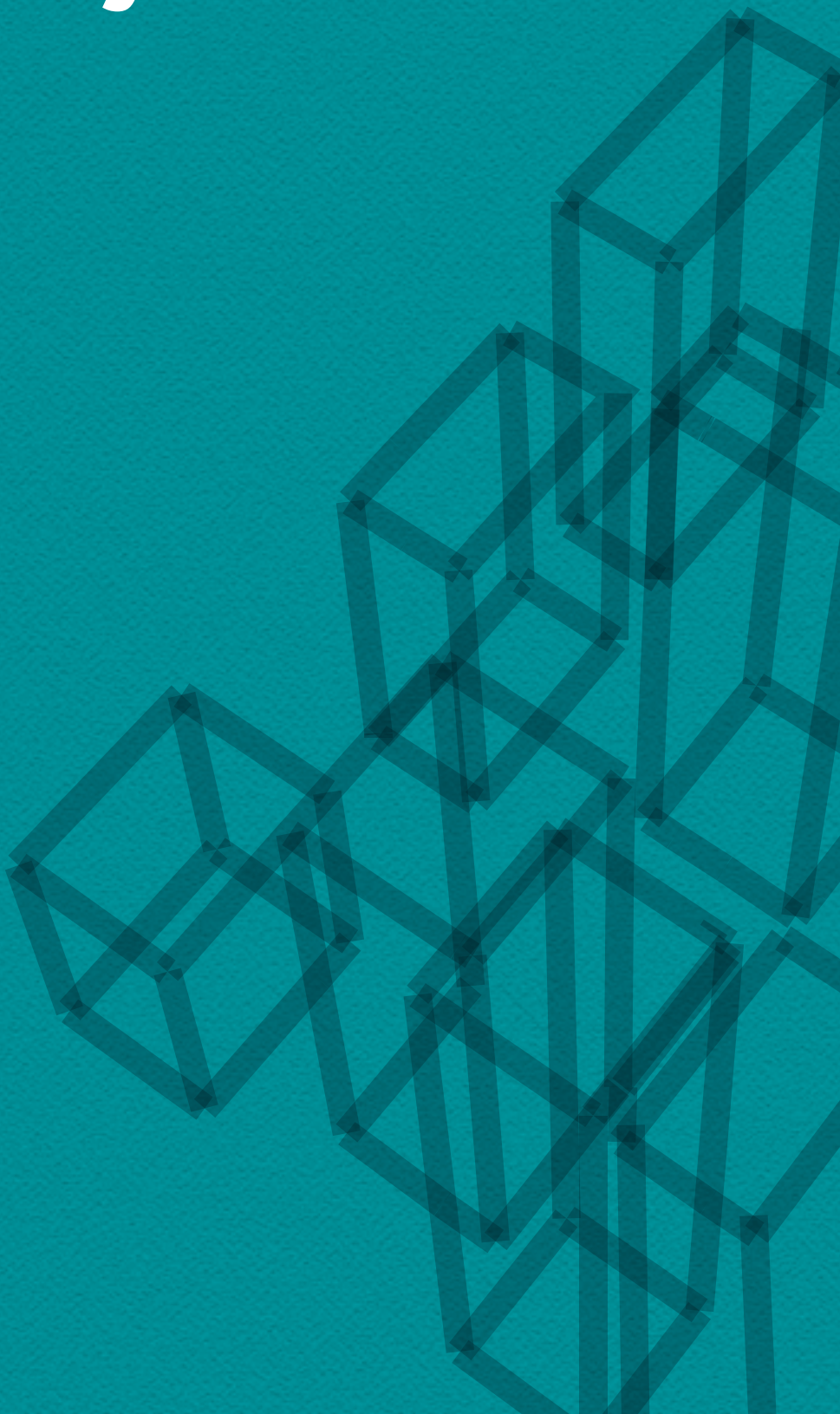
GOOD PRACTICE GUIDE

Municipal Building Efficiency



C40 CITIES
CLIMATE LEADERSHIP GROUP

C40 Cities Climate Leadership Group

The C40 Cities Climate Leadership Group, now in its 10th year, connects more than 80 of the world's greatest cities, representing 600+ million people and one quarter of the global economy. Created and led by cities, C40 is focused on tackling climate change and driving urban action that reduces greenhouse gas emissions and climate risks, while increasing the health, well-being and economic opportunities of urban citizens. www.c40.org

The C40 Cities Climate Leadership Group has developed a series of Good Practice Guides in areas critical for reducing greenhouse gas emissions and climate risk. The Guides provide an overview of the key benefits of a particular climate action and outline successful approaches and strategies cities can employ to implement or effectively scale up these actions. These Guides are based on the experience and lessons learned from C40 cities and on the findings and recommendations of leading organisations and research institutions engaged in these areas. The good practice approaches are relevant for cities engaged in C40 Networks as well as for other cities around the world.

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EXECUTIVE SUMMARY

Energy consumed in buildings accounts for almost half of the carbon emissions within C40 cities, of which one-third comes from public buildings.[i]

Cities around the world usually have a high degree of control over their municipal buildings, such as City Halls, government offices, hospitals, schools, libraries or museums. This authority provides city officials with a powerful opportunity to improve energy efficiency and reduce carbon emissions from their municipal buildings. Moreover, municipal building energy efficiency improvements can serve as a model for private buildings and inspire building owners to take action.

This Good Practice Guide focuses on the key elements to successfully deliver building energy efficiency in municipal buildings, leading to better economic, social, and environmental outcomes for cities. These good practice approaches include:

- **Assess baseline energy performance through modern data management**
- **Define an Energy Efficiency Strategy and set clear targets**
- **Set ambitious energy efficiency standards for municipal buildings**
- **Choose the right energy savings performance contract (EPC) model**
- **Demonstrate success of new technologies to create markets for energy efficiency**
- **Provide municipal facilitation and advisory for energy efficiency**
- **Raise awareness and promote behavioural change**

The C40 Municipal Building Efficiency Network was established to support C40 cities' efforts to improve the energy efficiency of the buildings they own, lease or manage by facilitating the sharing of good practice and technical expertise.

