their tenants, buyers and lenders is currently not collected. Anecdotal evidence suggests that disclosure is requested for real estate transactions involving large downtown office buildings. Now that benchmarking data is available, the City wishes to encourage the real estate sector to understand the importance of this data and how it can be used. It aims to move beyond mere compliance towards action on improving energy efficiency. It believes continued education of such stakeholders is required for future efforts.

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4.2.8

SINGAPORE – *Existing Buildings Legislation*

Abstract: The landmark legislation for the greening of existing buildings was enacted to accelerate progress in meeting the stretched national target of ‘greening’ at least 80% of Singapore’s building stock by 2030.

Citywide reduction target

There are two aspects to climate reduction targets for the city-state Singapore. The first pledge is to reduce national GHG emissions by 16% by 2020 from business-as-usual (BAU) levels, on the condition that there is a legally binding global agreement in place, in which all countries implement their commitments in good faith. In line with the above, Singapore has embarked on implementing policies and measures in the hope of reducing emissions between 7% and 11% from BAU levels by 2020.

Building-specific reduction target

Not specified.

I. Programme context

Overview

The legislation to green existing buildings (EB legislation) was passed in September 2012 as part of a strategy by the Building and Construction Authority (BCA) under the 2nd Green Building Master Plan (GBMP) to achieve the national target of greening at least 80% of the building stock by 2030. The implementation of this legislation signals a shift in focus from new to existing buildings. This was driven by the realisation that targeting the latter is the key to reducing emissions in the greater portion of the building stock in Singapore.

Background - Building Control Act and BCA Green Building Master Plan

Two major green building policies were enacted under the Building Control Act to mandate minimum environmental sustainability standards for all new and existing buildings in Singapore (see Figure 4.2.8). The first was the Building Control (Environmental Sustainability) Regulations implemented in 2008, a legislation aligned to the focus on improving the energy efficiency of new buildings under the 1st GBMP. The second legislation and focus of this case study—i.e. Building Control (Amendment) Act 2012—emerged in response to the existing building focus of the 2nd GBMP. The 3rd GBMP launched in September 2014 focuses on engaging building occupants and tenants as a holistic approach in reducing the energy consumption of buildings.

Key elements

The EB legislation instituted three key elements:

1. **Minimum Green Mark Certified standard:** Building owners are required to meet a minimum environmental sustainability standard at the time of an installation or replacement of any water-cooled/air-cooled chiller or unitary system. This aims to spur building owners to install energy efficient centralised air-conditioning systems to reap energy saving benefits over the typical lifespan of 15 to 20 years.

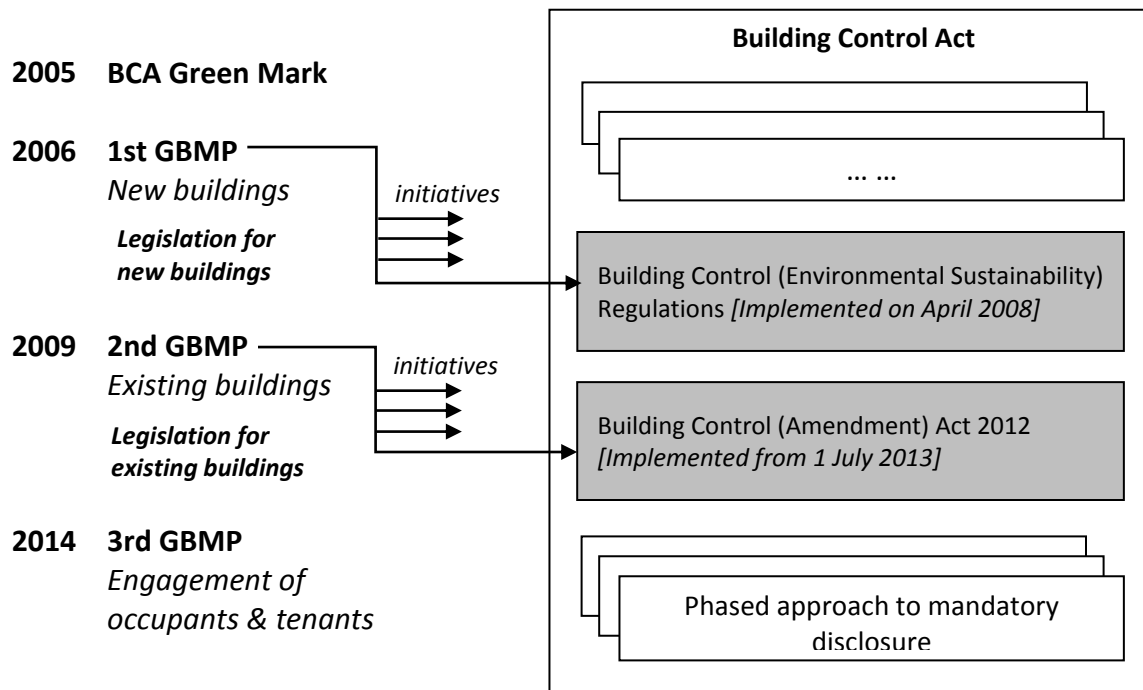


Figure 4.2.8 Legislative components under the Green Building Master Plans in Singapore

2. **Three-yearly energy audit on building cooling system:** Notified building owners must engage a Professional Mechanical Engineer or an Energy Auditor registered with BCA to carry out an energy audit on their chiller system in accordance with the prescribed Code and submit the necessary documents to BCA. This is to ensure that a building cooling system continues to operate efficiently and comply with minimum standards throughout its lifetime.
3. **Annual mandatory submission of building information and energy consumption data:** Building owners are to submit building information and energy consumption data annually through an online submission portal. The submitted data will form the basis of national building energy benchmarks, which will be shared with building owners to encourage them to pro-actively improve the energy performance of their buildings.

Target and scope

The EB legislation initially focuses on commercial buildings namely offices, hotels, retail and mixed developments. The minimum Green Mark certified standards and three-yearly energy audit for building cooling system are applicable to commercial buildings with gross floor area of at least 15,000 m², while the annual mandatory submission is applicable to all commercial buildings regardless of building size. The responsibility to comply with all three legislative requirements is on building owners. On the other hand, the legislation for new buildings is applicable to all new buildings and any extension, renovation or retrofitting works to existing buildings that involve a gross floor area of 2000 m² or more. Jointly, the two legislations mandate and improve the energy efficiency of the buildings in Singapore.

Overall goals of the programme

The EB legislation was introduced to ensure progress to green at least 80% of buildings by 2030

and promote energy efficiency in buildings. It was also designed to enable the collection of data to form the basis of a national energy benchmark for the building sector. This energy benchmark will encourage building owners to take a proactive approach to improving performance by allowing comparisons of current performance with other buildings. The establishment of minimum efficiency standards also aims to allow owners to increase energy performance whilst enjoying rewards such as reduced energy expenditures.

Submission and requirements of benchmarking and building data

Under the EB legislation, all notified commercial building owners are required to submit building information and energy consumption data starting from 1 July 2013. To initialise the submission cycle, an online submission portal, Building Energy Submission System (BESS), was developed to facilitate seamless data collection. Downloadable self-help tools such as a user submission manual, technical guide, and training and demonstration videos have been built in to assist building owners in familiarising with the submission requirements and procedures. For the first year, building owners are required to collate and submit the following building information:

1. Ownership and activity type (ownership, occupancy type, building activity type)
2. Building data (gross floor area, air-conditioning floor area, renovation/retrofitting works)
3. Service information (lifts, ACMV, lighting and hot water systems)
4. Energy consumption (electricity, diesel, gas etc.)

To overcome difficulties in aggregating energy consumption data from monthly energy bills of landlords and tenants, the BESS submission process is streamlined by drawing electricity data directly from utilities. For the subsequent years, building owners are only required to update any changes to the building information and view the energy consumption data prior to completing the submission.

At the close of the submission period, data collected through BESS are checked for any inconsistencies or data entry errors and, where necessary, building owners are contacted for verification before data are used for analytics and benchmarking. Furthermore, building information submitted by Green Mark buildings are cross-checked against their Green Mark submissions to ensure consistency of data submitted to BCA.

Verified data are analysed to establish national energy benchmarks for commercial buildings. Findings and benchmarks are shared with building owners via two platforms, namely the BESS and the inaugural BCA Building Energy Benchmarking Report (BEBR) 2014 which was released in September 2014. With the annual mandatory submission currently in its second cycle (as of 2014) a review of data requirements and reporting procedures will be conducted as part of future policy planning, such as a phased approach to mandatory energy disclosure.

Enforcement

In cases of non-compliance, a deadline extension and grace period with multiple reminders are given to the relevant building owners. For non-complying building owners, enforcement actions would be taken after repeated reminders. If convicted, an offender is liable to a fine up to S\$ 10,000.



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II. Inputs for the programme

Inputs during design stage

The legislation took about three years from design to implementation. During the design phase, stakeholders' feedback was gathered by BCA officials through industry consultation sessions with representatives from developers, Energy Services Company (ESCOs), Management Corporation Strata Titles (MCSTs), Mechanical and Electrical (M&E) consultants, building managers and government agencies. This was then used to fine-tune the proposed legislation. Separately, the annual mandatory submission through BESS was pilot tested with industry before the commencement of the legislation.

The design team also learned from New York City's experiences, and particularly the initial challenges faced by building owners in collecting aggregated building energy consumption data from tenants or utility suppliers. BCA mandated utility suppliers to provide energy consumption data directly to the Authority. This has served to minimise the burden on building owners to gather and aggregate past energy bills and also ensure greater data accuracy.

Prior to the introduction of the EB legislation, several incentive and financing schemes had been rolled out to encourage developers and building owners to carry out energy efficient retrofitting works for existing buildings. These have come solely from the Singapore government with no funding from non-profits or sponsors. A Green Mark Incentive Scheme for Existing Buildings (GMIS-EB) for S\$ 100 million was established in 2009 to fund the replacement of chiller plant

and other retrofitting works. This targets existing private commercial buildings with a minimum gross floor area of 2,000 m² and central chilled water air-conditioning plants, or plans to upgrade to such plants. GMIS-EB expired on 28 April 2014 and the cash incentive has been fully committed.

In 2011, a pilot Building Retrofit Energy Efficiency Financing (BREEF) Scheme was introduced to provide financial assistance to small and medium building owners for energy efficiency retrofits. Under the BREEF Scheme, BCA co-share 50% of the risk of any loan default to encourage private financial institutes to provide credit to small and medium building owners. In its initial phase, five projects were financed with over S\$ 6 million. Under the second pilot phase of BREEF from 1 April 2014, the co-share credit risk has been increased to 60%, with credit facilities extended to residential buildings.

Inputs during implementation stage

Implementation of the annual mandatory submission and associated duties such as communications, outreach, enforcement, analysis and monitoring etc. are currently assumed by a team of three BCA officers. This comprises of two part-time Executive Managers and one part-time Senior Manager (i.e. with other job responsibilities). All three officers provide direct assistance to building owners and building submission representatives such as MCSTs, managing agents and facilities managers through channels such as telephone hotlines, emails, onsite visits and one-to-one consultations.

Professional associations such as Singapore Institute of Architects, Institution of Engineers Singapore, Real Estate Developers Association Singapore and International Facility Management Association were engaged to disseminate circulars of the legislation to members. In addition, as a key outreach platform for diffusing latest news and information to industry stakeholders, BCA leverages on the Construction and Real Estate Network (CORENET), an online submission and information portal for planning approval, building and structural plans approvals and other official documents.

III. Programme results

Compliance and benchmarking results

In 2014, the annual mandatory submission entered its second year of implementation. The BCA BEBR 2014 covering the analysis of data collected in the first year, i.e. calendar year 2013, was released during the International Green Building Conference (IGBC) 2014 from 1 to 3 September 2014. The overall compliance achieved for the first year of data collection is 99%, as at 30 June 2014.

Growth of green buildings achieved

Although it is still too early to assess the unique impacts of the EB legislation on green building practices, various other policies and incentives established by BCA have contributed to a distinct growth in the number of Green Mark rated building projects in Singapore. These Green Mark buildings have grown by 17 in 2005 to about 2,200 in September 2014, now representing about 63 million m² or equivalent to more than 26% of Singapore's total gross floor area.

Programme effects on retrofit market

A growth in demand for several businesses and services related to building energy efficiency has been observed. This includes an increase in the number of Green Mark Managers and Professionals trained through various BCA Academy courses, and growing number of Environmentally Sustainable Design (ESD) consultants. Singapore is currently aiming to train 20,000 green collar specialists by 2020, comprising of industry personnel at Professional, Manager, Executive and Technician (PMET) level, to meet the market demand for professionals in design, maintenance and management of green buildings.

IV. Lessons learned for replication

IV-i Key drivers of success

Stakeholder engagement

BCA officers have made efforts to build close ties with various stakeholder communities such as developers, ESCOs, MCSTs, M&E consultants, building managers and government agencies. The input of these stakeholders into the design and refining of the various elements forming the wider framework of the EB legislation (see Figure 4.2.8) have helped to achieve a higher degree of acceptance for the EB legislation as well as various green building initiatives implemented under the GBMPs.

In June 2013, several industry briefing sessions were held before implementing the annual mandatory submission of building information and energy consumption data. These outreach efforts guided the affected building owners and representatives such as MCSTs, managing agents and facilities managers through the new legislative requirements. Communication channels such as telephone hotlines, emails, onsite visits and consultations with BCA officers were established to facilitate the smooth implementation of the legislation. Through these measures, the government aims to encourage compliance to the new EB legislation and secure ample information and energy consumption data from the commercial building stock for analysis.

IV-ii Main challenges

Cooperation from building owners

Establishing contact and gaining the cooperation of building owners proved time intensive during the early implementation stages. To ensure a substantial compliance rate for data analysis and benchmarking, it was necessary to directly reach out to all targeted building owners on the new legislative requirements. The data collection cycle was initialised through written notices issued at the end of March 2013. This provided targeted building owners with three months of advance notice to prepare the required building information for submission and complete the first time account registration through BESS. At the end of the submission period, BCA officers conducted onsite enforcement visits to establish direct contact with the non-compliant building owners in November and December 2013. Following onsite visits, BCA officers followed up with reminder emails and phone calls directly to non-responding building owners to further notify about penalties for non-compliance, while also extending assistance in completing submissions if required.

Small and medium building owners

Many small and medium building owners lack expertise in building management. Outreach efforts revealed that these owners typically lack the capacity to collate necessary building information to complete their submissions due to the absence of building professionals such as facility managers. To overcome this obstacle, BCA officers provided step-by-step assistance to direct these building owners to various channels to retrieve the building information.

Market information asymmetry

It was observed that existing building owners may not possess comprehensive building information and energy consumption data to allow for the monitoring of energy efficiency. On the other hand, tenants and occupants are also usually unaware of the energy performance of a particular building. As a means of bridging this information gap, the annual mandatory submission of building information and energy consumption data requires the aggregation of building information for the common spaces and tenanted areas. In parallel, aggregated energy consumption data for the entire building obtained from the utilities are shared by BCA, with the building owners during their submissions. Together with the submitted building information, the energy performance of the buildings is provided to building owners through the simple energy benchmarking reports available on BESS. The detailed analysis of the submitted data are shared with the industry through the BCA BEBR 2014.

Manpower challenges for enforcement and administration

The limited headcount (three part-time) is a major challenge on the ability of the BCA team to assist building owners in compliance.

Attempts to influence tenant behaviour

Since 2010, BCA has introduced an array of new occupant-centric Green Mark Schemes targeted at office, retail, restaurant and supermarket tenants. In parallel, many owners of large buildings have also implemented a series of initiatives to engage tenants in green practices such as recycling, energy and water saving and waste reduction. Despite such efforts, larger building owners have reported that take-up rates for these tenant engagement initiatives are relatively low. Increased tenant demand for energy efficient buildings has not been observed to any significant degree, as tenants are mostly unaware or unconcerned of the energy performance of commercial buildings. Increasing tenant awareness on building energy consumption and sustainability is therefore a key focus area for the future. As part of the 3rd GBMP (see Figure 4.2.8), building energy performances are shared publicly, beginning with voluntary energy disclosure through the BCA BEBR 2014.

