



CNCA

CARBON NEUTRAL CITIES ALLIANCE

# Framework for Long-Term Deep Carbon Reduction Planning

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Developed for the Carbon Neutral Cities Alliance  
by the Innovation Network for Communities

# About the Carbon Neutral Cities Alliance

The Carbon Neutral Cities Alliance (CNCA or “Alliance”) is a collaboration of leading global cities working to cut greenhouse gas emissions by 80% or more by 2050 or sooner (“80x50”)—the most aggressive GHG reduction targets undertaken by any cities across the globe. The Alliance aims to address what it will take for leading international cities to achieve these deep emissions reductions and how they can work together to meet their respective goals more efficiently and effectively.

The Alliance was born in Copenhagen in June 2014 at an organizing meeting of the following cities:

Berlin, Germany	Portland OR, USA
Boston MA, USA	San Francisco CA, USA
Boulder CO, USA	Seattle WA, USA
Copenhagen, Denmark	Stockholm, Sweden
London, United Kingdom	Sydney, Australia
Melbourne, Australia	Vancouver, Canada
Minneapolis MN, USA	Washington DC, USA
New York City NY, USA	Yokohama, Japan
Oslo, Norway	

These cities came together to share lessons in planning for and implementing deep carbon reductions and agreed upon opportunities to accelerate best practices through collaboration in the Alliance’s first year, including:

- ▶ *Developing Carbon Neutrality Planning Standards*—Developing approaches, analysis, and tools to support carbon neutrality; standardizing measurement and verification methodologies for tracking progress.
- ▶ *Advancing “Transformative Change” in Key Urban Sectors*—Sharing and implementing best practices for achieving “transformative” deep carbon reduction strategies in urban transportation, energy use, and waste systems.
- ▶ *Advocating for Policy Change*—Identifying and advocating for policies at the state, regional, and federal levels to reduce emission sources not controlled directly by cities and engaging with other external stakeholders who are critical to cities’ success.
- ▶ *Speaking with a Common Voice*—Helping CNCA cities demonstrate their leadership and communicate with a common voice.
- ▶ *Creating a CNCA “Innovation Fund”*—Investing in high-potential, city-led projects that develop, test, implement, and amplify deep decarbonization strategies and practices.
- ▶ *Increasing Alliance Impact*—Sharing Alliance learnings with a broader audience to benefit the “next wave” of cities striving for carbon neutrality.

The Alliance is staffed by the Urban Sustainability Directors Network (USDN) in partnership with the Innovation Network for Communities (INC) and C40 Cities Climate Leadership Group (C40), and is supported by The Kresge Foundation, Barr Foundation, Summit Foundation, Rockefeller Brothers Fund, V. Kann Rasmussen Foundation, MacArthur Foundation and Bullitt Foundation.

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# Acknowledgments

The Framework for Long-Term, Deep Carbon Reduction Planning was written by Pete Plastrik and John Cleveland of the Innovation Network for Communities (INC), and edited by Carbon Neutral Cities Alliance Director Johanna Partin.

A number of organizations and individuals made invaluable contributions to conceptualizing and producing the Framework:

**Carbon Neutral Cities Alliance Members:** The 17 founding member cities of the Alliance commissioned this Framework and provided substantial input to its content—reviewing a draft outline, providing up-to-date planning documents, and responding extensively to numerous interview questions. A number of Alliance members provided substantial feedback and guidance, including Susan Anderson (Portland), Austin Blackmon, Carl Spector and Brad Swing (Boston), Leah Davis (London), Audun Garberg (Oslo), Barry Hooper, Cal Broomhead and Brian Reyes (San Francisco), Sadhu Johnston and Malcolm Shield (Vancouver), John Lee (New York City), Toshinori Mishima (Yokohama), and Tracy Morgenstern and Christie Baumel (Seattle). Alliance intern Samantha Rosenbaum provided research assistance.

**Urban Sustainability Directors Network:** USDN contributed data from surveys of its North American members and committed to “test drive” the draft framework with members. USDN’s Innovation Fund Manager Susanna Sutherland reviewed drafts and generated a large inventory of potential resources to include in the Framework.

**C40 Cities Climate Leadership Group:** C40 provided data and analysis for the Alliance’s first meeting in Copenhagen in 2014 that has been used in portions of the Framework.

**The Kresge Foundation:** The foundation, a main funder of the Alliance, directly supported the development of the Framework as part of its grant to the Alliance, and its Environment Program staff reviewed draft content.

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# Foreword

Avoiding the most destructive effects of climate change requires reimagining and reinventing our great urban centers – which account for nearly three-quarters of humanity’s carbon emissions – to put them on a path toward a zero-carbon future. Transformative changes in transportation networks, energy systems, commerce centers, neighborhoods and even governance practices are essential to meeting the challenge of cutting greenhouse gas emissions at least 80% by 2050 – the goal of the extraordinary collaboration of international cities that make up the Carbon Neutral Cities Alliance (CNCA).