The purpose of this Good Practice Guide is to summarise the key elements of municipal building efficiency good practices for global dissemination, highlighting the success of C40 cities in planning and delivering building energy efficiency measures.

1 BACKGROUND

1.1 Purpose

C40 Cities Climate Leadership Group is developing a series of Good Practice Guides in areas critical for reducing GHG emissions and managing climate risks. The C40 Good Practice Guides provide an overview of the key benefits of a particular climate solution and outline good practice principles based on activities and strategies successfully employed by C40 cities. These Guides are based on the experience and lessons learned of C40 cities working together in specific C40 networks and also draw on findings and recommendations of leading organizations and research institutions engaged in these areas.

The following Good Practice Guide focuses on the key approaches to successfully improve energy efficiency in municipal buildings, with a survey of good practice principles leading to better economic, social, and environmental outcomes for cities. These approaches are drawn from the experiences of cities engaged in the C40 Municipal Building Efficiency Network and are relevant for cities around the world.

1.2 Introduction

Energy consumed in buildings accounts for almost half of the carbon emissions within C40 cities, of which one-third comes from public buildings.[ii]

Cities around the world usually have a high degree of control over their municipal buildings, such as City Halls, government offices, hospitals, schools, libraries or museums. This authority provides city officials with a powerful opportunity to improve energy efficiency and reduce carbon emissions from their municipal buildings. Moreover, municipal building energy efficiency improvements can serve as a model for private buildings and inspire building owners to take action.

2 MUNICIPAL BUILDING EFFICIENCY AND CLIMATE CHANGE

2.1 What is municipal building efficiency?

Municipalities often have a vast array of choices when trying to improve the energy efficiency of the buildings they own, lease or manage. To reap the energy efficiency benefits in municipal buildings local governments can adopt a range of technical solutions in the buildings they control. These technical solutions include high-performance building shells; efficient heating and cooling; sun control, shading and passive solar heating; efficient lighting and increased day-lighting; and smart system control technologies that optimize energy use within the building.

2.2 Benefits of municipal building efficiency

There are multiple benefits of municipal building energy efficiency, which help create a viable and attractive building energy efficiency project. These include:

Climate change mitigation - Improving municipal energy efficiency leads to reduced energy consumption, which in turn contributes to GHG emissions reduction and greater resource efficiency. Additionally, higher energy efficiency of municipal buildings (through efficient heating and appliances, for example) helps smooth-out energy demand by reducing the peak demand load and thus facilitates integration of renewable sources into the grid.

Economic savings - Lower energy consumption brought about by improving energy efficiency in municipal buildings means reduced requirements for energy infrastructure and fuel purchasing, thus directly saving money for the municipality and freeing up funds for other projects. Reduced energy consumption also leads to lower vulnerability to fossil fuel price shocks or resource delivery disruptions and improved energy security of the city in general.

Job creation - Delivery of municipal building efficiency projects creates new temporary and permanent green jobs and further supports employment through offering re-training opportunities.

Support to disadvantaged households - Higher energy efficiency in municipally owned residential buildings supports better and more affordable energy access for disadvantaged households. The impact of energy savings is even greater compared to average income households, as poorer households usually spend proportionally more money on energy than wealthier ones.

Improved health and well-being - Greater energy efficiency, particularly through improvements to insulation and the building envelope, often leads to improved comfort in office buildings, venues or social housing, as well as better outdoor air quality. Better insulation and efficient heating and cooling systems help prevent asthma and other diseases and reduces the level of indoor pollutants. Similarly, improved municipal building energy efficiency contributes to improved air quality in the city.

Governance benefits - Delivering municipal building efficiency projects can also contribute to spreading energy efficiency in other sectors (commercial, industry, private residential). Municipal projects can help create a market for energy efficiency solutions (such as new technologies or local providers) that need initial support and a demonstration project to establish a market position. Successful delivery of municipal building efficiency demonstration projects can also help lower perceived risks among private investors.

2.3 Challenges to delivering successful municipal building efficiency

There are a number of barriers that local governments might face when planning for and implementing municipal building efficiency projects. These include:

Multiple stakeholders - Energy efficiency improvement projects often require the collaboration of a large number of stakeholders. Multiple providers – construction companies, energy service companies, energy utilities - often need to come together to deliver building efficiency projects, requiring more management capacity from the local government. In particular, energy utilities might be reluctant to support energy efficiency projects, especially if their revenue comes simply from selling energy, without any financial compensation for promoting energy efficiency among their customers.

Market barriers - Market barriers can also discourage energy efficient investments. The value of energy efficiency projects might not be fully appreciated in areas with low energy tariffs or high fossil fuel subsidies.

Technical and technological challenges - A key technical challenge to delivering municipal building efficiency projects might be the lack of affordable and readily available energy efficiency technologies (or technical experience) suitable to local conditions, as well as longer-term maintenance capacity. At the same time, having to choose amongst a high number of competing equipment options (with a lack of modelling or scenario-building technology) and facing uncertainty about the building's projected performance can prevent successful delivery of the energy efficiency project.

Limited access to finance - Local governments that have a limited budget for energy efficiency or limited access to external credit might have limited ability to cope with the high up-front costs, dispersed operational benefits or limited investment returns of energy efficiency projects. External investors might also be discouraged by the generally high perceived complexity and risk of energy efficiency investments.

Limited institutional capacity or experience - Limited institutional capacity (including financial, staff, time and budget) of local governments could prevent them from gathering reliable and sufficient baseline information about the energy performance of buildings and their energy efficiency potential in case benchmarking studies are unavailable. Limited experience with similar projects might make it more difficult for the municipality to develop, implement, and maintain energy efficiency investments or attract investment. A lack of inter-departmental coordination could also lead to policy incoherence, conflicting goals and competition for funds. Finally, limited capacity to collaborate with the private sector within private-public partnerships can also reduce the financial viability of municipal building efficiency projects.

Lack of political support – An unfavourable political environment might also limit the local government's capacity to develop regulations, codes or standards supporting energy efficiency, especially if national legislation is a barrier or is ineffective at achieving energy efficiency goals.