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4.2.9

SYDNEY – *Smart Green Apartments programme*

Abstract: To investigate how private sector apartment buildings can contribute to a vision of Sustainable Sydney 2030, the City piloted the Smart Green Apartments programme with 30 buildings between 2011 and 2013. This sought to guide multi-apartment buildings to decrease energy and water consumption and waste outputs through free audits and information on government rebates.

Citywide reduction target

Sydney's highest level of strategy is the Sustainable Sydney 2030 plan, which paints a vision of the City of Sydney as 'Green, Global and Connected' and a leading environmental performer and global partner addressing the challenges of climate change. To confirm how the City will achieve its targets, one of which includes a 70% reduction in GHG emissions by 2030 from 2006 levels, the City has developed a suite of strategic Master Plans to map out the potential of technology and process changes. At the same time they are also developing various customer focussed strategies which confirm the specific actions that must be undertaken by all customers and stakeholders within target sectors.

Building-specific reduction target

Buildings and their occupants account for 80% of the City's emissions, with the commercial building sector the largest contributor. The residential apartment sector accounts for 10% of the City's emissions and in the City's first customer focussed strategy the City is considering setting a goal to reduce emissions in the residential apartments sector by 40%, and water consumption by 7%, by 2030 from 2006 levels.

I. Programme context

Key elements

With up to 73% of its residents living in apartments, many of which are towers, Sydney is often referred to as 'the Vertical City'. These residential buildings account for 10% of the City's GHG emissions, 38% of its water use and 14% of its waste. City data predicts that half of the population in the state of New South Wales (NSW) will be living in apartments by 2030. In response to this situation, the City launched the Smart Green Apartments (SGA) Programme in 2011 to help apartment owners and managers to reduce energy and water use, minimise waste and GHG emissions, and improve environmental sustainability.

The programme consists of despatching professional auditors to selected residential apartment buildings to conduct sustainability assessments and investigate potential improvements regarding water and energy consumption, renewable energy and waste. The programme started off with five pilot buildings in 2011 and has since expanded to 30. Participating building owners and managers receive the following benefits:

- free water and energy audit of building, including performance indicators monitoring and efficiency plans
- assessments of waste and recycling practices

- action plan with retrofitting recommendations
- business case information on capital costs, projected savings and pay back periods, and government rebates
- knowledge and capacity building

Each building received a tailored action plan that was presented to apartment building decision makers such as executive committees and strata and building managers to enhance the capacity of owner corporations to implement upgrades.

Benefits from participation include: (1) financial advantages from lower energy costs, (2) improved attractiveness of property in real-estate market where energy prices and demand for energy efficient buildings are growing, and (3) stronger resident and management communities.

The programme has established a database consisting of energy consumption, opportunities identified and progress of any improvements implemented. This serves as the empirical evidence base for designing the above-mentioned Residential Apartment Sector Sustainability Strategy. Experiences from these 30 buildings will be disseminated to other buildings via initiatives in this strategy. Initial learnings are being shared through a network of over 100 apartment buildings across the City through targeted communications and workshops.

Strata schemes

A strata scheme is a system of building ownership. Individuals each own a unit (i.e. a single apartment or townhouse) while sharing a responsibility for operations and maintenance of common assets. These include, for example, energy and water consuming central plants, equipment for hot water and heating, ventilation and air conditioning systems, driveways, pathways, fences, gardens, external walls, entertainment areas and so on. For a strata scheme to exist, a property must comprise at least two individually owned units, which can be residential, commercial or a mixture of both. Such a property can be a single level set of units, townhouses or commercial offices, or a vertical block of apartments.

Although each state and territory in Australia uses different terminology, Strata Community Australia defines related concepts (especially in New South Wales) as the following:

- **Owner:** A person or company owning a strata unit registered on the Certificate of Title.
- **Owners corporation:** Also known as a body corporate, this is the body composed of all the owners in the strata scheme. Each owner of a unit is part of the owners corporation and has the right to participate in its decision making.
- **Strata building:** A building with at least two individually owned unit dwellings. The vast majority of apartments in the City of Sydney are classified as strata.
- **Strata manager:** A professional responsible for the general maintenance of the building and common areas. Also referred to as body corporate managers, strata managing agents, managers, and agents, depending on the state or territory.
- **Unit (Lot):** A portion of property that can be separately owned and sold. In a strata scheme, a unit is generally a single apartment or townhouse.

Apartment buildings in the City of Sydney

There are over 20,000 buildings in the local government area containing private dwellings. Of these, over 1900 are apartment buildings. Of these, 40% are low rise (3 storeys and less), 30% are medium rise (4-5 storeys) and 30% are high rise buildings (6 storeys and above). While the

number of apartment buildings is smaller compared to other residential building types, they accommodate the vast majority of dwellings. Of the almost 100,000 dwellings in the City approximately, 75% are accommodated in apartments. Looking ahead, approximately 20,000 dwellings are expected to be built in the next eight years, with over 90% being new high rise building developments.

Programme target and scope

The target for the SGA programme was multi-unit residential apartment buildings with over 20 units in the City of Sydney, and more specifically, owners corporations and management service providers. Since its launch, over 100 apartment buildings expressed their interest in participating in the programme. Of these, a total of 30 were selected, with efforts to ensure representation of diverse profiles and expertise levels in regards to building sustainability (i.e. frontrunners and late adopters etc.). Another focus of the City was on medium and high rise apartment buildings over four storeys as these generally have centralised systems and therefore higher resource consumption.

Overall goals of the programme

SGA does not have any specific metrics such as reduction targets. However, it was conceived to play an important role in achieving the Sustainable Sydney 2030 objectives by contributing to the reduction of water and energy consumption—two core elements of the Sustainable Sydney 2030 vision.

Links to other programmes

Concurrent to the Smart Green Apartments programme, the City has contributed to the creation of an online toolkit called Smart Blocks. This was developed in collaboration with Strata Community Australia, City of Melbourne, Green Strata and Owners Corporation Network. This national programme provides guidelines on how to navigate strata decision making concerning energy efficiency upgrades of common areas in apartment buildings. It offers resources such as case studies, specific strategies to decrease energy consumption, information on costs and funding options and rebates.

In parallel, the City is currently developing a strategy to address the specific opportunities and challenges identified in the Smart Green Apartments programme on a sector level. Knowledge outcomes from the programme are being used to shape policies such as the above-mentioned Apartment Building Sector Strategy. This Strategy will eventually fix specific reduction goals and enable the Sustainable Sydney 2030 vision to be realised in both existing and new apartment buildings.

II. Inputs for the programme

Inputs during the design phase

The design of SGA took place over a year, beginning in 2011. A key element of this conception phase involved a pilot phase of five buildings. Staffing was 0.6 FTE for design and 1 FTE for the pilot programme, with no specific budget allocated.

Previous research by the city was important, such as the Multi Unit Residential Building Energy and Peak Demand Study (Energy Australia, 2005). One of its key findings was that, contrary to

common belief, residents living in high rise apartment buildings produce higher GHG emissions than people living in detached houses, mid-rise, low-rise and townhouses. This is due to smaller household size in relation to single houses, and centralised systems on common property, of which energy intensity increases with building height. A second study informing the SGA programme came from the University of New South Wales in 2012 on the role and effectiveness of strata management. It found that residents in strata titled apartments are often unaware of their rights and responsibilities and lack capacity to tackle complex issues relating to governance and administration, maintenance and sustainability upgrades.

Stakeholder engagement also formed a key component of the design phase. In June 2011, a Smart Green Apartments stakeholder reference group was established to encourage collaboration across government and industry stakeholders. It consisted of state planners, energy utilities, members from the Green Building Council and owner/tenant representation organisations. This group was made possible by previous collaborations between the City and the community, which emerged during the formation of the Sustainable Sydney 2030 strategy in 2007.

Inputs during the implementation phase

Apartment building owners have received free energy audits up to a value of AU\$ 10,000 each. These were jointly financed by a State government partner (NSW Office of Environment and Heritage) and the City of Sydney. In addition, the City spent AU\$ 100,000 for water auditing, events and monitoring and verification of the program. The City's residential engagement has been enhanced through the development of the National Smart Blocks resource, funded by an Australian government grant of \$1.09 million.

As of June 2013, the City has spent one year delivering the remaining 25 pilot buildings. This coincided with the launch of Smart Blocks in June 2013 after 18 months of preparation. The Apartment Building Sector Strategy is also being developed in conjunction with the implementation of Smart Blocks during the period of 2013-14. It is expected that this will involve advocacy for policy reform over the next five to ten years.

In terms of staffing, the City allocated between 1-1.5 FTE in the second year for conducting the assessment of 30 buildings, with 1 FTE in the third for follow-up support and development of the Apartment Building Sector Strategy.

The City continued stakeholder engagement during implementation. In addition, they sought collaboration with other governmental departments such as the NSW Government's Office of Environment and Heritage (OEH) to link the pilot with existing energy savings programmes, which subsidise up to 80% of energy audit costs to owner corporations.

The City has also provided the owner corporations and managers of participating apartment buildings with resources to engage residents. These included posters, flyers and Internet alerts on various details of a building's participation such as the type of activities in progress. Green Villages and Strata Skills 101 also aim to foster the engagement, knowledge and capacity of residents regarding residential sustainability and strata living.



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III. Programme results

The City has identified that, on average, buildings can reduce energy consumption by up to 30% by implementing a variety of cost effective measures. Together these savings amount to an average of AU\$ 74,000 per year per building, with less than 3.6 years required to recover investment costs.

Programme effects on retrofit market

SGA has succeeded in stimulating retrofitting activity in apartment buildings either participating or affiliated with the programme. Of all sustainability improvement recommendations made by the City to the 30 participating buildings, approximately 37% have been implemented. Further, over 100 buildings have expressed interest in the programme to date. This suggests that lessons from SGA will be assimilated by other owner corporations and managers around the city.

Other findings to emerge from the programme are as follows. Firstly, the City has identified that nearly 60% of energy consumption comes from the shared portions of properties such as lighting, swimming pools (pumps and heating), heating and ventilation systems etc. Since lighting upgrades generate the highest return on investment within the shortest payback period (usually less than two years), many buildings have saved 20-30% of lighting costs by upgrading lighting fixtures (e.g. more efficient bulbs or installation of motion detectors).

Regarding water, programme data indicates that almost 90% of water consumption in participant buildings comes from individual apartments (40% from showering, 30% from

bathrooms and basins etc.). The programme identified that sub-metering of water usage is one of the keys to promote water efficiency as it gives a clearer idea of water-wise practices for owners, managers and occupants.

In addition, other improvements to the sustainability of apartment living have occurred through the programme. For instance, efforts were made to foster waste reduction by encouraging recycling and adding multi-lingual signage. Some apartments have installed bike racks to encourage alternative transport usage, whilst others have built rooftop green patches and vegetable planting areas to improve common areas and strengthen community connectivity.

IV. Lessons learned for replication

IV-i Key drivers of success

Information plus financial incentives

The City aimed to provide information combined with support to take action. Firstly, audits were subsidised (around 20-30% by the City and the rest by other government programmes). Secondly, these audits identified specific measures to improve energy and water performance, in addition to estimating capital costs and payback periods. Thirdly, information was also provided for government rebates available to help finance property improvements. In this way, this auditing exercise generated convincing financial arguments and incentives to spur apartment decision makers into action.

Existing sustainability framework

The broader vision and targets set out in the Sustainable Sydney 2030 strategy helped justify the need to tackle GHG emissions and water and energy efficiency in the apartment sector.

Collaboration with key stakeholders

Support from key stakeholder communities was crucial for SGA, which relied on voluntary participation from the residential apartment sector. Dating back to the formation of the Sustainable Sydney 2030 strategy, the City developed a reputation for forming strong collaborations and achieving concrete outcomes with industry and the community. It was able to leverage this trust when assembling the reference groups with stakeholders. Support and momentum for the design of the SGA programme was gained by holding regular meetings and keeping these stakeholders informed of developments in the programme. Another important factor in gaining support for the programme was the various benefits for stakeholders, additional to the opportunity to advance sustainability. For example, this included the opportunity to meet other government and industry stakeholders in the same sector and exchange knowledge.

Selection of diverse buildings

The City deliberately chose participants with varying sustainability expertise and capability. This was to capture as broad a data set as possible for informing the Apartment Building Sector Strategy and future programmes. Participants ranged from early adopters with a history of energy initiatives to those just beginning to adopt sustainability practices.

IV-ii Main challenges

Strata scheme governance and decision making

Strata schemes are unique in the way that they consist of an owners corporation, where individual unit owners take part in a collective governance mechanism for the entire property. In this body, decisions are made through a specific governance structure stipulated in state legislation. Since there are numerous stakeholders involved in each multi-apartment building, a key challenge for the City was to ensure that participants signing up for the programme had engaged the various people required for the decision making process to apply for and deliver the programme. This process took considerable time and effort for both the building stakeholders and the City.

Data collection issues

Like many other cities implementing sustainability programmes, the City of Sydney faced issues in data collection. Since most of the pilot buildings were not accustomed to collecting aggregated energy performance data for the entire property, it proved a key challenge for the City to ensure that the necessary data was collected. To this end, the City forged a partnership with an energy network provider to help buildings determine whether this data was already available, and where necessary, to integrate consumption data from each individual unit dwelling.

Credible benchmarking or rating tools

The most important challenge for City officials will be the development of credible benchmarking or rating tools to equip both programme participants and the community in assessing a particular property's energy efficiency. One of the learning outcomes of the programme was the need for the development of key performance indicators for this purpose, which did not exist. Yet this could be quite misleading to compare a diverse range of buildings with differing structures, ages and equipment. A key challenge for the future is therefore the development of a reliable benchmarking or rating system to drive understanding in the apartment market regarding sustainability performance—and in particular energy efficiency. One barrier to realising this, however, is that the current housing market in Sydney is thriving due to a supply shortage. It is therefore expected that high energy efficiency will not be a key differentiator in such conditions. That said, officials believe that even the presence of simple star ratings scheme would have potential to encourage people to choose buildings with superior energy performance.

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4.2.10

TOKYO – Tokyo Cap-and-Trade Program

Abstract: A mandatory cap-and-trade programme set up by the Tokyo Metropolitan Government to reduce GHG emissions in the most energy intensive building sector in the Tokyo Metropolitan Government jurisdiction. Key features include flexible approaches for facility owners and substantial measures to ensure the accuracy of data reporting and realisation of reduction targets.

Citywide reduction target

The Tokyo Metropolitan Government (TMG) aims to reduce citywide GHG emissions by 25% and energy consumption by 20% below 2000 levels by 2020.

Building-specific reduction target

As part of this wider target, Tokyo has called for a 17% reduction in GHG emissions from commercial and industrial sectors by the year 2020. This target also applies to the cap-and-trade programme targeting large facilities.

I. Programme context

Key elements

The Tokyo Metropolitan Government (TMG) has until now taken several measures to promote building energy efficiency. The Tokyo Cap-and-Trade Program (TCTP) implemented on the 1st of April 2010 is one such initiative, also being the world's first urban cap-and-trade scheme. The programme is a stepped-up measure of the Tokyo Carbon Reduction Reporting Program that started in April 2002. Under the former reporting programme, targeted facilities were required to annually report emissions and reduction plans, and encouraged to reduce emissions. This initiative resulted in a mere average reduction of 2%. In contrast, by the end of FY2012 the current TCTP has achieved a total 22% reduction from baseline emissions (itself determined by the average of any three consecutive years between FY2002-2007). The flow of the implementation cycle is illustrated below in **Figure 4.2.10**. A complete compliance cycle of the TCTP consists of the following three key elements:

1. **Compliance period:** Each compliance cycle lasts five years, after which the next begins. Within that period, covered (i.e. mandated) facilities are required to report energy consumption and GHG emissions by the end of November next year. If the target is not met through internal measures, facility managers or owners will plan the procurement of external carbon credits and implement further reduction measures to ensure the emissions target will be met by the end of the cycle.
2. **Compliance adjustment period:** This lasts one and a half years, beginning from the end of the first compliance period. During this time, total actual emissions and emission allowances are confirmed. To meet emissions reduction targets, facilities owners or managers are permitted to continue trading credits until the end of the adjustment period.