Limited information and awareness – An awareness of energy efficiency benefits amongst city employees and the larger public is crucial for developing successful energy efficiency projects with lasting impacts. This is due to the fact that a large part of energy efficiency gains are

dependent on building occupants' behaviour. At the same time, awareness of energy efficiency benefits amongst the public can help create a favourable political platform and support for the creation of ambitious energy efficiency policies for the private sector as well.

3 GOOD PRACTICE APPROACHES TO MUNICIPAL BUILDING EFFICIENCY

3.1 Categories of Best Practice

Within the C40 Municipal Building Efficiency Network, at least seven distinct, but often complementary, management approaches have been identified for successfully improving energy efficiency in municipal buildings:

- **Assess baseline energy performance and track progress through data management**
- **Define an Energy Efficiency Strategy and set clear targets**
- **Set ambitious energy efficiency standards for municipal buildings**
- **Choose the right energy savings performance contracting model**
- **Demonstrate success of new technologies to create markets for energy efficiency**
- **Provide central advice on energy efficiency options**
- **Raise** awareness and promote behaviour change

C40 has identified case studies from cities in the Municipal Building Efficiency Network that highlight best practices in each of these categories.

3.2 Assess baseline energy performance through modern data management

The first step of a city is to assess their buildings' baseline energy performance. This will help the city to:

- Prioritise the policies and initiatives that will maximise energy use reductions from buildings;
- Set ambitious but realistic targets; and
- Build a robust strategy outlining how their climate goals can be met.

Case study: *Houston – Open energy performance data for municipal buildings*[iii]

Summary: The City of Houston is taking a multifaceted and data-based approach to ensure efficiency, cost-effectiveness and sustainability of its buildings, which make up 40% of the city administration's total energy use. The city's goal is to achieve 20% energy savings in municipal buildings by 2020. The city has conducted data collection and benchmarking of city facilities and publishes energy performance data for every municipal building over 25,000 square feet.

Results: The data covers 62 city-owned buildings representing more than 5 million square feet of space. Analysing this energy-use information allows the city to identify operational and

management improvements to increase energy efficiency, save money, and contribute to government transparency. Benchmarking enables a comparison of building performance over time, which in turn helps prioritize the facilities with the highest energy intensity and motivates appropriate action if building performance diminishes. Through benchmarking and subsequent retrofits, the city plans to achieve ENERGY STAR® certification and maintain the standard through continuous data monitoring. The energy consumption data was collected using the U.S. EPA ENERGY STAR Portfolio Manager software tool.[iv] The most recent (2013) site energy use intensity data for each building is available to the public online at: *http://houstoncityenergyproject.org/about/leading-by-example/.*

Reasons for success: The success of Houston's benchmarking approach is based on early recognition of the need to benchmark and monitor the whole portfolio of large municipal buildings, in order to be able to prioritise energy retrofits and/or bundle eligible projects together. In addition, making the energy performance data available to the public was recognised as key contributor to greater transparency and government accountability and important step to help motivate action among private building owners by demonstrating the success of the approach.

Case study: *New York City – Data-driven approach to municipal building efficiency*[v]

Summary: New York City has adopted a data-driven approach[vi] to deliver its '30x17 target' (30% GHG emissions reduction below 2005 levels by 2017). The city uses its benchmark results and other data sources to monitor building performance over time and prioritize energy efficiency projects. The city has also implemented its principal energy efficiency legislative package - the 'Greener, Greater Buildings Plan'[vii] (2009), expanded by 'One City: Built to Last'[viii] (2014) - requiring energy audits and cost-effective retrofit measures as well as promoting clean energy. The city evaluates the energy performance results regularly through extensive monitoring and year-to-year data analyses against benchmark baseline scores. These allow the city to identify the impact that different factors, such as energy efficiency investments, smart building management and occupant behaviour have on energy use.

Results: Local Law 84 of 2009 (part of the Greener, Greater Buildings Plan) requires reporting of benchmarking results for all buildings of at least 10,000 gross square feet that are owned by the city or for which the city pays the annual energy bills, as well as for private buildings over 25,000 gross square feet (around 2,300 square meters) from 2014. As of August 2015, around 11,800 facilities had been benchmarked,[ix] with those buildings identified as having the greatest opportunity for energy savings prioritised for retrofitting. To date, the city's building retrofit programme has resulted in over 190 energy efficiency projects, with annual energy cost reductions of around $10.5 million. The 'One City: Built to Last' programme takes this a stage further by targeting every government building requiring significant energy upgrades.

Reasons for success: The success of NYC's data approach is based on the comprehensive scope of the exercise, targeting a large number of buildings to create an extensive database allowing

for more robust benchmarking. Coupling the data-gathering with targeted energy audits also helps to diagnose specific problems and ensure more targeted retrofits.

When/why a city might apply an approach like this: Cities in general should adopt the comprehensive energy mapping and data-driven approach as a critical first step to improving energy efficiency in buildings. The approach provides a critical starting point and allows monitoring over time to help maximise energy efficiency and cost-effectiveness, ensure that retrofits are targeted most effectively and that energy efficiency investments achieve maximum value.

3.3 Define an Energy Efficiency Strategy and set clear targets

By setting a clear vision and targets, city governments can build awareness and encourage longer-term support for improving municipal building efficiency. Articulating energy efficiency, renewable energy, district energy and GHG emissions reduction targets not only provides clear long-term guidance and focuses political attention, but can also help overcome conflicting interests in different city departments and prioritise policies. As C40 research shows, cities are 3 times more likely to take action if a goal or target has been established.[x] A large number of cities around the world have successfully set targets and adopted Energy Efficiency Strategies and Action Plans.

Case study: *Toronto - Energy Conservation & Demand Management Plan*[xi]

Summary: In 2007, Toronto City Council adopted the "Climate Change, Clean Air and Sustainable Energy Action Plan" which committed to increasing energy efficiency at City facilities. In 2009, "The Power to Live Green" report was also adopted by City Council, in which it proposed an 80% reduction in GHG emissions by 2050 compared to 1990 levels. The most recent and targeted *Energy Conservation and Demand Management Plan* (ECDM) was adopted in July 2014. The plan takes a systematic approach to identifying energy conservation opportunities through classification of buildings and energy consumption benchmarking. The 10-year ECDM covers all city facilities, which alone spent over US$53 million on electricity and natural gas in 2012. The ECDM identifies opportunities with the potential to reduce energy consumption by up to 30% by 2019, leading to annual cost savings of over $17 million. This achieves an average payback period of less than 8 years through energy savings and utility company incentives.