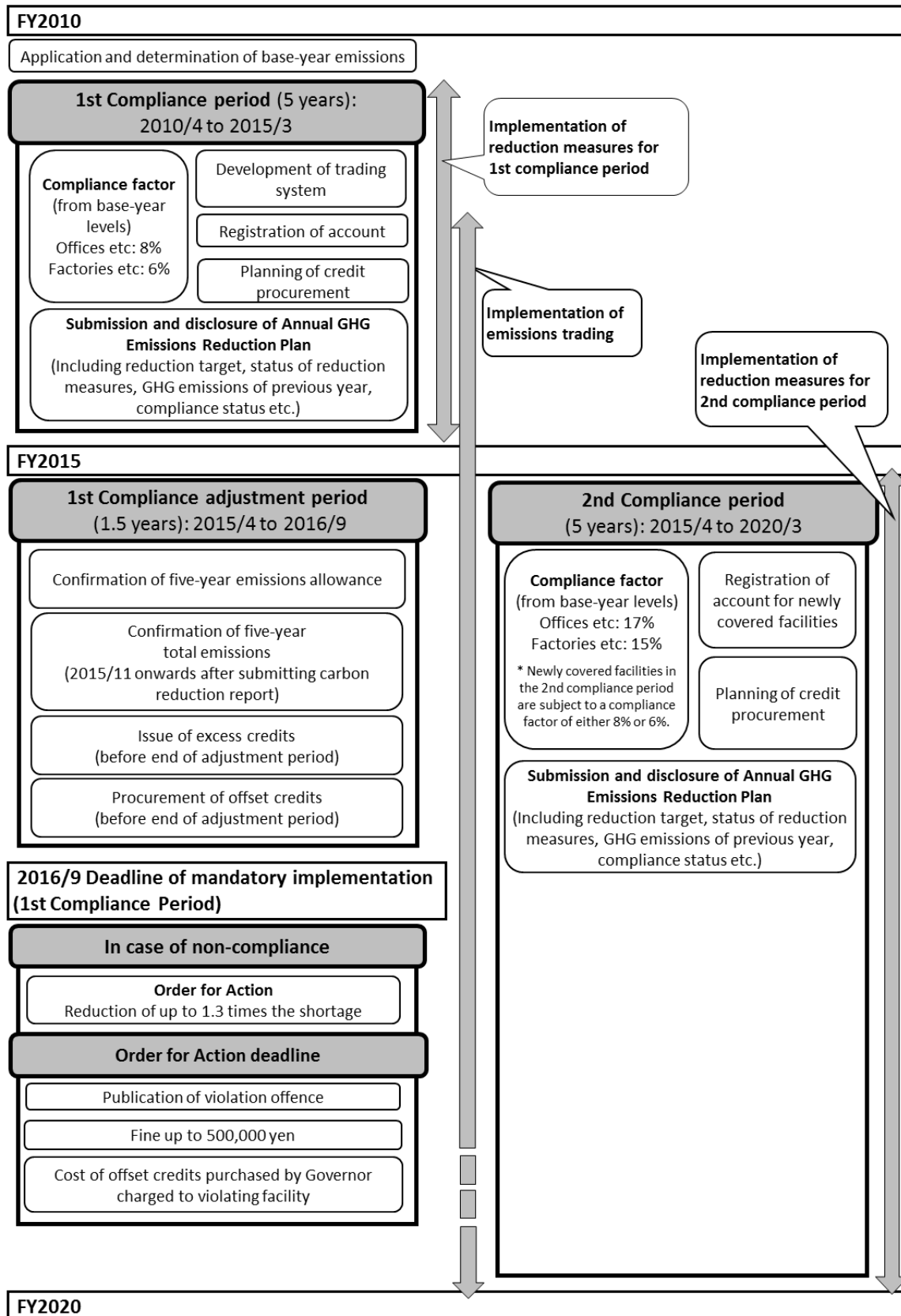


Figure 4.2.10 Flow of the Tokyo Cap-and-Trade Program

3. **Deadlines for mandatory implementation and Order for Action:** In the case where mandatory emissions reduction targets are not met, an Order for Action will be issued to non-compliant facilities. This administrative order will oblige managers and owners to reduce emissions to an amount up to 1.3 times greater than the target shortfall. If a facility does not fulfil this requirement by the deadline, the act of violation will be rendered public and the facility will be fined an amount up to 500,000 yen. In addition, they will have to pay the purchase price for offset credits procured by the Governor of Tokyo to cover the shortage.

Currently as of 2014 May, the first compliance period of TCTP is in full implementation citywide and will terminate at the end of March 2015. After this the adjustment period and second compliance period will start.

Data from covered facilities is currently disclosed publically on the Internet. This includes detailed facility-level information on emissions from energy and water consumption, progress towards reduction targets and details of any credit procurement or sale. It also includes overall statistics for the programme regarding total emissions reductions achieved and the volume and nature of credit trading.

Programme target and scope

TCTP targets existing large facilities from the commercial and industrial sector, also inclusive of government buildings. It targets buildings whose previous fiscal-year energy consumption is superior to 1500 kilolitres of crude oil equivalent. Under this condition, approximately 1400 buildings (about 1100 commercial [mainly offices] and 300 industrial [e.g. factories and water/sewage treatment plants], both of which include government and municipal facilities) are covered. Although these facilities represent only about 0.2% of all commercial and industrial facilities in Tokyo, they nevertheless account for about 40% of the total CO₂ emissions from those sectors.

A covered facility is designated as 'Facilities with GHG Reporting Obligations' (Reporting Facilities) and required to report to TMG every year. When a Reporting Facility meets the above energy consumption condition for three consecutive years (first fiscal year excluded), it will be designated as a 'Facility with CO₂ Reduction Obligations' (i.e. a Compliance Facility). A Compliance Facility has to meet an emissions reduction target by implementing reduction measures and participating in emissions trading.

In principle, the owner of a Compliance Facility holds the responsibility to ensure achievement of the emissions reduction target. Yet since the scope of covered facilities in the whole building extends to include tenanted space, tenants are therefore obliged under this programme to cooperate with building owners. For large tenants who either (1) occupy a floor area of 5000 m² or greater, and/or (2) consume in excess of 6 million kWh or more annually in electricity, they must meet stricter requirements including the submission of an annual report to the TMG via the owner. Such tenants may also, where necessary, directly receive guidance and warnings from TMG.

Types of credits for trading

A covered facility needs to procure credits in the event that the emissions cap is expected to be exceeded. Five types of credit can be traded: (1) excess credit from other covered facilities, (2) credit obtained from CO₂ reductions voluntarily achieved by small and medium facilities in Tokyo, (3) credit obtained from generation of renewable energy, (4) excess credit from large facilities outside of Tokyo, and (5) credit from facilities covered by the Saitama Cap-and-Trade Program, a similar programme in an adjacent prefecture. Each type of credit has its own validity period. In general, a credit issued in a compliance period is valid until the end of the next compliance period.

Nomination of a general manager and technical manager

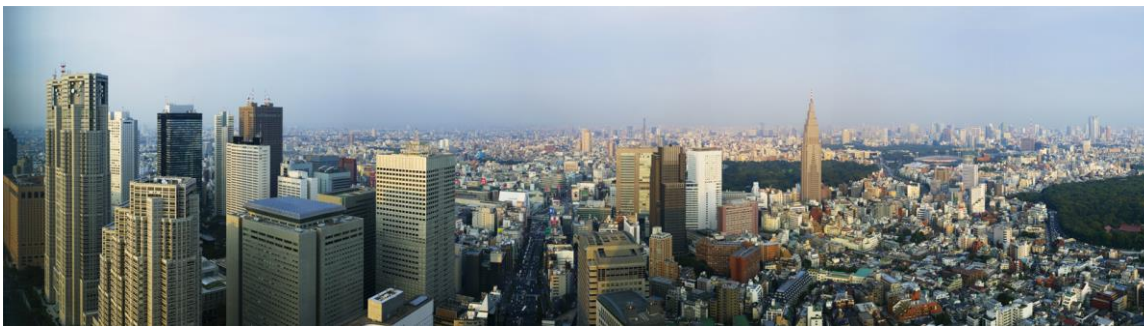
Covered facilities must nominate both a general manager and technical manager for each facility when complying with TCTP. A general manager must belong to a department charged with overseeing the implementation of global warming countermeasures in that facility and must occupy a position of decision-making authority. They must supervise and monitor employees and communicate with top-level management. Conversely, a technical manager must possess a technical certification such as that for an architect, engineer or energy technician. They must provide technical advice and recommendations to the general manager and top-level management. In the case where the role of a technical manager is contracted to an external party, a nominated manager may oversee no more than a total of five facilities simultaneously.

Top-level facilities

Facilities demonstrating outstanding performance in emissions reduction and satisfying high-level standards established by the Governor of Tokyo can apply to be recognised as a 'top-level' facility. These standards concern areas such as energy efficient design, equipment (lighting and cooling/heating etc.), renewable energy, building operations and the involvement of tenants in data gathering and monitoring. There are two categories: a 'top-level' and 'near-top' level. Facilities may gain certification after meeting minimal requirements and then conducting a compliance verification through a registered third party. Assessments are then conducted periodically after certification to ensure continued compliance. This voluntary certification system has a dual incentive effect. Firstly, certified facilities receive the benefit of a reduced compliance factor (reduction to 1/2 for top-level and 3/4 to near-top level). Secondly, certified facilities will gain increased societal recognition as a highly efficient building, which can serve to boost competitiveness in the market. For the period April 2010 (i.e. programme start) to March 2014, a total of 35 facilities have been certified as top-level, and 48 as near-top level.

Overall goals of the programme

The TCTP requires covered facilities to achieve absolute emissions reductions of either 6% (for factories etc.) or 8% (for offices etc.) from base-year emissions for the first compliance period, and then either 15% or 17% for the second. This goal is derived from the TMG emissions reduction target under the Tokyo Metropolitan Environmental Master Plan of 2008 and discussions in a TMG report to the Environmental Council. As part of an overarching strategy to achieve a citywide 25% reduction of GHG emissions below 2000 levels by year 2020, these documents have deemed a 17% reduction by the year 2020 as being a fair target for the commercial and industrial sectors in Tokyo. The progress of the programme is evaluated through annual reports of actual energy consumption and GHG emissions submitted by owners of each facility.



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Links to other city policies or programmes

Since 2002, TMG has developed and enforced a policy called the 'Green Building Program' aiming to promote environmentally superior new architectural developments. Owners of buildings larger than 5000 m² are required to submit a building environmental plan. This includes comprehensive information on areas such as ratings for energy efficiency, renewables, construction materials, building lifetime, greenery and water cycles, and heat-island effect. As well as being required in advance to a building permit application, a report is also required after the completion of construction. There are even stricter requirements for buildings larger than 10,000 m², with owners needing to meet higher energy standards and issue Energy Performance Certificates to potential buyers or tenants. This programme for new development was introduced in 2002 around the same time as the predecessor of TCTP (i.e. the Tokyo Carbon Reporting Program). In accord with several reforms of the TCTP and its predecessor, the Green Building Program has also been tightened twice; once in 2005 and once in 2010. At present, almost 400 buildings are required to submit plans annually under the Green Building Program, with many of these highly likely to be eligible for the TCTP in a few years' time as they cross the 1500 kilolitre threshold. Buildings submitting reports under the Green Building Program are therefore well placed to be tracked and followed up by the TCTP.

Programme effects on other initiatives for small and medium buildings

Under the TCTP, emission reduction measures taken by small and medium buildings are recognised and qualify as credits that can be traded with other large facilities.

On the other hand, TMG has a different programme called the Carbon Reduction Reporting Program for Small and Medium Facilities. This requires annual reporting from small and medium building owners and also involves disclosure of reported data. A benchmarking tool has been developed from the reported data, with the second version of the benchmark published in March 2014. The benchmarking tool can enable owners to understand the energy use of their facilities and then find potential energy management opportunities. The disclosure of data can also encourage competition amongst owners and encourage the implementation of energy efficiency measures. Besides this, TMG also offers free energy retrofit advice and tax incentives to small and medium building owners.



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II. Inputs for the programme

Inputs during the design phase

Planning and design of TCTP took place from 2006 to 2008. Preparation started in late 2006 and was publicised via a proposal for a mandatory emissions reduction programme for large facilities during the announcement of the Tokyo Climate Change Strategy in June 2007. There were four full-time officers and two additional supporting members involved in the final design stage. Deliberate discussions were held at TMG's Environmental Council between May 2007 and March 2008. In addition, between July 2007 and January 2008, several stakeholder meetings concerning the introduction of TCTP were held. These involved representatives from industry groups such as real estate, department stores, hotels, ESCOs and utilities, as well as other participants such as NGOs and academics.

Several research projects were commissioned to consulting firms with engineering, accounting and other backgrounds during both early planning and detailed design stages. In June 2008, a bill to amend the Tokyo Metropolitan Environmental Security Ordinance was passed. As this amendment incorporated various elements and objectives of TCTP, this reformed bill formed the legal framework to enable implementation of TCTP. After passage of the bill, consultation processes regarding the finer details of the programme design continued. These encompassed public consultation, expert meetings and consultations with the Environmental Council.

Inputs during the implementation phase

As mentioned, TCTP consists of two five-year compliance periods stretching from FY2010 to FY2019. About 15 in-house staff have been involved in the implementation stage (ten for implementation and administration and five for emissions trading). Typical tasks undertaken include management of annually submitted reports, certification of top-level facilities, certification and issuing of credits, outreach such as briefing sessions and diffusion of best practices, and management of verification system. Several briefing sessions are held each year to inform external parties about minor changes, annual schedules, achievements and other inputs to the programme. As mentioned above, tenants are required to cooperate with owners in collecting energy use data, reducing emissions and engaging in the cooperative structure. TMG also has arranged for the utilities (mainly Tokyo Electric Power Company (TEPCO) and Tokyo Gas) to provide energy use data to facility owners if requested.

III. Programme results

Progress to date

As of the year 2014, TCTP has entered its fifth and final year of the first compliance period. Progress is being monitored from energy use and emissions reduction data from the annual reports submitted by owners of covered facilities. This data is required to be externally checked by registered verification agencies before submission to TMG.

Based on a review of 98% of all covered facilities in January 2014, total base-year emissions were established at 13.61 million tonnes of CO₂. Based on this, it was reported that a total 13% reduction of GHG emissions was achieved in FY2010, growing to 22% in FY2011 and remaining steady at 22% again in FY2012. These progress results are highly promising as they all exceeded the maximum compliance factors for the first compliance period (8%) as well as the second compliance period (17%). By banking (i.e. carrying forward) excess credit into the next compliance period, most of the current covered facilities are expected to be able to fulfil emissions reduction requirements.

Market effects on retrofitting and building energy efficiency

TMG believes that TCTP has helped to stimulate growth of the retrofit market. Several indicators serve in testimony of a market transformation. These include, for instance, progress in building retrofitting technologies and techniques since introduction of the programme, an increase in the number of installations for BEMS and LED lighting, and lastly, a rise in the number of ESCO businesses. This said, in appraising effects on the retrofitting market, it is also necessary to take into account the influence of the Great East Japan Earthquake in March 2011 which has also been a substantial driver of retrofitting activity. This has occurred as many commercial and industrial buildings across greater Tokyo were forced to take drastic measures to reduce electricity consumption to cope with supply shortages following the Fukushima power plant disaster and National and Metropolitan Government calls for electricity conservation. Nevertheless, programme results in 2014 report that TCTP has succeeded in mitigating any growth in GHG emissions, even after government pressure for energy saving was significantly reduced. That is, the total reductions of 22% (achieved in FY2011) were maintained for the following year FY2012, a period where on the contrary, one might have expected a sudden rebound in GHG emissions as power supplies recovered.

As for other programme impacts, it has now become usual in Tokyo to design new buildings satisfying the requirements for a 'top-level facility' certification under TCTP. This signifies that the incentive of being recognised as a 'top-level facility' by the programme (together with the added reward of the reduction target being halved for that facility) is serving to spur low-carbon building practices for large new developments across Tokyo. As another indicator of the influence of TCTP, it is also widely recognised that Saitama prefecture has started a similar emission trading programme, which was influenced by Tokyo's leadership with TCTP.

IV. Lessons learned for replication

IV-i Key drivers of success

Stakeholder engagement

During the design stage in particular, TMG placed a large amount of emphasis on communication with stakeholders, especially owners and facility managers. Officials found that

the involvement of as many stakeholders as possible during the design process was useful for obtaining various feedback, which was utilised to make a more feasible and acceptable programme. This process then contributed to reducing the level of resistance for the reason that stakeholders felt that their concerns were being adequately reflected.

Intensive background research

TMG officials made strenuous efforts to ensure the success of the programme through intensive background research. The EU Emissions Trading Scheme, started in 2005 and criticised by some for not setting a more aggressive baseline, served as an important point of reference. With substantial data collected through the previous Tokyo Carbon Reduction Reporting Program, TMG worked to use this existing knowledge base to set an optimal baseline for TCTP and convince stakeholders of their data-backed confidence that the programme would succeed. This confidence also came from extensive knowledge on the potential for higher energy performance in the facilities that would be affected by TCTP. This was gained from onsite visits and interviews with individual facilities, under the supervision of TMG's highly experienced professional energy contractors, since the beginning of the Carbon Reduction Reporting Program.

Mandatory establishment of management structure with technical experts

Since introduction of TCTP, senior decision makers have been in effect forced to take into account GHG emissions, energy efficiency and management in corporate management and planning. One of the ways this has been achieved is through the mandatory requirement that covered facilities establish a formal management structure for matters such as energy and GHG emissions. A distinguishing characteristic of this requirement is that the management structure must include a general manager as well as a technical manager (either in-house or a third-party) to provide advice on reduction measures. Before the TCTP programme, many technicians possessed knowledge on how emissions reductions could be achieved, yet were unable to implement these because they were unable to influence senior level decision making regarding facility upgrades. With introduction of TCTP, technical managers are now given the responsibility of reporting and advising directly to senior management boards about emissions reduction issues and measures that can be incorporated in business strategies or building management plans for concerned buildings. This TCTP-driven influence on senior-level decision making has, in many situations, facilitated the upgrading of inefficient equipment in many organisations.

Capacity building

For both stakeholders and City officials, capacity building is playing a crucial role. TMG is carrying out various initiatives to increase stakeholder awareness and knowledge about energy efficiency in buildings through seminars, educational events, the compilation of best practices into online case studies, and the provision of free energy audits to small-medium facilities. Capacity building is also taking place internally, with many TMG staff undertaking on the job training to build knowledge on energy efficiency techniques and initiatives in buildings and industry conditions. This knowledge is considered essential for dealing with external stakeholders and third parties. Officials are also seeking to build knowledge by learning from other cities, and international organisations.

Mid-term reduction obligation

In other cap-and-trade systems such as the EU Emissions Trading Scheme, for example, reduction obligations apply annually, which is optimal for stimulating short term carbon trading. In contrast, TCTP aims to achieve average reductions over a five year obligation period. This mid-

term focus serves to encourage investments for energy efficiency upgrade measures.

IV-ii Main challenges

Determining baselines and emissions caps

It proved a highly technical challenge to determine the best method of setting baselines and emissions caps for the programme so that a meaningful reduction in emissions could actually be achieved, without excessively burdening the targeted facilities. The TMG team was acutely aware that the ultimate success of the programme depended on the ability to establish the optimal baseline. When establishing baseline emissions, TMG opted for a considerably flexible approach. Base-year emissions are calculated based on the average of any three consecutive fiscal years between 2002 and 2007 so that the facilities can incorporate the results from their efforts in past years (such as voluntary energy efficiency upgrades implemented during the previous Carbon Reduction Reporting Program). On the other hand, the emissions cap (compliance factor) was strictly set to either 6% or 8%—figures deemed as ‘fair’ by several studies conducted during the design stage.

Double checking of data verification

Substantial measures have been taken since the beginning to enhance data accuracy. Firstly, annual reports submitted by the owners were required to be checked by registered verification agencies before submission to TMG. Secondly, Tokyo officials also check data accuracy and contact owners in cases of any problems as there were some cases where data verified by registered agencies contained errors. The combination of this double checking process has thus helped to improve significantly the reliability of data obtained over the years. Data obtained through the programme is crucial as it will serve to monitor the effectiveness of the TCTP itself, whilst also identifying best practices. It is hoped that data obtained will allow City officials to make improvements to other existing programmes and implementation measures regarding energy efficiency and climate change governance.

Tenant engagement

TCTP mandates that tenants cooperate with building owners in pursuing energy efficiency and reducing GHG emissions. For example, this includes the provision of energy consumption data when needed, cooperation with owners responsible for reducing energy consumption, attendance in owner-initiated commission meetings, or cooperation with building operation guidelines in regards to energy consumption. Despite such stipulations, it is nevertheless proving challenging overall for the TMG team to successfully engage tenants in energy efficiency and GHG reduction measures.

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4.3 Analysis

The ten case studies illustrate the rich variety of initiatives implemented by C40 cities to respond to climate change and improve sustainability in the commercial and residential building sector. The case studies document both *regulatory* (i.e. compliance mandated by law) and *voluntary* policy initiatives to reduce GHG emissions, drive energy efficiency, and foster retrofitting and sustainable building practices.

As outlined in **Table 4.1** the regulatory programmes highlighted in the case studies consist of:

- various reporting and benchmarking schemes for gathering and comparing individual building performance for energy (and water) consumption and GHG emissions;
- periodic energy efficiency auditing or retro-commissioning requirements;
- minimum energy efficiency codes for retrofitting; and
- minimum emissions reductions under cap-and-trade schemes.

The voluntary programmes include ‘friendly competitions’ to measure and compare environmental performance, identify opportunities for further improvement, and enhance capacity to retrofit and improve environmental performance.

Drawing upon the diverse array of programme structures and experiences from C40 cities, this section outlines and analyses common lessons and key trends.

4.3.1 Key characteristics

Implementation year

As indicated in **Table 4.1** and **Table 4.2**, the majority of the programmes have been implemented only relatively recently, since 2010. Four programmes were implemented after 2012. These programmes are important to study since they represent new and sometimes experimental approaches. However, concrete results in the form of measurable reductions in GHG emissions and energy consumption, the number of green jobs generated with ESCOs and other service providers, or the amount of green premium realised have yet to emerge. The real effect of these programmes will materialise in the coming years, which should be kept in mind when interpreting the results and impacts to date.

Table 4.2 First year of implementation³*All programmes are new and implemented after 2010.*

Year	Number of programmes surveyed	
2010	2	(Melbourne, Tokyo)
2011	4	(Houston, New York City, San Francisco, Sydney)
2012	2	(Hong Kong, Seattle)
2013	2	(Philadelphia, Singapore)

Target and scope

As shown in **Table 4.3**, the majority of programmes discussed in the ten case studies focus on commercial buildings, including offices, hotels, retail venues, multi-apartment buildings, and, in some cases such as Tokyo, factories and warehouses. Conversely, programmes targeting residential buildings were, on the whole, far less common. Sydney is the only programme aimed specifically at residential buildings while benchmarking programmes in Seattle and New York City address the residential sector as well as the commercial sector. In the case of Sydney, the residential focus reflects the fact that 50% of the population is expected to reside in apartment buildings by 2030. These buildings account for 10% of citywide GHG emissions, 38% of water use and 11.5% of waste.

Table 4.3 Targeted sector*Most of the programmes target commercial buildings while some cover residential buildings.*

Sector	Number of programmes surveyed	
Commercial	7	(Hong Kong, Houston, Melbourne, Philadelphia, San Francisco, Singapore, Tokyo)
Commercial & Residential	2	(New York City and Seattle)
Residential	1	(Sydney)

Policy Type

Overall, the ten programmes surveyed by this study can be broken down into two types:

- Regulatory (i.e. compliance required by law)
- Voluntary

³ As stated in footnote 2, this refers to the first year that the programme came into effect and not the year when an ordinance or law was passed.

Regulatory programmes were overall the most common. As shown in **Table 4.1** and **Table 4.4**, they account for seven of the total case studies. The regulatory approaches include various policy initiatives such as benchmarking for building energy (and water consumption) and GHG emissions (namely New York City, San Francisco, Seattle and Philadelphia), energy efficiency requirements for new construction, retrofitting and building installations (namely Singapore and Hong Kong) and carbon emissions trading schemes (in Tokyo). The reason behind the promulgation of regulatory approaches seems to be an awareness of the limited capacity of voluntary programmes to enforce changes in building operation and retrofitting, and the challenge of securing the participation of building owners and managers in the absence of legal frameworks. For example, the limitations of a non-regulatory approach are being felt in Melbourne’s 1200 Buildings Program. Similarly, the Tokyo Cap-and-Trade Program also sought to address the limitations of the preceding Carbon Reduction Reporting Program, which in contrast, did not mandate emissions reductions.

Table 4.4 Policy type

Most of the programmes surveyed are regulatory.

Policy type	Number of programmes surveyed	
Regulatory	7	(Hong Kong, New York City, Philadelphia, San Francisco, Singapore, Seattle, Tokyo)
Voluntary	3	(Houston, Melbourne, Sydney)

However, the case studies also demonstrate the crucial role that non-mandatory approaches can play. Three cities (Houston, Melbourne and Sydney) have established voluntary capacity building and leadership programmes. These seek to enable participants to measure and compare environmental performance and sustainability practices, identify areas for further improvement, facilitate knowledge exchange and sharing of best practices and, through linkages with other programmes and financial incentive schemes, enhance building owners’ ability to undertake retrofits. The ability of these programmes to secure participation from building owners and managers in the absence of mandatory legal regulations appears to be driven largely by the opportunity for buildings to receive favourable publicity (and thereby strengthen competitiveness in the marketplace) and advance existing sustainability commitments. The unique value of these voluntary approaches seems to be their ability to involve smaller buildings that are typically not targeted directly by mandatory schemes. In the case of Houston, a voluntary approach has also proved successful in engaging with building tenants.

Targeted building size

Table 4.5 below shows that the majority of initiatives surveyed are aimed at large buildings, with medium sized buildings only targeted by two programmes (Hong Kong’s Building Energy Efficiency Ordinance and Sydney’s Smart Green Apartments). It is important to note that the definitions of ‘large building’ tend to vary from city to city (hence the absence of explicit floor area sizes in **Table 4.5**). The overwhelming focus on large buildings can be explained by several factors. Firstly, larger buildings are generally responsible for the bulk of building sector GHG emissions in a city. Secondly, the capacity of small and medium building owners to comply with benchmarking requirements and energy efficiency regulations is often hampered by a lack of expertise in building management and the absence of building professionals, such as facility managers, for reporting energy consumption. Thirdly, larger buildings are typically better able to utilise and act upon benchmarking results. Finally, a focus on larger buildings allows city officials to potentially achieve the widest impact with the smallest allocation of public resources, given that a smaller number of building owners (representative of a large total floor area) are affected by regulation requirements.

With the exception of Houston, all city programmes are principally aimed at building owners and managers rather than tenants, despite the fact that compliance from building owners and managers will often require the cooperation of tenants for data collection.

Table 4.5 Targeted building size

Large buildings are the main focus of the programmes surveyed.

Building size	Number of programmes surveyed	
Medium to large	2	(Hong Kong, Sydney)
Large	5	(New York City, Philadelphia, San Francisco, Seattle, Tokyo)
All	3	(Houston, Melbourne, Singapore)

4.3.2 Inputs during design and implementation phase

Timeframes

The number of years devoted to programme design and activities such as background research, stakeholder consultations and preparations for implementation is shown in **Figure 4.1**. As illustrated below, the majority of programmes (i.e. seven out of nine) were designed within two years. The notable exception is Hong Kong’s Buildings Energy Efficiency Ordinance, where five years were devoted to conducting extensive background research, legal preparation, technical consultations with industry bodies and public hearings. As a secondary trend, it can be seen that the three voluntary programmes were assembled in relatively short

time periods, with cases from Sydney and Houston both designed within a year.

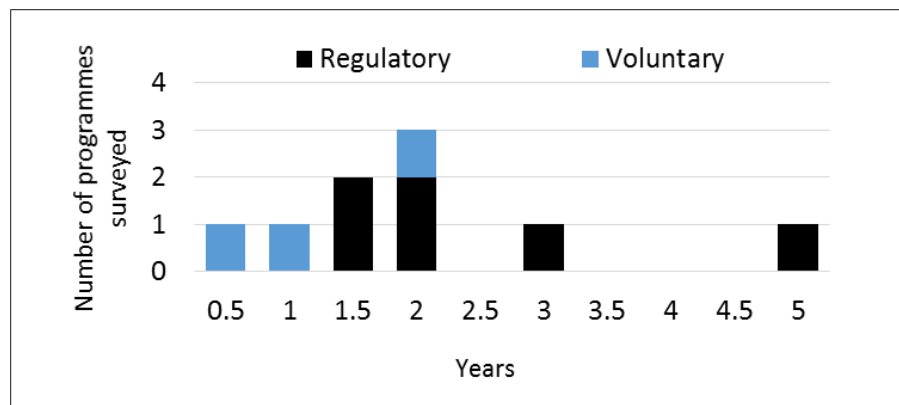


Figure 4.1 Length of design phase⁴

*Majority of programmes are designed within two years,
while regulatory programmes typically take longer than voluntary programmes.*

Staff

A notable characteristic of the programmes surveyed is the surprisingly low number of staff (expressed as full-time equivalent [FTE])—required for both design and implementation. This should be contrasted with the vast amount of total building floor space targeted by programmes, which in some cases like New York City and Hong Kong, for example, represent as much as half or more of the total floor area in the city. **Figure 4.2** below shows that during the design stage, six out of eight programmes were staffed by three or fewer FTEs, with only two regulatory programmes involving five staff. **Figure 4.3** shows that staff numbers increased marginally during implementation to cope with additional tasks such as data verification and management, administration, outreach, communications and training. Nonetheless, only one programme, namely the Tokyo Cap-and-Trade Program, was implemented by five FTEs or more, with the vast majority (i.e. eight programmes) staffed by between two and three FTEs. Tokyo allocates 15 in-house staff to deal with the implementation and administration of the regulatory scheme that has direct financial impacts on building owners.

It should be noted, however, that results in both **Figure 4.2** and **Figure 4.3** show whole number FTEs. In reality, one FTE can consist of several staff juggling programme responsibilities with other job commitments. Additionally, in most of the case studies, resources from other departments, partners or private sector consultants were occasionally made available to support city staff administering the programmes.

⁴ Precise data was unavailable for one case.

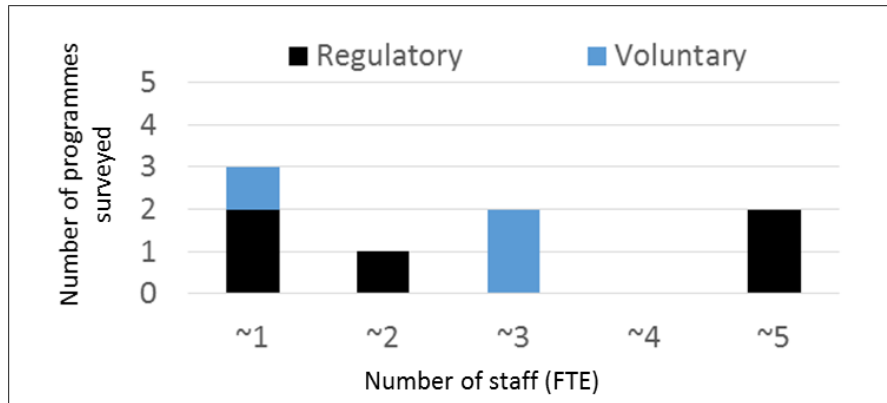


Figure 4.2 Number of staff during *design* phase

Half of the programmes surveyed needed fewer than two FTEs for the design stage (n = 8)⁵.

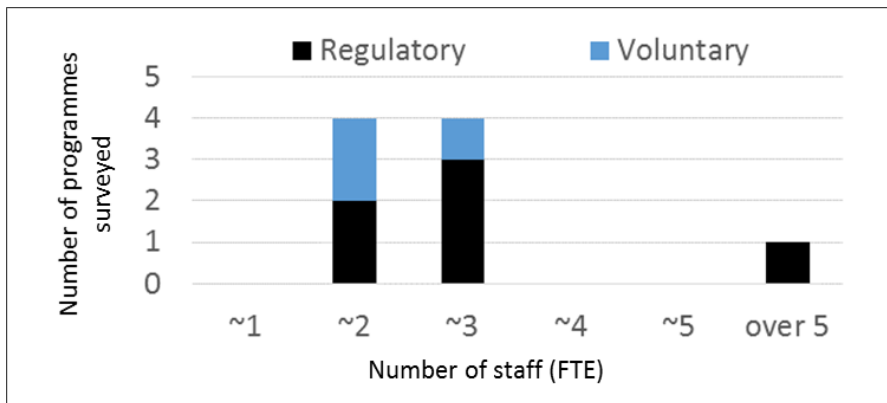


Figure 4.3 Number of staff during *implementation* phase

The number of staff increases from the design phase, however, still the majority only allocate two to three FTEs for the implementation phase with the support from other departments or partners (n = 9)⁶.