Results: Successful programs such as the Better Buildings Partnership[xii] and the City's Energy Retrofit Program[xiii] have implemented over $100 million of energy-related projects. Other initiatives include installation of renewable energy facilities at Exhibition Place, the Enwave Deep Lake Water Cooling system, and policies such as the Toronto Green Standard.[xiv]

Reasons for success: Toronto has recognised the importance of target setting and strategy making to create long-term stability of business and investment expectations, as well as guide

local policies and initiatives in improving energy efficiency of the municipal portfolio. Benchmarking underlying the Plans and Strategies also helped quantify the economic and other benefits of energy efficiency measures, driving the necessary actions.

Case study: *Hong Kong – Energy Saving Plan 2015-2025+* [xv]

Summary: In Hong Kong, electricity consumption represents more than half of the city's total annual energy use, with buildings accounting for about 90% of the city's electricity use. In May 2015 Hong Kong's Environmental Bureau unveiled the Energy Saving Plan for the Built Environment 2015-2025+, which sets a new target of reducing Hong Kong's energy intensity by 40% by 2025. The plan analyses the city's energy use and sets out the strategy, policy and key actions that can help Hong Kong achieve the new target.

Results: Hong Kong's energy efficiency policy focuses on driving energy savings through a combination of educational, social, economic and regulatory initiatives. Apart from setting an ambitious city-wide goal, the Plan also requires the Hong Kong Government to take key actions, such as: set the target for all major new government buildings and new public housing to achieve at least BEAM Plus Gold and Gold ready standards[xvi] respectively; reach a 5% electricity reduction target for municipal buildings by 2020 (from a 2014 baseline); conduct periodic reviews to expand or tighten relevant energy-related standards including the statutory requirements under the Buildings Energy Efficiency Ordinance (2010), the Building (Energy Efficiency) Regulation (1995), and the Energy Efficiency (Labelling of Products) Ordinance (2008); update public education programmes and encourage public sector institutions to save energy; strengthen government energy saving efforts by appointing Green Managers and Energy Wardens; support community campaigns through government funding schemes; and cooperate with key commercial energy consumers to develop sector-specific campaigns to promote energy efficiency.

Reasons for success: The success of Hong Kong's Energy Saving Plan comes from the city's strong regulatory experience and history of effective enforcement. Additionally, by providing the underlying data for current energy consumption in the municipal building portfolio the city is able to show the potential for improvements and demonstrate the credibility of the targets.

When/why a city might apply an approach like this: Cities can define local targets to help streamline municipal building efficiency into urban planning and create a more stable policy environment to promote investor confidence. Where national building energy efficiency targets or legislation don't exist, outlining a strategy and targets at the municipal level can be even more important. In cities with limited building efficiency experience, clear targets can be particularly helpful in focusing political attention and generating the necessary momentum for municipal building efficiency improvements, while contributing to any city GHG emissions reduction targets.

3.4 Set ambitious energy efficiency standards for municipal buildings

Developing robust energy efficiency building codes and standards is one of the most efficient and cost-effective measures that cities can take to support the long-term energy efficiency of buildings.[xvii] Because of their proven benefits, many cities choose to mandate standards that go well beyond the national or state requirements. Certifications and ratings, such as LEED[xviii], BREEAM[xix] or ENERGY STAR[xx], also enable building owners to track and evaluate the performance of their buildings, while outlining opportunities for improvements.

Case study: *Washington DC – Green Code and energy efficiency certification*

Summary: With the adoption of the Green Building Act[xxi] (2006) and the Clean and Affordable Energy Act (2008), Washington DC became the first city in the U.S. to pass legislation that requires green building certification, as well as energy and water benchmarking, for both the public and private sectors. This policy legacy has prompted an impressive growth of green buildings and, as of January 2016, the city contained more than 119 million square feet of LEED-certified real estate from more than 650 LEED-certified projects.

However, realizing that building codes are a jurisdiction's primary opportunity to tailor specific mandatory requirements for all buildings, in March 2014, in addition to its adoption of the latest version of the International Energy Conservation Code, the city adopted the DC Green Construction Code[xxii] based on the International Green Construction Code (IgCC). It extends the scope of green building requirements to all commercial construction projects larger than 10,000 square feet and all residential projects that are at least 10,000 square feet and 4 stories or higher.

Results: The adoption of the comprehensive green code was possible thanks to an early engagement of relevant stakeholders from the private sector, careful consideration of local context and market conditions, and provisions for flexibility within the code. The new code was also adapted to the DC context and carefully integrated with all of the city's existing codes and regulations (e.g. DC Plumbing Code, Zoning Code, Stormwater Regulation, etc.). Sections that were duplicative of other initiatives were deleted or amendments to other codes were made.

The code also provides flexibility to deliver the requirements in different ways. For example, projects can elect to achieve the ASHRAE 189.1 standard or LEED, National Green Building Standard, or Enterprise Green Communities[xxiii] certification as an alternative to the code requirements. In addition to the standard required sections of the green code, DC adopted an amended version of the IgCC's Appendix A, from which project teams can choose a certain number of project electives from the overall list of possible electives.

Training has also been an important part of code implementation. Since 2012, more than 75 trainings have been given and several critical resources have been released, including a Green

Building Program Manual[xxiv] for green building policy in general, and standard code submittal templates[xxv] and sectional reference guides that aid in energy and green code compliance.

Reasons for success: The successful adoption of the ambitious DC Green Construction Code was possible thanks to a collaborative approach to its development and adoption, and strong commitment to implementation among private-sector stakeholders. Two existing instruments also facilitated the code's adoption and successful implementation, namely the Green Building Fund[xxvi] (funded by revenue from permit fees) and the Performance Bond & Binding Pledge[xxvii] (a penalty for non-compliance with green building certification)**.**

When/why a city might apply an approach like this: Cities in general should consider this approach, especially to guarantee energy efficiency and green practices in new construction and major retrofits for municipal buildings and to spur similar action in private buildings. Before adopting a construction code with mandatory green building and energy efficiency standards, it is advisable to start with certification requirements for individual municipal projects to build administrative capacity, uncover in practice any potential conflicts with existing building and related codes, and demonstrate success of the approach. This can later facilitate integration of a green construction code within the existing regulatory environment.