Background research

The design of many programmes was preceded by background research. As depicted in **Table 4.6**, cities typically acquire knowledge in three ways:

- in-house research;
- commissioned research conducted by external consultants; and
- review of existing studies.

Many cities use external consultants or existing literature to gather essential input during the programme design stage, while some also conducted additional in-house research. Half of the ten programmes involving the contracting of external groups, such as engineering firms

⁵ Precise data was unavailable for two cases.

⁶ Precise data was unavailable for one case.

and corporate think tanks, to conduct research. These commissioned studies researched areas such as the characteristics of the targeted building stock or the potential economic or environmental impacts of programmes (e.g. 1200 Buildings from Melbourne), and experiences of global programmes (e.g. San Francisco's Existing Commercial Buildings Energy Performance Ordinance and Hong Kong's Buildings Energy Efficiency Ordinance). Other city programmes acquired information via existing knowledge sources. These include, for example, reports from universities on energy efficiency in apartment buildings (e.g. Sydney's Smart Green Apartments) or published case studies on other cities (e.g. benchmarking programmes from New York City and Seattle).

Regardless of the method used to create new or acquire existing knowledge, the most common areas studied by the various programmes were experiences from other cities, followed by the characteristics of the building sector targeted (e.g. age, size, owner profiles and potential for GHG emissions or energy consumption reduction, etc.).

Table 4.6 Type of background research produced/utilised⁷

*Apart from in-house research, cities often use external consultants
and existing studies to support programme design.*

Type	Number of programmes surveyed (multiple answers possible)	
In-house	3	(New York City, Sydney, Tokyo)
External consultants	5	(Hong Kong, Tokyo, Melbourne, New York City, San Francisco)
Existing studies	5	(Houston, New York City, Philadelphia, Seattle, Sydney)

Stakeholder consultations

Consultation with key stakeholders was a major input for all the programmes. The stakeholders consulted included representatives from the:

- *Private sector* (professional architectural or engineering associations; bodies representing building owners, managers and tenants; engineering firms and service providers; corporations and energy utilities);
- *Civic sector* (NPOs and community groups);
- *Government and public sector* (city planners, other government agencies and utilities) ; and
- *Academia* (universities).

⁷ In some programmes, multiple categories of research produced/utilised apply.

During the design phases, formal and informal consultations played a key role in assessing the needs and characteristics of affected stakeholders and their capacity to comply with regulations. Officials in all programmes reported that stakeholder consultations provided valuable feedback regarding the feasibility of new programmes or policies. In many cities, stakeholder meetings also served as negotiation opportunities. Several ordinances, such as those from San Francisco, Singapore and Seattle, for example, were modified as a result of stakeholder feedback to better address their needs and concerns. In addition to providing information and feedback, stakeholder consultations also played a key role in generating support for the programme and assisting with outreach and communications. In the case of Singapore, industry stakeholders played the important role of pilot testing newly developed online data submission procedures. In Melbourne, representatives from industry, government and academia functioned as a steering community during both programme design and implementation. In many cities, government officials from other departments were consulted to ensure that new initiatives and legislation would be consistent with existing policy measures and financial incentive systems.

Stakeholder consultations and collaborations with external partners continued into the implementation phase for many cities. Interestingly, some organisations and businesses consulted during programme development evolved into official partners and took on an implementation role (see **4.3.4 Partner support** below).

4.3.3 Results and impacts

An analysis of the various impacts reported by cities during interviews or in official project documents suggests that programme outcomes can be classified as follows in **Table 4.7**.

It should be noted that most city officials were highly cautious when reporting programme outcomes. There appear to be two principal reasons for this. The first is that, as explained earlier, the majority of programmes have only been in implementation for a few years. As such, the real effects of these policy experiments are not expected to become clear for another several years, particularly with regards to quantitative results in terms of GHG emissions and energy consumption reductions, green jobs creation through ESCOs and other service providers, and the amount of green premiums realised. Experience with benchmarking programmes in particular indicates that several years are required for building owners and markets to produce tangible results. The second reason for caution when reporting results is that it is difficult to separate the effects of a single programme or policy from wider market shifts and from other city or state policies. For the majority of programmes, therefore, anecdotal evidence is the most useful current indicator of progress towards individual programme goals and greater energy efficiency and sustainability across

the building sector.

Table 4.7 Various types of impacts

Type of impact	Example
Energy use/greenhouse gas emissions	● Reductions in GHG emissions, energy and water consumption
Market	● Stimulation of retrofit activity ● Growth of ESCOs, service providers and green jobs ● Growth of green building and energy efficiency certifications ● Manifestation or increase of green premiums
Awareness/capacity building	● Overcoming the 'split incentive dilemma'⁸ ● Enhanced capacity to improve building environmental performance through knowledge sharing, and access to finance and other incentives ● Greater understanding of climate, energy and sustainability issues

Energy use/greenhouse gas emissions impacts

Reducing the environmental impacts of existing commercial and residential buildings is the ultimate goal of government policies and programmes examined in this study. Key metrics that convey such improvements include reductions in GHG emissions and energy (oil, gas and electricity) and water consumption.

As noted previously, many cities were unable to quantify the extent of environmental impacts in building energy efficiency due to the relatively recent introduction of a particular programme. Nonetheless, some cities have managed to produce concrete data (see **Table 4.8**). The most notable results have been reported from the emissions trading scheme in Tokyo. Results released in January 2014 confirm that overall, a 13% reduction of GHG emissions was achieved by the end of FY2010, and a 22% reduction by FY2011 (which was maintained in FY2012) from the total base-year emissions of 13.61 million tonnes of CO₂. This equates to a total reduction of 3 million tonnes of CO₂, which exceeds the maximum compliance factors for the first (8%) and second (17%) compliance period. The City of Houston was also able to collect results from its Green Office Challenge. From the 375 participating buildings and tenants, reductions of 28 million kilowatt hours in energy consumption and 280 million litres in water consumption were achieved.

⁸ The split incentive problem occurs where both the building owner and tenant are reluctant to make a large initial investment to improve building energy efficiency. This is because, on one hand, any outlay from the owner only results in long-term cost-savings on energy bills for the tenants. On the other hand, any investment from the tenant only results in improvements to a property they do not own.

For programmes involving benchmarking (either mandatory or voluntary), the improvement of ENERGY STAR scores serves as another potential indicator of environmental impacts. For example, in New York City the 2013 benchmarking report conveys that compared to year one (2011), median ENERGY STAR scores for year two increased from 64 to 67, with 25% of submittals qualifying for an ENERGY STAR certification (i.e. a score of 75 or higher) compared to 20% in year one (representing an increase of 284 buildings in year two).

Table 4.8 Examples of consumption/greenhouse gas impacts observed

City	Impacts
Houston	At the Green Office Challenge, reductions were achieved in energy consumption by 28 million kilowatt hours and water consumption by 280 million litres among 375 buildings and tenants participating.
New York City	Compared to year one (2011), median ENERGY STAR scores for year two (2012) increased from 64 to 67, and the percentage of submittals qualifying for an ENERGY STAR certification increased from 20% to 25% (an increase of 284 buildings in year two).
Tokyo	A 22% reduction of GHG emissions was achieved by FY2011 (and the same was maintained for FY2012) from the base-year emissions.

Market impacts

Many cities reported that programmes were already stimulating the retrofit market (see **Table 4.9**). With quantitative data lacking due to the programmes' recent implementation, most cities provided anecdotal evidence, although some cities were able to quantify the impact.

Sydney's voluntary Smart Green Apartments programme was able to establish that for the 30 participating apartment buildings, approximately 37% of sustainability improvements and retrofitting recommendations made by the City were implemented. The City of Melbourne is similarly reporting an acceleration of retrofitting activity for 2008-2013 relative to the previous five year period 2006-2011. 450 buildings (20% of the 2,256 buildings containing office space) have undertaken upgrades to lighting, building mechanical systems, metering/sub-metering and chillers. Although it is difficult to determine the precise effect of the 1200 Buildings programme on this wider market shift, direct cause and effect linkages emerged with, for example, the number of buildings (five) entering into finance agreements with the City to fund retrofitting. In the same way, Hong Kong was able to confirm a growth in retrofitting from its Buildings Energy Efficiency Funding Scheme, which financed more than 6,400 buildings to undertake energy auditing and upgrade works.

Table 4.9 Examples of market impacts observed

City	Impacts
Hong Kong	Confirmed a growth in retrofitting from a relevant funding scheme
Houston	- Contributed to the growth of LEED and ENERGY STAR certifications across the city by demonstrating successful cases for smaller and existing buildings. - Confirmed the existence of green premiums in the local building market.
Melbourne	- Reported recent acceleration in retrofit activity. - Confirmed the existence of green premiums in the local building market.
New York City	ESCOs and other entrepreneurs were launching new businesses in the city.
Singapore	- Saw an increase in the number of certified Green Mark Managers and Environmental Sustainable Design (ESD) consultants etc. - Supported a dramatic increase in the number of Green Mark rated buildings.
Sydney	Many of the sustainability improvements and retrofitting recommendations made during the programme were implemented.
Tokyo	- Confirmed a rise in the number of ESCO businesses. - Observed a trend of new buildings designed to satisfy the requirements for a 'top-level facility' certification under the Cap-and-Trade scheme.

As argued in reports from the Institute for Market Transformation in the US in 2012 and a study commissioned by the City of Melbourne in 2009, policies to drive greater building energy efficiency, mandate benchmarking and disclosure of results are predicted to generate substantial benefits for the economy. This will occur firstly as new jobs are generated in response to the increased demand for retrofitting works, energy efficiency services and new technologies, and secondly as savings from improved energy efficiency are reinvested back into the economy. Growth in the number and scale of ESCOs and service industries such as energy engineers, architects and consultants, etc. therefore represents another key indicator of potential market impacts from government policy.

Cities such as New York City, Singapore and Tokyo report that demand for and the size of these industries had expanded in response to new regulations. Although precise figures were not provided, Tokyo was able to confirm a rise in the number of ESCO businesses. This trend was also mirrored in New York City where officials confirmed that ESCOs and other entrepreneurs were launching new businesses in the city in response to a growing demand for services related to benchmarking and auditing. Officials in Singapore reported similar impacts. Indicators cited in evidence of this were an increase in the number of certified Green Mark Managers and professionals trained through various Building and Construction Authority (BCA) Academy courses, in addition to a growing number of Environmentally

Sustainable Design (ESD) consultants.

An increase in the numbers of green building and energy efficiency certifications can also serve as an indicator of market transformation and expansion of retrofitting activities. For example, Singapore reported that the Existing Buildings Legislation, in conjunction with other government policies, had served to spark a dramatic increase in the number of Green Mark rated buildings (up from 17 in 2005 to over 2,200 in September 2014). Similarly, officials in Houston remarked that, the Houston Green Office Challenge had contributed to the dramatic growth of LEED certifications across the City by demonstrating that smaller and existing buildings can obtain LEED or ENERGY STAR status. Furthermore, the City has set a target of attaining the highest number of LEED or ENERGY STAR-certified buildings in the US. In Tokyo, officials noted an increasing tendency to design new buildings to satisfy the requirements for a 'top-level facility' certification under the cap-and-trade programme.

The ability of programmes to manifest or stimulate green premiums⁹ has not yet been widely observed in the cases surveyed, although Houston and Melbourne confirmed the existence of green premiums in local real estate markets. As a long-term outcome, it is expected that the various programmes currently being trialled will trigger new green premiums or advance existing ones. However, a key challenge for the evaluation of programme outcomes will be the quantification of impacts on building prices and the attribution of that impact to a particular programme.

The split incentive dilemma was cited as a major barrier to promoting greater building efficiency and retrofitting in many cities. Several programmes have demonstrated an ability to address this challenge. The Buildings Energy Efficiency Ordinance in Hong Kong has mandated building owners to improve buildings by setting minimum requirements for energy efficiency in four key building service installations, thereby freeing tenants from the responsibility of sharing the cost of retrofit works. The 1200 Buildings programme in Melbourne also served to overcome this problem in some cases. Although they have yet to see a significant uptake by the market, the Environmental Upgrade Finance mechanism offers building owners the option of sharing retrofit costs (i.e. the loan repayments) with tenants. Furthermore, loan repayment obligations are attached to the building and can be passed onto the next owner in the event that the building is sold.

Awareness/capacity building impacts

An example of impacts on awareness or capacity building concerns the enhancement of

⁹ This refers to buildings with high environmental performance attracting higher rental yields or sales prices as a result of increased market demand.

capacity to improve building environmental performance through knowledge sharing and access to finance and other incentive schemes. As shown in **Table 4.10**, multiple programmes, such as those in Melbourne, Houston, Sydney (all voluntary, capacity building programmes) and San Francisco, reported that the ability of building owners (and tenants) to improve energy efficiency and sustainable building practices was significantly enhanced by the knowledge sharing and exposure to best practices that resulted from participation in these programmes. The case from Houston, for example, reported that without participation in the Green Office Challenge, owners and tenants may not have had the opportunity to meet and share success stories with each other. The case of Sydney also demonstrated that experiences and best practices from the 30 participating apartment buildings were shared with a wider network throughout the City. Capacity to implement upgrade measures in response to benchmarking results and energy auditing recommendations was also boosted by these programmes. This capacity enhancement was achieved by introducing participants to finance and incentive schemes offered by the City, State or utilities.

Table 4.10 Examples of awareness/capacity building impacts observed

City	Impacts
Houston	Without participation in the Green Office Challenge, owners and tenants may not have had the opportunity to meet and share success stories with each other.
Melbourne	The ability of building owners to improve energy efficiency and sustainable building practices was significantly enhanced by knowledge sharing and exposure to best practices.
Philadelphia	Public and industry awareness with regard to the roles of retrofitting, such as boosting energy efficiency and cutting energy expenditures, has been increasing.
San Francisco	The ability of building owners to improve energy efficiency and sustainable building practices was significantly enhanced by knowledge sharing and exposure to best practices.
Seattle	The Seattle 2030 District emerged in response to the mandatory benchmarking programme.
Sydney	Experiences and best practices from the 30 participating apartment buildings were shared with a wider network throughout the city.

Other impacts in this category include increased awareness of owners, tenants and related industries with regards to climate, energy efficiency and sustainability issues in the building sector. It is expected that an increased understanding of these issues would contribute to an increased willingness to consider them in building operation, upgrades and new construction. For example, Seattle reported that the Seattle 2030 District - a coalition of private downtown

buildings aiming for carbon neutrality in new buildings and a 50% reduction in energy usage for existing buildings by the year 2030 - was developed in response to the Building Energy Benchmarking and Reporting Program. In Philadelphia, there was also evidence of public and industry awareness growing as a result of benchmarking programmes, with organisations such as the local chapter of the Building Owners and Managers Association (BOMA) gaining an increased understanding of the role that retrofitting can play in boosting building energy efficiency and cutting energy expenditures for building owners.

4.3.4 Success factors

The various programmes surveyed contain a rich amount of information on factors and strategies that can serve to enhance the success of policy initiatives and voluntary leadership schemes to promote greater energy efficiency and sustainability in existing commercial and residential buildings. As pointed out in **Table 4.11**, key lessons are summarised below in the hope that they may assist the implementation and design of future programmes by other cities around the world.