3.5 Choose the right energy savings performance contract (EPC) model

Energy savings performance contracts (ESPCs), a type of public-private partnership (PPP),[xxviii] involve an energy service company (ESCO) that provides a client (local government) with a full range of services related to the adoption of energy efficient products, technologies, or services. ESPCs are well suited to more complex activities, such as renovating the existing municipal buildings portfolio or retrofitting streetlights, which require a range of customized solutions. ESCOs might also provide upfront financing of energy efficiency upgrades, so that the client can amortize the costs over time. In many cases, the ESCO's compensation is contingent on demonstrated performance, so that the services and equipment can be paid from the actual energy cost savings.

Global experience shows that ESPCs can be very effective for realising energy efficiency gains, since ESCOs have a business interest in ensuring that an energy efficiency project is actually implemented and saves energy. Many local governments have also been able to take advantage of their ability to bundle public-sector energy efficiency projects on a larger scale using ESPCs, thus reducing the administrative burden from having to develop, procure, and implement retrofits for one facility at a time. Bundled projects also allow ESCOs to benefit from economies-of-scale and lower their transaction costs. The C40 Municipal Building Efficiency Network has recently developed an ESPC library with case studies from around the world, sample ESPC contracts and detailed guides and handbooks.

A common concern raised by local governments is the lack of ESCOs operating in their city which can make it difficult to pursue ESPCs. In this case, municipalities can help drive market

development through the demonstration of stable demand for energy efficiency services, by issuing a series of bundled tenders for building energy efficiency projects, for example. The case studies below show three different ESPC models with more or less direct public involvement in the projects.[xxix]

Case study: Houston – Open tender ESPC[xxx]

Summary: In 2007, with the support of C40 Cities and the Clinton Climate Initiative,[xxxi] Houston initiated a large-scale energy efficiency retrofit programme to address all city buildings.[xxxii] 271 buildings (over 11 million square feet) are being retrofitted under an energy savings performance contract performed by Schneider Electric and Siemens. The goal is a 25% reduction in energy demand from buildings, which would save over 22 million kWh of electricity every year. The approach was to issue a single contract for all 271 buildings at the same time, split into in different tranches according to the building typology. This allowed the ESCO to optimize the interventions while benefiting from economies of scale.

Results: Over the last four years, retrofits of 87 city buildings have resulted in energy and operational savings averaging US$5.2 million a year. The results have exceeded original estimates, with an expected payback period of just ten years. The first six tranches of upgrades covered 4.3 million square feet, including police stations, health and parks facilities, and the city's main office tower. A new US$8.2 million project to upgrade 18 libraries and two other facilities is scheduled to finish in 2015, with expected savings of US$550,000 annually.

Reasons for success: The city government committed to retrofitting the whole municipal building portfolio through this initiative, which attracted leading firms that brought innovative and competitive solutions. Moreover, by going through the procurement process just once, the city streamlined the selection of firms and accelerated project implementation – thereby expediting the delivery of energy and cost savings in the buildings. Grouping similar building types into multiple-building tranches not only simplified the project management and finance by arranging it as one deal rather than several, but also exploited economies of scale and allowed for a blended project payback of up to 20 years. The city clearly defined its programme goals (e.g. minimum percentage of energy savings) as well as some specific aspects of the buildings that should be addressed (e.g. the building envelope) that the ESCOs had to address, which provided the ESCOs a working framework, while leaving space for maximum innovation and adaptation to building occupants' needs.

Case study: *Paris – Public-private co-management ESPC for schools retrofits*[xxxiii]

Summary: In 2007, the Municipality of Paris adopted its first Climate Plan, aimed at reducing the city's GHG emissions by 75% by 2050. One of the Climate Plan's goals is to reduce energy consumption and CO2 emissions in municipal buildings by 30% by 2020 from a 2004 baseline. Since Paris' primary and pre-schools comprise more than a quarter of all city-owned buildings and represent around 38% of energy consumption of municipal buildings, a School Retrofit

Project was included as part of the Climate Plan. This specific initiative is tasked with retrofitting 600 schools, with a target of 65GWh of energy savings per year.

In order to guarantee the savings, schools involved in the project are covered by energy efficiency contracts, signed between the public authority and an ESCO. The ESCO guarantees minimum savings in energy and is penalised if these targets are not met.

Results: The first contract (signed in December 2011 for 20 years) for 100 schools is being delivered through a private finance initiative (PFI). The ESCO pre-finances the initial work and starts being paid back by the public authority after all the works have been completed. The ESCO thus conducts the pre-work studies, carries out the work and delivers the maintenance and energy monitoring for the duration of the contract. The ESPC model Paris adopted involves partial sharing of responsibilities between the two contract parties. Thus, in 72 of the schools, the municipal technical employees are in charge of the maintenance, while the ESCO is responsible for providing their training. The ESCO is also required to educate school employees and pupils about eco-friendly measures.

An advantage of the PFI contract is that the 30% energy savings commitment is for the overall contract, i.e. a group of schools and not per school. This allows the ESCO to optimise its work programme across buildings and benefit from economies of scale. The retrofit of the first 100 schools is expected to lead to a reduction of 10.7 MWh of energy consumption per annum over the period 2014-2031, resulting in savings of 2,300 tonnes CO2 per annum. The first intermediate results indicate savings in excess of the 30% targets have already been achieved.[xxxiv]

Reasons for success: Bundling the city-owned school buildings into a single project has enabled Paris to benefit from economies of scale for the ESPC. The shared responsibility between the city and ESCO for buildings maintenance helped to transfer the ESCO's expertise to municipal employees via training, building municipal capacity for future projects.

Case study: *London – ESPC co-ordination by a dedicated RE:FIT Programme Delivery Unit*[xxxv]

Summary: London's public building retrofit programme (RE:FIT), aims to introduce energy efficiency retrofits in 40% of London's public buildings by 2025. All retrofits are coordinated by a RE:FIT Programme Delivery Unit (PDU) and initiated under guaranteed-savings contracts (ESPCs) by ESCOs. The ESCO guarantees a set level of energy and water savings, resulting in a financial saving over the period of the arrangement, while also taking responsibility for the risk associated with the delivery of energy savings. The programme streamlines the procurement process by providing standardised, EU-regulation compliant framework contracts for the design and implementation of energy-conservation measures. This simplifies the process for public sector clients and also reduces supplier bidding costs and time, thereby reducing costs for both parties. Moreover, the model allows for buildings to be grouped for retrofitting, facilitating greater energy, carbon and monetary savings through economies of scale.

The unique feature of the London RE:FIT model is the creation of the RE:FIT Programme Delivery Unit (PDU) in February 2011, facilitated by European Commission funding under the ELENA Programme. The Unit manages the RE:FIT framework and promotes the programme's uptake by London-based public sector organisations. It also provides specific support throughout the RE:FIT process, from providing initial information to verifying energy savings once the project has been delivered.

Results: RE:FIT is now being used by more than 160 of London's public sector bodies, including 28 of the 33 London Boroughs, 23 NHS organisations and 109 other organisations (retrofitting government buildings, schools, libraries, museums, etc.). A pilot retrofit programme to reduce energy use in 42 public buildings, implemented from 2008 to 2010, resulted in overall energy cost savings of £1 million per year against a total investment of £7 million. This encouraged the Greater London Authority (GLA) to expand the programme eligibility to all city public buildings (as of 2012, 111 buildings have been retrofitted),[xxxvi] while aiming to retrofit 600 buildings and generate estimated savings of 45,000 t-CO2 by the end of 2015.

Reasons for success: Economies of scale were created through bundling together a number of energy efficiency projects. London also benefitted from external funding (EU ELENA Programme), as well as from strong institutional capacity and experience with complex projects to launch its RE:FIT PDU. The city was therefore able to streamline energy efficiency improvement projects across the city departments and agencies at lower cost, by keeping the expertise and capacity "in-house".

When/why a city might apply an approach like this: Cities considering comprehensive municipal buildings retrofits should exploit the opportunities of bundling projects together and engaging an expert ESCO to reduce the cost and risks associated with such a programme. Different ESPC models can be applied depending on the city characteristics, such as: regulatory powers; financing capacity; risk tolerance; and the degree of access to low-cost finance.

3.6 Demonstrate success of new technologies to create markets for energy efficiency

Cities can partner with local businesses and research institutes to exploit the natural advantages of cities as a proving ground for new energy efficient technologies. Cooperation between business and local authorities can support the development of new innovative technologies (such as sensors, controls, smart thermostats, energy consumption visualization, etc.) by creating the necessary research facilities and encouraging commercialization through the introduction of incentives and enabling regulation.[xxxvii]

Case study: *Wuhan - Wuhan New Energy Research Institute*[xxxviii]

Summary: Wuhan has recently completed the construction of the Wuhan New Energy Research Institute Centre, one of the most advanced energy efficient buildings in the world. The

institute's 140m-high main building (Wuhan Energy Flower) is designed according to the U.K. BREEAM standard and the "China Green 3-star" standard. The project is a world-leading building with zero fossil-fuel energy consumption and zero net carbon emissions, and is also the largest green building in China. Equally important is the role of the building as it houses the New Energy Research Centre containing over 2,000 sustainable engineering students and researchers dedicated to delivering new innovations in the field of green technology.

Results: The Wuhan Energy Flower is a low-energy consumption building, which harnesses rainwater and uses wind and solar energy to cover its energy needs (annual electricity produced by wind and sunlight is estimated at 480,000 KWh). The design of the building is adapted to the local subtropical climate, where temperatures peak at 45°C and the air is hot and humid for half of the year. The building is designed with an overhanging roof to maximise shading of the glass-fronted southern façade, which otherwise allows for maximum day lighting. In winter, the south-facing offices get direct sunlight, as the sun is lower in the sky. The large overhanging roof, tilted towards the sun, is covered with 3,500 m^2 of PV solar panels, generating electricity for the local grid. A 57m-high steel framed pillar emerges from the centre of the building and contains a vertical wind turbine. It also enables the building's "mixed-mode" natural ventilation: air is heated by the sun in a 3m-diameter tube made of black aluminium panels at the base of the pillar, which is connected to a central duct running vertically through the centre of the whole building. As hot air rises through the central shaft, the stack effect causes air to be sucked through the building via window openings, helping to ventilate the space. The system is supported by two HVAC units, serving as backup. The building also has a rainwater harvesting system, providing water to toilets and a rooftop garden (38% of water used in the building is reclaimed water).

Reasons for success: A strong partnership between the City of Wuhan and the New Energy Research Institute, combined with the high standards during the procurement process, enabled the creation of the world-class low-energy building, serving as a demonstration of viability of new technologies.

Case study: *Stockholm – Green IT Strategy*[xxxix]

Summary: Stockholm has identified considerable potential for increasing energy efficiency and reducing greenhouse gas emissions through the implementation of new technical solutions within city-owned properties, in particular through Green IT. Green IT involves using information technology to reduce the environmental impact of buildings in general, as well as the energy consumption and environmental impacts of the IT sector itself. Stockholm's Green IT Strategy[xl] (2009), aims to create "a citywide, standardised and modern IT infrastructure" that enables the GHG emissions from municipal operations to be minimised. The city's goal is to reduce its operating costs, through reducing energy usage by 10% below 2006 levels. The Strategy describes the most important goals, the necessary related actions, and the results that the city expects to achieve. There are at least 9 'action areas' in the Green IT Strategy that directly relate to buildings and office efficiency, including: energy-efficient buildings (HVAC

adjustments); visualization of energy and electricity usage (including individual metering and charging); digital meetings; digital document processing; greener IT sector (eco-friendly and cost-efficient IT procurement); green data centres and telecommunications; standardized energy-efficient workplaces; and more efficient printouts.