Table 4.11 Common success factors reported

Types of success factors
● Stakeholder engagement ● Partner support ● Top-level political support ● Flexibility ● Different strategies for different segments ● Commitment to driving action via incentives and capacity building

Stakeholder engagement

The involvement of stakeholders during both the design and implementation of programmes was reported by virtually all cities as a crucial success factor. **Section 4.3.2** above illustrates that potential stakeholders are diverse and include representatives from the private sector (e.g. industry associations, building managers and tenants, service providers, corporations and energy utilities), the civic sector (e.g. non-profit organisations and community groups), the government and public sector (e.g. other government agencies and utilities) and academia (universities). The engagement of these sectors proved to be a key success driver for various reasons. Firstly, stakeholder participation during the design phase allows the identification of the needs and interests of certain communities, which can then be subsequently incorporated or reflected into the design of a particular legislation or programme and the setting of particular objectives or targets. Feedback from stakeholder

communities also enables early assessment of a particular programme's feasibility, and if required, the modification of certain requirements in response to stakeholder concerns or needs. This occurred for example in Tokyo, Philadelphia and Houston as well as in other programmes. In particular, in Houston it was reported that stakeholders (many of which later became programme participants) played a major role in adapting the programme, which was largely based on an ICLEI-Local Governments for Sustainability initiative, in accordance with local needs. Their input ensured that the Green Office Challenge did not focus solely on energy efficiency (which would alienate many participants) but more so on sustainable office practices, including behavioural and employee engagement dimensions (e.g. recycling and transport modes).

Cities such as Hong Kong, Singapore, Seattle and San Francisco reported that stakeholder engagement served to foster co-operative relationships with key industry players and thereby drive acceptance of programmes. In the case of regulatory measures such as benchmarking and auditing requirements, it also helped attain higher compliance levels. Aside from ensuring the integration of needs and concerns in the design of a certain programme or legislation, in Sydney other potential benefits for stakeholders engaging with city officials in the drafting process for programmes and legislation were noted. These include, for example, the opportunity to meet and share knowledge with other industry and government stakeholders in the sector. The case from Philadelphia also illustrated the ability of stakeholders to assist with outreach and the mobilisation of wider public and industry support. Associations such as the local Coalition for an Energy Efficient Philadelphia and the local chapter of the Building Owners and Managers Association aided with outreach by communicating about the new benchmarking scheme to members.

Partner support

Several cities indicated the potential for certain organisations or enterprises to become official programme partners and assume roles beyond those expected during the public consultation process. For example, in New York City, academic partners at New York University and the University of Pennsylvania assisted with data analysis and cleaning, in addition to providing outreach and technical support for building owners and managers. Non-profit organisations in Houston and professional associations in Singapore and Sydney assisted with marketing and communication, whilst corporate partners in Houston played key roles in the provision of sponsored funds to the City and free energy audits to participants. Additionally, Houston's Green Office Challenge received official support from ICLEI-Local Governments for Sustainability and the Clinton Climate Initiative, both of which had expertise in implementing Green Office Challenges and voluntary programmes in other cities. Such support included, for example, guidance in the integration of the ICLEI Green Business

Challenge software application for tenant reporting and monitoring.

Across the various programmes, utilities have also served as key partners. At the most basic level, utility roles have included cooperating in the supply of aggregated whole building data for benchmarking. With some programmes, such as those in Philadelphia, San Francisco, Singapore and Seattle, cooperation extended to enable automated data uploading. In the case of San Francisco, utilities played a vital role by providing training and information sessions to building owners and managers. By utilising these and other types of partner support during implementation, it appears that on the whole, cities have been able to overcome some of the challenges of limited city staffing and financial resources for these programmes.

Top-level political support

The importance of top-level political support for programmes was cited by several cities as an important success factor, both for regulatory and voluntary programmes. San Francisco and Seattle reported that support from department directors and elected officials, such as the Mayor and Council members, was crucial for building momentum for newly introduced benchmarking programmes. High-level political support appears to be even more important for voluntary programmes. A non-regulatory initiative from Houston, for example, reported that visible, official support from the Mayor and the prospect of receiving formal mayoral recognition (and associated media coverage) for outstanding practice proved a key driver in securing participants and stimulating a sense of competition amongst differing owners and tenants.

Flexibility

Despite the regulatory nature of benchmarking and environmental requirements for buildings (and the legal authority to issue fines in cases of non-compliance), the vast majority of programmes indicated a significant degree of flexibility when enforcing compliance. For example, most cities have sought to encourage compliance by refraining from issuing fines for non-submittal of benchmarking data. Instead, they extended grace periods for reporting deadlines and working to open communication channels by contacting non-submitting building owners and managers. As reported by several cities, it is often the case that an incidence of non-compliance is in fact a reflection of a lack of ability to comply. Based on such awareness, the stance of many cities has been to encourage compliance by communicating the benefits of creating and sharing benchmarking data, assisting with technical advice and the acquisition of data, and also by providing incentives and financing resources. The programmes from the City of San Francisco, Hong Kong and Singapore provide three examples of this. As a result of flexibility and a commitment to capacity building rather

than legal enforcement through issuing of fines, many cities have found that compliance rates have improved.

Different strategies for different segments

Programmes from cities such as Melbourne and San Francisco illustrate that the adoption of different communication, incentive and support strategies for different audiences and building sectors can also be a key to success. Concerning communications, in marketing the Existing Commercial Buildings Energy Performance Ordinance, officials from San Francisco opted for different messages and mediums for different market sectors. For building owners, key messages were focused on potential financial savings rather than on climate change mitigation. In contrast, for more public web communications or presentations, messages were focused on cross-referencing benchmarking initiatives in other cities, financial benefits and the importance of reducing GHG emissions for the real estate industry. In the 1200 Buildings Program in Melbourne, when recruiting large, corporate building owners, officials emphasised the potential to gain publicity and showcase corporate social responsibility, as well as offered a leadership programme to create opportunities for increased recognition. On the other hand, for smaller to medium building owners with fewer means of self-financing retrofits and taking advantage of government subsidies and grants, the bulk of efforts were concentrated on capacity building. This included training and seminars, development and diffusion of case studies and best practices, and efforts to enhance financial capacity through state and federal government subsidies and a City-initiated retrofitting finance scheme (Environmental Upgrade Agreements).

Commitment to driving action via incentives and capacity building

Many programmes have met with success by linking regulatory and voluntary programmes to financial incentives and capacity building efforts to help building owners act on the results of energy audits and data reporting schemes. This was a noteworthy feature of the voluntary leadership programmes from Sydney and Melbourne, for example. Sydney's Smart Green Apartments programme sought to spur retrofitting activities by providing participants with action plans and retrofitting recommendations, information on capital costs, projected savings and pay back periods, and introductions to government rebates. Such efforts resulted in a total of 37% of all retrofitting recommendations being implemented by the 30 participant apartment buildings. Melbourne's 1200 Buildings Program has also sought to spur action through its innovative retrofitting funding mechanism (Environmental Upgrade Agreements). The benchmarking scheme from San Francisco is also making attempts to enhance capacity to carry out retrofitting activities in response to benchmarking results and energy audits. For example, it provides linkages to existing programmes targeted at small businesses and small to medium sized buildings, such as GreenFinanceSF Property Assessed

Clean Energy (PACE) and the San Francisco Energy Watch. In addition to financial incentives, a key feature of the latter programme is the provision of free audits and the project management of retrofitting and retro-commissioning projects. Other strategies in city programmes to increase capacity for implementing upgrade measures include the compilation and diffusion of building-specific case studies and the hosting of networking and information sharing events. Some programmes to adopt such strategies include those from Tokyo, Sydney, Houston and Melbourne.

4.3.5 Key challenges

The ten cases featured in this report demonstrate that cities seeking to implement either regulatory or voluntary approaches to advancing building energy efficiency and sustainability will inevitably encounter various obstacles. However, the various programmes surveyed also provide convincing evidence that many of these challenges can be overcome (**Table 4.12**).

Table 4.12 Common key challenges reported

Types of challenges
● Data accuracy ● Difficulties obtaining aggregated data ● Outreach and marketing ● Moving from benchmarking compliance to understanding ● Tenant engagement ● Staffing limitations

Data accuracy

Ensuring the accuracy of data submitted to a city, for benchmarking and emissions trading schemes for example, has been cited as a challenge by the majority of the cities surveyed. For example, many US benchmarking programmes have had to manage incorrect data entries — mostly from human error — for information such as energy/water consumption, GHG emissions and total floor area. These accuracy problems have largely occurred as a result of input errors during self-reporting, manual entry of data from energy invoices, etc. and technical flaws in reporting methodologies from service providers. Many cities have nonetheless demonstrated an ability to come up with suitable solutions. The most effective appears to be the preparation of automated reporting platforms with energy and water utilities, thereby eliminating the need for manual data entry. Other measures include the development of data cleaning methods to identify common errors such as under-reported floor areas, as demonstrated by the case from New York City. Efforts to improve data reliability also extend to the issuing of individual ‘report cards’ to 35 major service providers

to highlight error tendencies and suspected flaws in reporting methodologies. Some cities such as Tokyo and Seattle used external third parties to verify data. In Tokyo's Cap-and-Trade programme, the economic significance of data regarding emissions reductions and trading required a highly robust verification system. A double-verification system was established as a result. Firstly, annual reports submitted by owners are checked by registered verification agencies before submission to the Tokyo Metropolitan Government. Secondly, City officials verify data accuracy and contact owners in cases of any inconsistencies. This process has helped to significantly improve the reliability of data obtained over the years. The programme from Hong Kong employs a similar approach. It requires auditing and energy efficiency reporting to be carried out by Registered Energy Assessors, whose skills and credentials are regulated by the government.

Considering the fact that data verification by cities requires substantial human and economic resources, the benchmarking programme from Seattle demonstrates an interesting strategy for boosting data reliability. Officials actively encourage eligible building owners across the city to obtain ENERGY STAR certification. As ENERGY STAR certification requires an engineer-led inspection of reported energy consumption from past energy bills, this serves to enhance the accuracy of the self-reported benchmarking results.

Difficulties obtaining aggregated data

Another major lesson emerging from the cases is that programmes implementing benchmarking systems (or collecting building performance data) will inevitably experience difficulties in obtaining aggregated whole building data for energy consumption. This was confirmed by experiences from several programmes, such as those from San Francisco, New York City, Sydney and Singapore. In the case of mandatory benchmarking schemes, these obstacles have affected the capacity of building owners to comply with city regulations, which then influences overall compliance rates. Major reasons for this appear connected to the presence of direct contracts between tenants and energy suppliers, the unwillingness of individual tenants to provide necessary data (especially in cases of high consumption), and building owners' lack of familiarity with the process of obtaining data for the whole building. The case from Singapore demonstrates that such challenges in data acquisition then burden officials with the time-intensive task of advising building owners on the required steps for acquiring the necessary data. The cooperation of utilities has therefore been crucial for addressing these concerns. Many have played a key role by creating automated aggregated data or even uploads to Portfolio Manager on behalf of customers.

Outreach and marketing

Several cities reported challenges encountered when reaching out to targeted building

communities. Although overall compliance rates across the seven regulatory programmes are impressively high, it should be emphasised that this is the result of significant outreach and marketing efforts. Challenges relating to efforts to market programmes, drive compliance and educate building owners on the importance of building efficiency and retrofitting were particularly significant for the small to medium building segment. Experiences in Singapore and Melbourne demonstrate that this is largely due to the lack of expertise in building management amongst these owners, their inability to collate the necessary data and to self-finance retrofits. These experiences suggest that unique capacity building strategies are required for dealing with small to medium building owners. The goal of such measures must be to overcome the knowledge gaps caused by the absence of professional building managers, and to create greater opportunities to access attractive finance solutions for efficiency upgrades.

Moving from benchmarking compliance to understanding

A general challenge cited in mandatory programmes involving benchmarking and auditing is the need to move beyond achieving mere compliance to triggering actions to improve energy efficiency. This challenge was noted in many cities such as Philadelphia, San Francisco and Seattle. With broad public understanding and demand for building energy efficiency being the core triggers for shifts in market trends, it appears that education is crucial for helping building owners understand how benchmarking data (and energy auditing) results can be used to generate economic savings, reduce environmental impacts and improve the market value of a building.

Tenant engagement

Reaching out to and engaging building tenants was noted as a key challenge by a number of cities. This potentially reflects the fact that building owners are the primary target audience of the various programmes surveyed in this report. Particularly for regulatory programmes, compliance falls to building owners rather than tenants. This is not to say that tenant engagement is not required for successful implementation of initiatives for advancing energy efficiency in existing commercial or residential buildings. Many programmes — both regulatory and voluntary — also require the cooperation of tenants in the provision of data, energy efficient operations, and investment in building upgrades. Regarding tenant-financed building upgrades, a major barrier appears to be the split-incentive dilemma where tenants hesitate to make necessary investments for energy efficiency in a building they do not own (and building owners may similarly hesitate when the monthly utility bills are paid by tenants, who therefore receive the energy savings delivered by retrofits). The split-incentive dilemma was particularly salient in Hong Kong and Tokyo and their regulatory programmes aimed at building owners. Tenant engagement issues were also significant in the case from Singapore,

where attempts from large building owners to engage building tenants in energy and water saving are meeting with limited success¹⁰.

Interestingly, a strength of the three voluntary programmes surveyed in Sydney, Melbourne and Houston is the demonstrated ability to engage building tenants. In contrast to regulatory measures in which responsibility for compliance falls chiefly on building owners, the ‘friendly’ nature of voluntary leadership programmes appears suited to engaging tenants directly. This was particularly the case in the Houston Green Office Challenge, which consists of two separate categories and monitoring mechanisms: one for tenants and one for building owners. Programmes such as those from Sydney have been particularly successful at nurturing cooperative relationships between building owners and tenants (including large numbers of tenant employees) around themes such as energy efficiency, water savings and office or residential sustainability in general.

Staffing limitations

Many cities reported that limited staff resources have posed significant challenges during the design and implementation of building energy efficiency programmes. Firstly, city officials have had to juggle programme duties with other job responsibilities. Secondly, the outreach, marketing, and relationship building with building owners, required by many of the programmes, are particularly time-intensive activities. Several strategies have emerged to overcome these obstacles. Programmes from cities such as San Francisco, Tokyo, New York City and Philadelphia have collaborated with other departments to pool resources, expertise and capabilities. Although the programme from San Francisco cited the lack of staff resources as a significant challenge for data management, in Hong Kong and Philadelphia, coordination across multiple city agencies was a major success factor. Of note, the programme from Hong Kong has adopted a strategy of requiring the use of government approved Registered Energy Assessors to certify the energy efficiency of buildings and to conduct energy audits. This serves to ensure that building owners have access to standardised expertise in building energy efficiency and potential upgrade measures without relying on assistance from city officials.

4.3.6 Future perspectives

The wealth of experiences outlined in the ten cases reveal likely forthcoming challenges and future directions for city building energy efficiency efforts. Some key points to emerge are summarised below in **Table 4.13**.

¹⁰ This is a part of the background for their 3rd Green Building Masterplan, just launched in September 2014. It focuses on tenant engagement.

Table 4.13 Examples of future perspectives observed

Types of perspectives
● Public disclosure and communicating the value of environmental performance data ● Targeting small to medium sized buildings ● Engaging tenants

Public disclosure and communicating the value of environmental performance data

It has become clear from several case studies, including those of Philadelphia and San Francisco (especially their programmes involving data reporting), that city officials are aware of the need to influence market trends by boosting public awareness of building energy efficiency. The majority of programmes surveyed do not involve the public disclosure of benchmarking data, with others requiring only partial disclosure (i.e. to the parties involved in a real estate transaction). However, programmes in New York City, Tokyo and Singapore testify to the possibility of increasing public awareness and stimulating competition by disclosing environmental performance data for commercial and residential buildings (i.e. GHG emissions, energy and water consumption, etc.). The Tokyo Cap-and-Trade Program publishes detailed facility-level information on diverse points such as GHG emissions, energy sources consumed, progress towards reduction targets, and details of any credit procurement or sale on the Internet. Similarly, the benchmarking scheme in the Greener, Greater Buildings Plan in New York City also requires public disclosure of energy and water use relative to building floor area data.

The programmes from both New York City and Singapore suggest that in some circumstances, it is desirable to gradually phase in public disclosure obligations. The disclosure of building energy performance information in Singapore will begin with voluntary disclosure through the BCA Building Energy Benchmarking Report 2014. In New York City, mandatory disclosure began with government buildings in the first year of the benchmarking ordinance, commercial buildings in the second year, and residential buildings required to disclose data in the third year. A key future challenge in these cities will be to build public awareness so that benchmarking results become core factor in decision-making during building rentals or sales. For cities that do not require reporting of energy use data, future efforts will be needed to educate and increase understanding amongst individual building owners and key industry groups on the value of programme outputs such as benchmarking data and auditing results. In particular, such education measures must convey the important role that energy efficiency data can play in guiding future efforts to improve environmental performance and generate financial benefits through reduced energy expenditures and greater competitiveness in local building markets.

Targeting small to medium sized buildings

In parallel to existing measures targeting larger buildings, many cities are developing additional programmes with varied approaches to help smaller to medium-sized buildings curb GHG emissions and drive energy efficiency and sustainability. The tendency to date for city programmes to focus on large buildings (bearing in mind that the definition for a ‘large’ building varies between cities) can be explained by two reasons.

Firstly, cities are under pressure to balance limited staff and financial resources with expectations for maximum results. It tends to be easier for cities to focus on larger buildings, especially when developing regulations. These buildings usually represent the majority of total building floor area and GHG emissions in a city, are fewer in number than smaller buildings, and are therefore more straightforward to target with a minimum allocation of resources. Recognition of this was a key factor behind the City of San Francisco’s decision to target buildings larger than 10,000 sq ft despite initial recommendations from the Mayor’s taskforce that buildings larger than 5,000 sq ft be covered by the regulation. The desire to achieve the greatest impact with the smallest allocation of public resources was also behind the City of Seattle’s decision to target buildings larger than 20,000 sq ft instead of 10,000 sq ft as originally intended (a decision which would have involved some 9,000 buildings across the city) for their regulation.

Secondly, there is widespread awareness across programmes that the capacity of small and medium building owners to comply with energy efficiency regulations and benchmarking requirements, and then act upon results, is limited compared to large building owners. This is mainly due to the absence of professional building managers who not only are crucial for collecting the required technical data, but also possess significant expertise in improving building energy efficiency and environmental performance.

These two reasons suggest that future efforts to target smaller to medium buildings via regulatory measures will require an increase in city staff and financial resources, as noted in the case of Tokyo’s Carbon Reduction Reporting Program for Small and Medium Facilities. In the case of New York City, the City recently proposed the expansion of three programmes similar to those under the Greener, Greater Buildings Plan, namely Benchmarking (Local Law 84), Audits and Retro-commissioning (Local Law 87), Lighting upgrades and Sub-metering (Local Law 88) to include mid-sized buildings that are 25,000-50,000 sq ft. This expansion will affect 16,800 additional buildings citywide, with regulations adapted to meet mid-sized buildings’ needs. Focusing on equity and benefits for buildings of all sizes, the City seeks to raise awareness and the transparency of energy and water consumption, and help building

owners identify low-cost opportunities for energy efficiency.

Through their experiences to date, cities have indicated that different strategies are required to target smaller buildings. Melbourne has learned that small to medium-sized building owners are generally not driven by corporate social responsibility nor attractive to government tenants legislated to choose green buildings, and are usually lacking in financial and human resources. The City chooses to support this building sector, instead of regulating them, by offering training and seminars and linking to subsidies and other financial incentives. Voluntary measures could also effectively address the needs of small and medium sized businesses. For example, the Houston Green Office Challenge has succeeded in gaining active participation from small to medium building owners and tenants. Furthermore, the programme successfully raised awareness amongst smaller Class B and C buildings that they can achieve LEED or ENERGY STAR certifications. City officials noted that this recognition had contributed to the dramatic increase in the number of LEED and ENERGY STAR buildings in the City during recent years.

Engaging tenants

Widely reported difficulties in securing the engagement of tenants (see **4.3.5**) indicates that future efforts will be required to more effectively involve tenants in building energy efficiency programmes. Nonetheless, some cities have already started tackling this issue. As one example, in Singapore the main focus of the third stage of the Green Building Masterplan, launched in September 2014, is on efforts to increase tenant awareness of building energy consumption and sustainability. The Masterplan includes programmes such as the Green Mark Incentive Scheme for Existing Buildings and Premises (GMIS-EBP) to help small to medium enterprise tenants (and building owners) to take up energy improvement works; the Green Lease Toolkit offerings guidelines for incorporating sustainability criteria into leasing contracts; and the Green Mark Pearl Award to recognise developers and building owners for substantial efforts in tenant engagement. Tokyo has been including large commercial tenants into the Cap-and-Trade Program since its inception. Large tenants are obligated to report annually to the city government via building owners. In addition, all tenants are required to cooperate with building owners by, for example, participating in owner-led commission meetings, following building operation guidelines addressing energy performance, and providing energy use data to building owners in case they directly contracted to utilities. In 2014, the City also initiated an award programme for tenants by evaluating the achievements reflected in the submitted reports. In addition, the City started the Carbon Report programme in June 2014 to provide energy performance labelling based on an existing benchmark scheme. They expect that the new programme will raise awareness of tenants through leasing agreements.

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¹¹ Also see Reference Lists in each case study.

5. Conclusions

This report highlights various building energy efficiency policies in cities around the world and aims to serve as a resource for city officials as they design new building energy efficiency policies or review existing ones. Its specific objectives are to illustrate the range of different policies, document information about the necessary conditions, opportunities and challenges of such policies, and analyse which approaches were successful and why.

Initial feedback from the city officials who participated in this research suggests that *Urban Efficiency* will help fill a gap in the literature on city-level building efficiency programmes (examples of online databases are shown in **Appendix 1**). By combining data from interviews with data from published documents, this research has provided insights that did not previously exist. In particular, information available online – mainly from city government websites – rarely mentions the inputs required for a building efficiency programme or the key success factors and challenges encountered. This critical information has now been captured and analysed for 10 cities. Moreover, the policy maps and the hyperlinked matrix of programmes in **Appendix 2** are new tools for cities to use, simplifying vast amounts of information about policies in 16 cities. It is hoped that these will serve as significant new resources for officials seeking a brief introduction into global policy approaches.

Urban Efficiency is not meant to be an exhaustive piece of research. Rather, it draws on readily available policies from a network of cities engaged in building energy efficiency initiatives. There is, admittedly, a significant focus on North American cities and their benchmarking and disclosure policies in this report. The policies reviewed have an emphasis on the commercial sector, and also on large buildings. Additionally, some information, namely regarding programme budgets, proved difficult to collect. This information is highly sensitive, and a specific budget was often not allocated for the programmes reviewed in this report. Finally, programme impacts were often difficult to identify, as so many of the policies were relatively new and had yet to generate significant, quantifiable results. For example, while cities could observe that the expanded local market for green buildings was associated with the city building energy efficiency programme, it has been difficult to prove or quantify the correlation or causation.

Urban Efficiency provides a foundation for additional research on building energy efficiency in cities, both in terms of the theoretical framework it sets out in the policy maps and in the programmes it has documented through the case studies. Future explorations of the topic

could expand on this research by increasing the number, range of programmes, and geographic scope of cities studied. City officials who participated in the research expressed a particular interest in learning more about tenant engagement and boosting public awareness on energy efficiency in buildings – especially for residential and small to medium sized buildings. Further research would also enable the theoretical framework of policy elements to be tested and refined. As mentioned above, evaluating the impact of programmes is an important but challenging area. This report could serve as an input into a more detailed investigation of how cities identify and calculate the impacts of their building energy efficiency policies. As a co-lead of the C40 Private Building Efficiency Network, the Tokyo Metropolitan Government looks forward to taking the lead in future research endeavors with C40, and to developing additional resources for peer cities and others in this important field.

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Appendix 1

List of web-based databases on energy efficiency policies worldwide

At the point of research, a dozen databases were found online covering building energy efficiency policies, however many of them solely focus on national or regional policy programmes and only three contain city-level data. Accordingly, this report aims to fill the information gap in the literature on city level building efficiency programmes.

Table. List of Web-Based Databases

City-level data		Organisation Name	Database name	URL	Description
WORLDWIDE					
YES	1.	Sustainable Buildings Centre (International Energy Agency (IEA))	Building Energy Efficiency Policies (BEEP) Database	http://www.sustainablebuildingscentre.org/pages/beep	Covers energy efficiency policies implemented in 34 countries worldwide. It includes building codes, labels, incentive schemes, zero energy buildings, etc.
	2.	International Energy Agency (IEA)	The IEA Policies and Measures (PAMs) Database	http://www.iea.org/policiesandmeasures/	Covers governmental policies and strategies on energy efficiency, renewable energy and climate change for countries worldwide.
	3.	World Energy Council (WEC)	Energy Efficiency Policies and Measure	http://www.wec-policies.enerdata.eu/	Covers energy efficiency policies and measures implemented in 90 countries worldwide

Table. List of Web-Based Databases (continued)

YES	4.	Buildingrating.org – A project launched by the Institute for Market Transformation (IMT) and the Natural Resources Defense Council (NRDC)	Policy briefs	http://www.buildingrating.org/content/existing-policies	Provides briefs on policies related to energy rating laws in different areas in the world such as Europe, Australia, China and US.
	5.	Sustainable Energy Regulation Network (SERN)	Policy and Regulation Database (REEEP)	http://www.reegle.info/policy-and-regulatory-overviews	Gives details on policy and regulatory measures for energy efficiency, energy frameworks and renewable energy, etc. It covers more than 165 countries.
	6.	Global buildings performance networks (GBPN)	Policy comparative tool for new buildings	http://www.gbpn.org/databases-tools/purpose-policy-comparative-tool	A comparative tool for energy efficiency policies in new buildings. It gives reviews on 25 building energy efficiency codes worldwide using 15 criteria
	7.	Energy Sector Management Assistance Program (ESMAP) administered by the World Bank	Energy Efficient Cities Case Studies Database	http://www.esmap.org/node/231	Provides a database of case studies from around the world on energy efficient eco- cities.

Table. List of Web-Based Databases (continued)

UNITED STATES					
	8.	American Council for an Energy-Efficient Economy (ACEEE)	US State Energy Efficiency Policy database	http://www.aceee.org/sector/state-policy	Database on energy efficiency state-based policies in the US.
YES	9.	American Council for an Energy-Efficient Economy (ACEEE)	US State Energy Efficiency Policy database (Local Policy)	http://aceee.org/portal/local-policy	Provides case studies and scorecards for city-level policies.
	10.	US Department of Energy (USDOE)	State Incentives and Policies for Renewables & Efficiency (DSIRE)	http://www.dsireusa.org/	Provides information on incentives and policies at the state-level for promoting renewables and energy efficiency in the US.
EUROPE					
	11.	Buildings Performance Institute Europe (BPIE)	Data hub of the energy performance of buildings	http://www.buildingsdata.eu/data-search	Provides information on policies and regulations related to the energy performance of buildings in Europe. Included are different topics like codes, labels and market instruments.
	12.	Institute of Studies for the Integration of System (ISIS)	MURE database (MURE (Mesures d'Utilisation Rationnelle de l'Energie)	http://www.muredatabase.org/	Covers energy efficiency measures and policies in European countries. Divided into energy end-use categories like household, transport, industry, tertiary etc. Ranks the impact of such measures on national-level.

Appendix 2

Policy map - City-led programmes

Policy maps of city-led programmes are available online at

http://www.kankyo.metro.tokyo.jp/en/int/attachement/Appendix2_Policy_map.xls

in excel format.

You will see the programme name and direct online link(s) with the information about whether the programme is for residential buildings or non-residential buildings, and whether for new buildings or existing ones.

Appendix 2. Policy map - City-led programmes					
Definitions: See notes attached to Column A (Also in Table 3.1 of Chapter 3)					
Country	China	Japan	Singapore	Australia	Australia
City	Hong Kong	Tokyo	Singapore	Melbourne	Sydney
1. Building Energy Codes					
Code name	Buildings Energy	Green Building Pr	Code for Environm	Melbourne plannin	
URL	http://www.beeo.em	http://www.kankyo.n	http://www.bca.gov.s	https://www.melbou	
Applicable types of building usage	Non-residential only	Non-residential only	Residential & non-re	Non-residential only	
Applicable types of building	New buildings only	New buildings only	New buildings only	New buildings only	
Note	Requires complianc	The programme is f			
Code name	Code of Practice f		Code on Environm		
URL	http://www.bd.gov.hk		http://www.bca.gov.s		
Applicable types of building usage	Non-residential only		Non-residential only		
Applicable types of building	New buildings only		Existing buildings on		
Note	All hotels and comm				
Code name	Code of Practice f		Code on Envelope		
URL	http://www.beeo.em		http://www.bca.gov.s		
Applicable types of building usage	Non-residential only		Residential & non-re		
Applicable types of building	New buildings only		New buildings only		
Note					

Figure. An image of the Policy map of city-led programmes

Appendix 3

Questionnaire sent to cities for case studies

Tokyo Metropolitan Government/C40 Research on Building Energy Efficiency

Questionnaire for Participating PSBEEN Cities¹

To be sent to PSBEEN cities who have indicated a willingness to participate. The information will be collected via a phone interview with C40 and TMG consultants unless the city prefers to submit a written response.

This research focuses on city-led programmes (taken here to include mandatory policies, voluntary initiatives, etc.) that target existing private sector buildings, including commercial and multifamily residential.

Building EE Programme Identification and Background

1. Please identify your city's principal or priority private sector building energy efficiency programme and its key elements (if wish to identify more than one, questions can be asked of both accordingly). *Links to relevant documents/webpages can be referenced to provide additional background.*
 - a. What is the programme target (e.g. commercial, residential, buildings of a certain size, building owners/owners + tenants, etc.) and scope (e.g. XX% of commercial buildings, etc.)? Why was that target and scope selected?
 - b. What is the current status of the programme: proposed (awaiting final authorisation); pilot (being tested); implemented across most of the city; or implemented citywide?
 - c. What are the overall goals of the programme (how is progress/success evaluated)? Is a programme goal explicitly derived from the citywide GHG emission reduction target?

¹ The C40 Private Building Efficiency Network was known as the Private Sector Buildings Energy Efficiency Network (PSBEEN) until July 2014.

- d. What progress towards the goal has been achieved to date, if it has been assessed? How is progress being assessed (what data collection methods or platforms are being used)?

Design/Development of Building EE Programme

2. Please outline the inputs during the design phase of the programme (if distinct from implementation):

- Overall budget (what percentage from city; identify any other sources)
- Timeframe (length of design phase)
- Staffing resources (FTEs dedicated to/working on programme)
- Research commissioned/used pre or during design
- Stakeholder engagement or consultation process

- a. Please identify any links to other city policies or programmes (i.e. zoning or land-use planning, tax incentives, etc.) that have been incorporated?

Implementation of Building EE Programme

3. Please outline the inputs during the implementation phase (if distinct from design)

- Overall budget (what percentage from city, identify any other sources)
- Timeframe (proposed length of programme implementation if known)
- Staffing resources (FTEs dedicated to/working on programme)
- Marketing/communications budget
- Monitoring/reporting/verification process and budget (including data collection)
- Stakeholder engagement

- a. Please identify any partnerships in programme implementation and the type of support provided (e.g. utilities allowing for automatic data upload or providing financial incentives; university assisting with data cleaning/analysis, non-profit directing tenant engagement, etc.).

- b. Please describe how/if tenants are engaged through the programme.

Overall Assessment

4. What do you consider to be the key drivers of success for your programme, in both the design phase and the implementation phases?
5. What do you consider to be the main challenges in both the design and implementation phases? What issues do you struggle with?
6. Do you think the programme outcomes are helping to drive the retrofit market in your city and increase demand for energy efficient buildings amongst building owners and tenants? Why or why not?

Additional Issues

7. Has your city successfully encouraged retrofit activity amongst small and medium buildings through the above-mentioned programme, or through other initiatives?
8. If your city collects building energy use data through the above-mentioned programme or others, how are buildings reporting the data?
 - Individual buildings or aggregated across the portfolio
 - Projected vs. actual energy use
 - What key metrics and reporting platform are used?
 - What verification method is used by the city (reliance on self-reporting, third-party verification of all data, third-party verification of a sample, etc.)?

Appendix 4

Metrics for accounting for multiple benefits of building energy efficiency (GBPN Briefing Note)

Prepared for: C40–PBSEEN¹ and Green Growth Networks

By: Dr. Peter Graham, Niamh McDonald & Jens Laustsen– GBPN Global Centre, Paris 10th June 2014

PBSEEN asked GBPN to prepare this brief on metrics and methodologies for accounting for the multiple benefits of building energy efficiency programs, with a focus on those most relevant to cities in the PBSEEN network. A brief summary of multiple benefits issues and associated indicators was prepared for discussion and prioritisation by cities in January 2014. The full summary is included in annex 1. The outcomes of calls with cities led to the following issues being prioritised for further work:

- Job Creation
- Economic Competitiveness
- Poverty Alleviation
- Climate Change Mitigation
- Health & Well-Being

At the request of C40, GBPN has further identified indicators that have been and can be used to assess these issues and what the data requirements are. Where possible we have provided examples of relevant data sources and work being done by cities to calculate co-benefits of building energy efficiency programs.