Results: An example of Stockholm's Green IT strategy with respect to building energy management is the Östra Real upper secondary school, which is built above the broadband cross-connection hub. Around 60 broadband operators use the hub, with the heat produced by the operations channelled into the school above via a heat exchanger. The underground room is cooled by a geothermal cooling system. The school thus benefits from 100 kW of extra heat, supplying 10% of its needs during the winter, and all of its heating in the summer.

Reasons for success: Stockholm builds on its experience with innovative and smart technologies to streamline the energy efficiency of the IT sector, as well as using IT to improve energy efficiency of the municipal building portfolio. Smart technologies can substitute for part of the building users' behaviour necessary to maximise building energy efficiency

When/why a city might apply an approach like this: Cities aiming to stimulate local energy efficiency markets have an important role to play in educating the market about the technologies' benefits, demonstrating the proof of concept, ensuring a supportive regulatory environment and/or even providing finance. In exchange, cities can benefit from driving down their own project costs through partnerships with innovative companies.

3.7 Provide municipal facilitation and advisory for energy efficiency

As the New Climate Economy reports show, cities have a key role to play in establishing sound governance frameworks, "implemented through effective and accountable institutions that support the coordinated planning and implementation of programmes of activity and investment across public and private sectors and civil society."[xli] Cities can deliver efficient policy planning through inter-departmental and inter-municipal coordination[xlii], as well as coordinate specific projects amongst city agencies and through public-private partnerships. Cities can also provide expertise and advice to local stakeholders and private actors. Finally, cities can benefit from inter-city collaboration within international networks such as C40, which provide for peer learning and best practice dissemination.

Case study: *Tshwane – Specialist assistance Sustainability Unit*[xliii]

Summary: The City of Tshwane established the City Sustainability Unit in 2013. Located within the Office of the Executive Mayor, its mandate is to assist the city in "developing a green economy strategy for the city and guide the process of transitioning into a low carbon, resource efficient and climate resilient city in line with the objectives and targets set in the Tshwane Vision 2055."[xliv] The unit's role is to coordinate between departments and assist in facilitating access to external funding for green economy projects, including municipal building efficiency.

Results: The City Sustainability Unit works in collaboration with other departments to implement their own green economy projects guided by the Vision 2055[xlv]. It has the benefit of addressing crosscutting issues and discouraging a silo approach in the different city departments. The unit also implements test cases and demonstration programmes (including introduction of new technologies) and hands these over to the relevant departments once a project is at a mature stage in development. The Unit also works to enhance the level of awareness and capacity for local representatives and citizens through stakeholder programmes and collaborative partnerships. A sustainability task team of representatives from key departments has been established within the Unit to align the different green economy programmes of the city by enabling inter-departmental communication and collaboration on crosscutting projects and streamline energy efficiency throughout the city initiatives.

Reasons for success: The success of the City Sustainability Unit comes from Tshwane's recognition of sustainability and energy efficiency as an issue integral to all sectors and municipal agencies. The Unit builds on its inter-departmental and crosscutting approach, centralising and spreading expertise, policy support, and technology innovation.

Case study: *Stockholm – Energy Centre for expert support to energy efficiency measures*[xlvi]

Summary: Founded in 2005, Stockholm's Energy Centre has provided expert support on the implementation of energy efficiency measures in municipal buildings, disseminating knowledge within the city, engaging with construction companies and checking progress against the 10% energy saving target set by the Stockholm Environment Programme 2012-2015.[xlvii] In 2015 the City Council decided on a new GHG emissions reduction target of 57% per capita, to be achieved by 2020 compared to 1990, and a new energy saving target of 10% over 2016-2019. These targets will be included in Stockholm Environment Programme 2016-2019. Stockholm's long-term goal is to become a "fossil fuel free city" by 2040.

Results: The Centre's expert support on the implementation of energy efficiency measures includes testing innovative technologies (e.g. heat recovery from ventilation and sewage water, thermal insulation, LED-lighting, etc.), introduction of energy management systems, knowledge gathering and dissemination within the city, and R&D projects. The Centre also collects critical data, including the energy mapping of all city buildings. An illustrative example is the Energy Centre's cooperation with the Real Estate Administration. The Energy Centre financed part of the first energy audits, assisted in securing extra financing for the Real Estate Administration from the city budget of an additional €20 million for employing in-house expertise and complete the project. Around 50% of the Real Estate Administration's building stock was targeted, which led to annual energy savings of about 30% (8 GWh_{heat} and 1,5 $GWh_{electricity}$) and annual financial savings of around €0,8 million in less energy costs. An important financial saving factor is less less future maintenance costs.

During the first three years of the current Environment Programme the city has reduced the energy consumption by 8% and the 10% target is considered achievable. Very much due to the expert support from the Energy Centre, but above all the ambition of all relevant bodies in the city to reach the target. The 8% reduction corresponds to an accumulated cost saving of about €20 million during the three years.

Reasons for success: Stockholm recognised the importance of inter-departmental cooperation and the potential for synergies to deliver cost savings. The Energy Centre allows the city to build municipal capacity and deliver energy efficiency projects amongst its agencies without replicating efforts and processes. Central coordination of energy efficiency projects within the municipality and the potential for replication of successful projects amongst the agencies also creates greater investor confidence and helps secure additional external funding.

When/why a city might apply an approach like this: Cities with long-term energy efficiency targets and/or a large potential for energy savings in the municipal portfolio should consider creating a specialist advisory unit to offer expert support across different municipal departments and agencies. This unit would build capacity, integrate regulations and standards and open up the opportunities to attract larger financing or develop ambitious energy savings performance contracts.

3.8 Raise awareness and promote behavioural change

Cities can provide leadership in reducing municipal building emissions, not only by improving the fabric of a building, but also by working with building occupants, to promote more energy efficient behaviour. It is estimated that up to 30% of energy demand is due to behaviour – including energy use habits and the purchase of energy using technologies.[xlviii] Thus, finding an effective way to engage people is essential for the success of any energy management programme. Cities have been designing various strategies to engage their staff, including specialised training and various awareness raising programs.