The following table presents an overview of some contemporary approaches to assessing the five key issues above. It can serve as a basis for discussion between cities on developing a basic framework for calculating co-benefits of building energy efficiency programs in cities. This summary will be presented during the upcoming PBSEEN workshop in Tokyo on 19th June.

¹ The C40 Private Building Efficiency Network was known as the Private Sector Buildings Energy Efficiency Network (PSBEEN) until July 2014.

From this session we would like to discuss whether cities are interested in moving forward to develop a more detailed project to produce a roadmap for calculating the multiple benefits of building energy efficiency efforts in C40 cities.

The key take-away from this brief review is that despite this being a relatively new field, enough work has been done already to support developing common platform of metrics and methodologies for assessing co-benefits of energy efficiency programs in cities. There are however, challenges including data quality and availability, the effectiveness of policy design and implementation, and factoring in rebound-effects. Such a platform could be developed as follows:

Phase One: Methodology Development

Development of draft methodology to assess multiple-benefits based on the small number of key issues/indicators prioritised by Cities in the network.

Phase Two: Pilot of the Methodology with one or small number of leading cities

Based on the outcomes of phase one engage with key cities to apply the draft methodology to assess the five key multiple-benefits from building energy efficiency programs.

Phase Three: Complete the Common Framework

Using expert and stake-holder groups involved in the pilots per review the results and refine the final framework. Then document and implement the tool and write the first report.

Table. Priority benefits and associated indicators

Benefit	Indicators	Metric	Data/Method	Examples
Job Creation	Direct improvement in employment rates through job creation Indirect improvement in employment rates as a result of increased spending. Induced Employment as a result of new workers spending earnings.	Jobs/\$ invested Jobs/ energy saved	Input-output data US: IMPLANv3 EU: Euro-Stat Current studies on employment from EE (several of these) (Direct Employment + Indirect Employment x induced employment multiplier) – jobs lost in energy sector = Net Jobs	EU: Net impact of about 17 to 19 jobs created for every million Euros spent on energy efficiency interventions (BPIE, 2011). US: Rating & disclosure policies could create 59,000 net new jobs by 2030 (IMT, 2011)
Health and Well-being	Improved physical health (IEQ) - Change in rates respiratory illnesses such as asthma & pulmonary infections.	Public health savings/\$ invested Change in QALYs/ measure installed Value of health saving/measure installed (\$-NPV)	Benefit/Cost Analysis Cost of implementation: Savings in public health spending Use of epidemiological evidence to capture the relationship between a change in exposure to cold/internal pollutants and certain negative health outcomes paired with a 'life table' model to estimate patterns of survival in the population (UK Dept of Energy & Climate Change, 2013).	Euro 25-67Bn/pa indirect cost-benefit for cost-effective renovation of heating & insulation (Næss-Schmidt et al. 2012) Quality adjusted life years (QALY) saved per measure installed: Cavity wall insulation – 0.049, Solid wall insulation – 0.036, Replacement boiler – 0.009 (UK Dept of Energy & Climate Change, 2013) Value of health saving per measure installed (£-NPV): Cavity wall insulation: £969, Solid wall insulation - £742, Replacement boiler – £303. (UK Dept of Energy & Climate Change, 2013)

Table. Priority benefits and associated indicators (Continued)

Benefit	Indicators	Metric	Data/Method	Examples
Health and Well-being (Continued)	Reduced local air pollution	Public health savings/\$ invested Change in QUALYs/ measure installed or action taken	Benefit/Cost Analysis - Input mix of energy production - Pollution emissions from different inputs - Health value of reduced pollution Health benefit value per ton of emissions (Benefit/ton or BPT)	Euro 1.9-2.86bn by 2020 from reduced electricity production (Næss-Schmidt et al. 2012) Average monetized benefit of a marginal change in pollutant or pollutant precursor emissions and consequent health impacts (U.S. EPA, 2011) Shanghai: BAU of economic growth compared with three alternative scenarios: energy efficiency improvements (average 2% annual improvement across all energy end use sectors), switching coal and oil for gas use for final sectors and wind electricity generation. (Chen et al., 2007)
	Fewer work/school days lost to illness	No. sick days/occupant/year Perceived Productivity	Survey - Building stock area - Building occupancy rates - Base-line & time-series occupant surveys - IEQ Monitoring	CH2 Melbourne: Excellent IEQ improved perceived productivity by 10% above base-line (Paevere & Brown, 2008).

Table. Priority benefits and associated indicators (Continued)

Benefit	Indicators	Metric	Data/Method	Examples
Economic Competitiveness (Green Growth)	Green GDP growth Increased competitiveness Energy Savings	- Green GDP - Genuine Progress Indicator - Energy Intensity/Capita - Net positive impact on public budgets	GG rate: overall GDP GDP - cost of pollution \$net income/kWh/yr Gross Value Add (GVA) of new employment Decrease in unemployment benefits/increase in tax-base resulting from net job creation (fiscal multipliers) Direct energy savings from publicly owned buildings	Danish National bank paper on improved efficiency and increase in oil price = savings equals to 2.5 euro competition benefit per hour of work
Poverty Alleviation	Reduction in energy poverty Decreased energy cost to households Increased access to sustainable energy services	Change in population below the fuel poverty line. \$Energy cost: Household income Solar PV/HW installed as % of total energy supply \$/kW green power purchased/yr as % total energy demand Access to smart-grids	Survey/Statistical Analysis Utility & population data Input-Output data Total Building-stock/by building type Residential occupancy/type	The investment of £4.6bn results in the application of measures to 2.5 million (all fuel poor) households, eliminating fuel poverty in 71% of households and alleviating it significantly in the remaining 29%. The GVA or economic benefit of this activity to UK plc stands at £1.2bn. (Centre for Sustainable Energy, 2008)

Table. Priority benefits and associated indicators (Continued)

Benefit	Indicators	Metric	Data/Method	Examples
Climate Change Mitigation	Reduced annual building energy and GHG intensity Reduced total annual building energy demand/emissions	kWh/floor area/yr kWh/per capita/yr kWh/occupant/yr (residential) CO₂^{-e}/floor area/yr CO₂^{-e}/per capita/yr CO₂^{-e}/occupant/yr (residential) GJ/yr/building type CO₂^{-e}/yr/building type	Top-Down: IEA & National Data-Sets Bottom-Up: Post-Occupancy/rating & disclosure building data Utilities Data Common-Carbon Metric GHG Protocol ULI-Greenprint Reports ICLEI/C40 - Tools	Energy efficiency measures can contribute 44% of the carbon abatement needed by 2035 to reach international climate change targets (IEA, 2013) Chicago – report emissions savings in # of automobile [and home] equivalents.

Appendix 4-A:

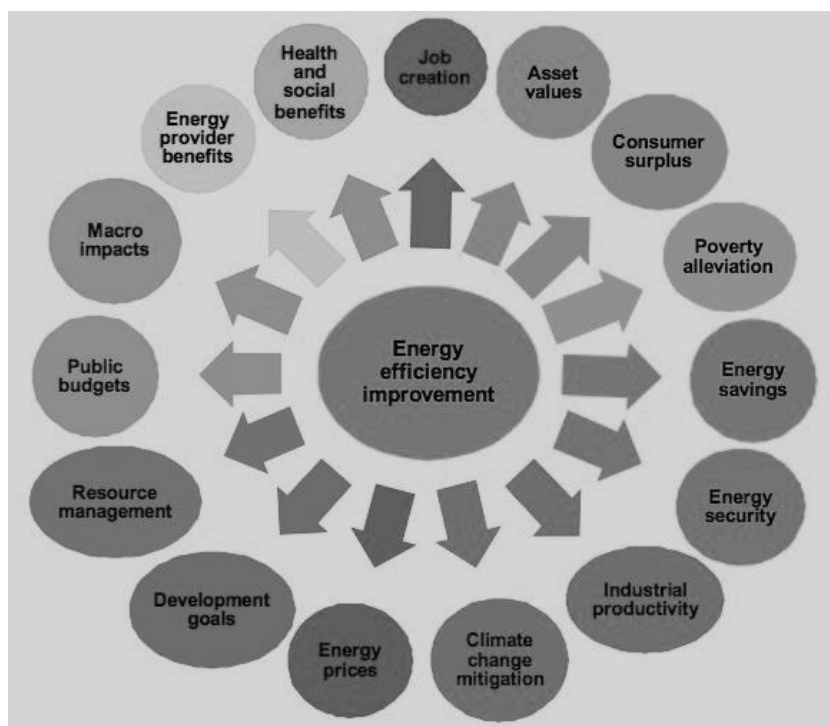
Briefing Note - Multiple Benefits of Building Energy Efficiency

Prepared for: C40 – PBSEEN and Green Growth Networks

By: Niamh McDonald & Jens Laustsen – GBPN Global Centre, Paris. 17th January 2014

There are many benefits in energy efficiency and particular of energy efficiency in buildings. For most actors the direct economic benefits of energy savings might be of lower priority than many other benefits. A number of recent studies have identified a variety of benefits that building energy efficiency programs offer. These range from energy security and job creation, to health and well being. We therefore use the term in Multiple Benefits rather than Co-Benefits in this briefing, which outlines some key indicators that may be relevant to C40 network members. The following is drawn from recent work in this field, in which GBPN has been involved.

Diagram of Multiple Benefits



Source: The multiple benefits of energy efficiency (IEA Spreading the Net: The Multiple Benefits of Energy Efficiency Improvements)

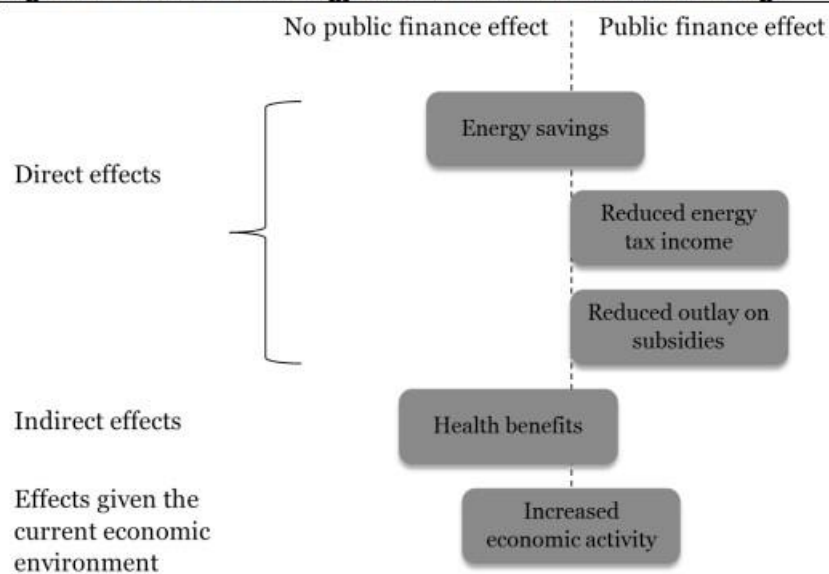
Table of benefits and associated indicators

Job Creation	• Improvement in employment rates through job creation • Indirect improvement in employment rates as a result of surplus consumer spending. • Net impact of about 17 to 19 jobs created for every million Euros spent on energy efficiency interventions (BPIE, 2011).	National / Local (City Level)
Energy Security	• Less dependency on imported fuels • Fewer issues relating to availability and accessibility of energy • Reduced vulnerability to price increases	National
Health and Social	<i>Personal benefits</i> • Improved physical health, including alleviation of chronic and acute respiratory disease, cardiovascular disease, allergies, arthritis and rheumatism – due to improved indoor and outdoor air quality and reduction of aggravating factors such as damp, mould and drafts • Reduced risk of accidents and injuries, particularly among the elderly • Improved mental health, primarily linked to the reduction of stress arising from improved energy affordability • Reduction in excess morbidity and excess winter deaths • Better educational attainment associated with improved internal dwelling temperatures and reduced forced mobility (need to move house for reasons of affordability), stemming from a more secure home environment • Impacts on personal assessment of status within the broader community	Individual/ Community

	<i>Community/societal benefits</i> • Reduced local air pollution from transport emissions • Fewer work/school days lost to illness • Improved visual amenity (linked to dwelling improvements) and community spirit • Reduced crime rates <i>(Summary of IEA Multiples Benefits workshop on Health & Wellbeing attended & contributed to by GBPN)</i>	Individual/ Community
Macro Impacts	• GDP growth, • Job creation • Trade flows • Price effects • Welfare effects • Increased national competitiveness <i>(Summary of IEA Multiples Benefits workshop on Health & Wellbeing attended & contributed to by GBPN)</i>	National
Reduced costs to the exchequer	• Lower expenditure on fuel • Reduction in fuel subsidies • Reduced expenditure on health	National
Poverty Alleviation	• Reduction in energy poverty and issues relating to energy access • Increased disposable income due to less money spent on fuel.	National / City Level
Climate Change Mitigation	• Energy efficiency measures can contribute 44% of the carbon abatement needed by 2035 to reach international climate change targets (IEA, 2013) • Energy efficiency a cost efficient way to deal with GHG reductions.	International

- Direct and indirect savings can accrue from energy efficiency measures.
- Savings on health and wellbeing could in some cases be the same or higher than the direct savings in energy costs
- The benefits of energy efficiency can be either public or private in nature.

Figure A.1 Effects of energy efficient renovation of buildings



Source: Copenhagen Economics

Figure 1. Effects of energy efficient renovation of buildings in Europe.

Source: Copenhagen Economics.

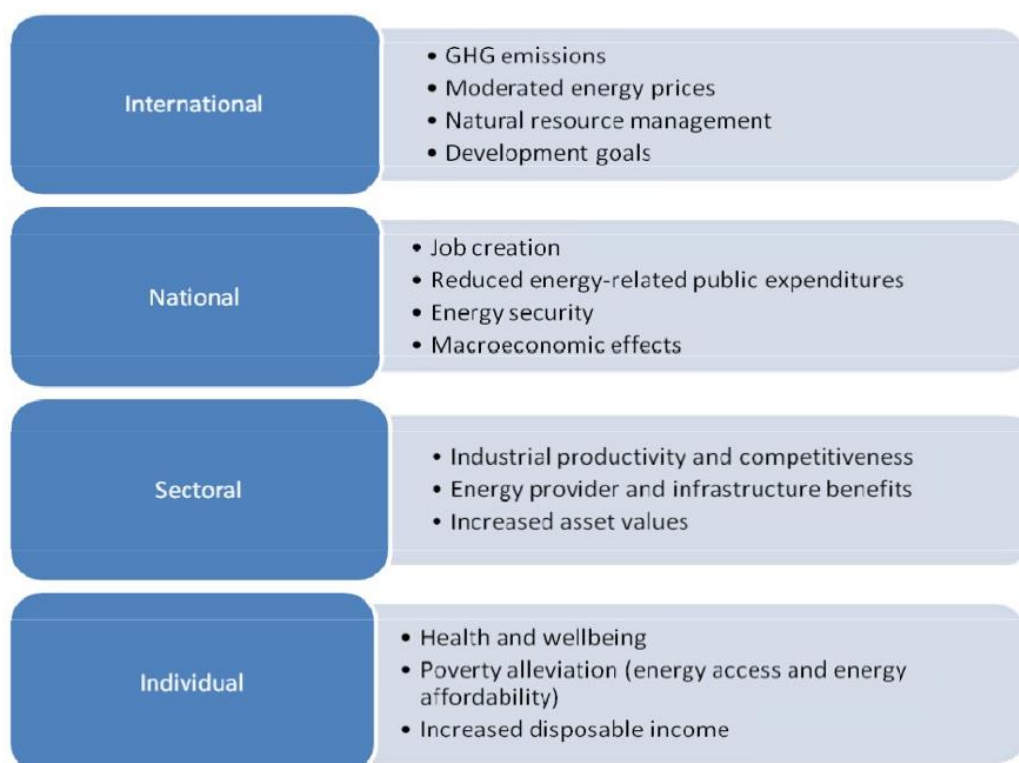


Figure 2. Spreading the net: The Multiple Benefits of Energy Efficiency Improvements (IEA, 2012)

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