Case study: *City of Cape Town - Customised training and awareness raising*[xlix]

Summary: The City of Cape Town has a holistic approach to implementing energy efficiency in its buildings, including the implementation of smart meters and data monitoring systems coupled with energy efficiency interventions. The city has also established an *Environmental Education, Training and Awareness Strategy* to promote behaviour change. Training of key employees was identified as critical to ensuring the sustainability of the energy efficiency programme.[l] The city hired a private company to train its facility managers on the fundamentals of energy management, requiring that the service provider include a practical component in the training to ensure that the concepts taught are understood by the employees. The city also developed a training guide on how to collect, interpret and act upon the smart meter data.

Results: The focus of the training was for non-technical staff, such as facility managers, building operators and maintenance staff. The city has trained 45 of its building facility managers to date, who are now better prepared to deliver sustainable management of their facilities.

Reasons for success: The success of Cape Town's customised training was built on recognition of the importance of behaviour change and awareness for delivering sustainable municipal building energy efficiency improvements. By incorporating practical elements into the training, the city and its partners ensured the lasting impact of the training and potential for spreading the message among other employees.

When/why a city might apply an approach like this: Any city aiming to improve municipal building efficiency should consider pro-actively training staff and educating stakeholders about energy efficiency and its benefits, as behaviour has large and direct impact on energy consumption. By engaging the broader public and private sector through information campaigns and awareness-raising efforts, the city can also build a wider support for energy efficiency and stimulate local markets.

4 FURTHER READING

For further information, more detailed technical guidelines on specific stages of municipal building energy efficiency planning, options for PPPs and more, you can also refer to the following publications:

- WRI (2015). Accelerating Action in Cities for Efficient Buildings: An Introductory Guidebook for Local Government Decision-Makers. *World Resource Institute*. Available soon
- EPEC (2012). Guidance on Energy Efficiency in Public Buildings. *European PPP Expertise Centre*. Available at: http://www.eib.org/epec/resources/epec_guidance_ee_public_buildings_en.pdf
- ESMAP (2015). *Analytical Tools for Municipal Energy Efficiency Planning*. Available at: http://www.esmap.org/node/378
- IEA (2013). *Transition to Sustainable Buildings. Strategies and Opportunities to 2050*. Available at: https://www.iea.org/media/training/presentations/etw2014/publications/Sustainable_Buildings_2013.pdf

[i] C40 (2015). Municipal Building Efficiency Network. Available at: http://www.c40.org/networks/municipal-building-efficiency
[ii] C40 (2015). Municipal Building Efficiency Network. Available at: http://www.c40.org/networks/municipal-building-efficiency
[iii] http://houstoncityenergyproject.org/about/leading-by-example/
[iv] http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager
[v] http://www.c40.org/case_studies/new-york-city-government-leading-by-example

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[ix] http://www.nyc.gov/html/gbee/html/plan/ll84_scores.shtml
[x] http://www.c40.org/blog_posts/10-years-of-results-c40-by-the-numbers
[xi] https://www1.toronto.ca/City Of Toronto/Environment and Energy/Action Plans, Policies & Research/PDFs/City of Toronto ECDM (2014-2019).pdf
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[xxx] https://www.c40exchange.org/display/LIB/Municipal+Buildings+Energy+Efficiency#sectionId=583504014
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[xlii] *ibid.*
[xliii] https://www.c40exchange.org/display/COLL/Municipal+Building+Efficiency+Webinar+on+Sustainable+Governance+-+Tshwane+and+Stockholm
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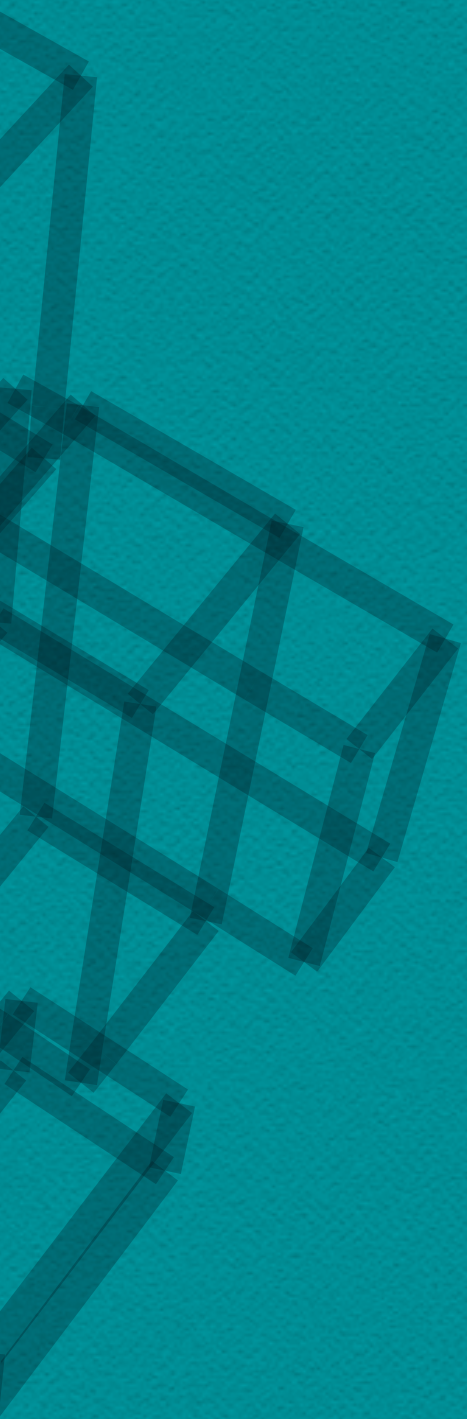
[xlviii] http://www.ieadsm.org/task/task-24-phase-1/
[xlix] http://africabusinesscommunities.com/news/south-africa-city-of-cape-towns-sustains-energy-initiatives-through-customised-training.html
[l] https://www.c40exchange.org/display/COLL/Municipal+Building+Efficiency+Network+Webinar+11+December+2014



London
North West Entrance, City-Gate House
39-45 Finsbury Square, Level 7
London EC2A 1PX
United Kingdom

New York
120 Park Avenue, 23rd Floor
New York, NY 10017
United States

Rio de Janeiro
R. São Clemente, 360 - Morro Santa Marta
Botafogo, 22260-000
Rio de Janeiro - RJ
Brazil

www.c40.org
contact@c40.org

February 2016