The magnitude of the challenge is daunting, to be sure. But it carries with it as well the potential to be powerfully catalytic, creating an unparalleled opportunity to incubate new models of economic prosperity, social equity, and enhanced quality of life – models that place people and communities first in a new era of climate resilience.

These models are crystallizing in leading-edge cities worldwide. In the pages that follow, visionary leaders from those communities share their lessons and strategies for deep carbon reductions, including new practices that cry out for standardization and replication around the world. These pioneers illuminate a future path that engages residents, reduces disparities, and protects public health while addressing the threats of climate change. They make clear that transformational change is possible even in the face of population increases and unabated economic growth.

The result is the Alliance’s seminal report, “Framework for Long-Term, Deep Carbon Reduction Planning.”

The Framework is an essential tool for cities worldwide to help plan and execute meaningful reductions in greenhouse gas pollution. It describes an emerging architecture for moving toward urban carbon neutrality. It documents the approaches, analyses, and tools that leading cities are using to advance their local goals. And it illustrates the methods used to measure progress.

I hope you’ll take the time to digest and reflect carefully on the extraordinary perspectives and pioneering approaches represented here. Acting with vision, courage and innovation, we can create a healthier, more equitable future for people in the world’s cities. **The Framework shows us how.**

*Rip Rapson, President and CEO, The Kresge Foundation*

*Jessica Boehland, Senior Program Officer—Environment,  
The Kresge Foundation*

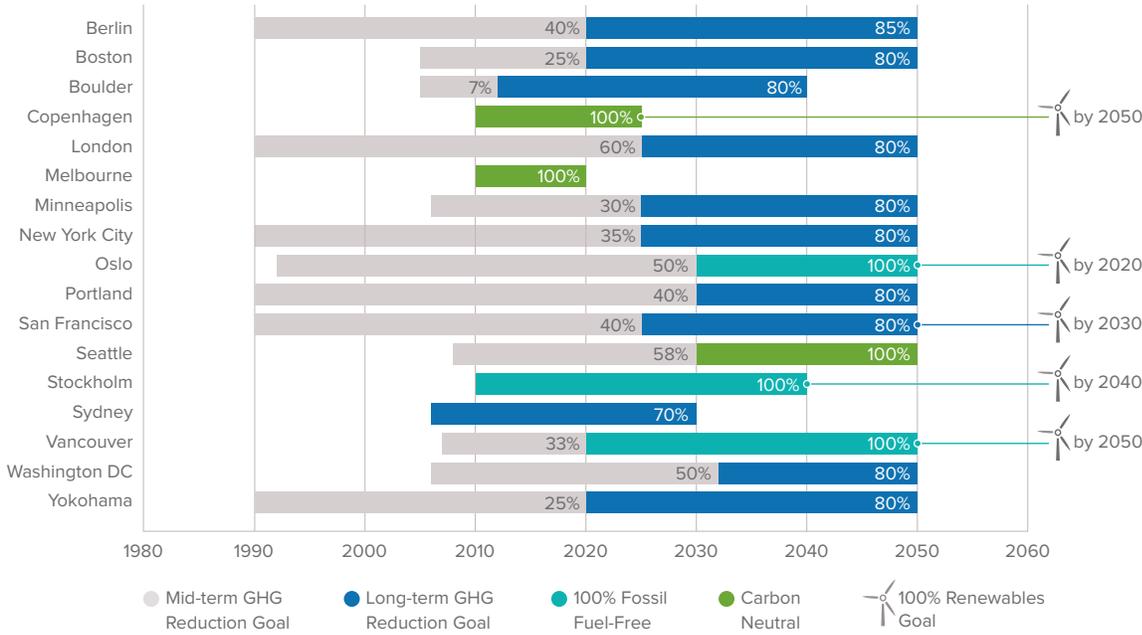
# Executive Summary

The Carbon Neutral Cities Alliance’s **Framework for Long-Term Deep Carbon Reduction Planning** (“Framework”) provides municipal leaders with a detailed synthesis of the processes, strategies, practices, tools, and institutional structures used by leading-edge cities worldwide to plan long-term, deep reductions in carbon emissions. The Framework draws almost entirely from the work of the cities in the Carbon Neutral Cities Alliance (CNCA or “Alliance”). It focuses exclusively on deep reductions, which typically require transformative rather than incremental approaches and take years to achieve. It is intended to serve as an initial streamlined template that cities can use to take a more robust, consistent, and comprehensive approach to developing deep carbon reduction plans. It also identifies specific strategic challenges that cities continue to face in making further progress on deep carbon reductions.

## Context

Avoiding the most destructive effects of climate change requires reimagining and reinventing our great urban centers—which account for nearly three-quarters of humanity’s greenhouse gas (GHG) emissions—to put them on a path toward a zero-carbon future. Transformative changes in energy systems, transportation networks, commerce centers, neighborhoods and even governance practices are essential to meeting the challenge of cutting greenhouse gas emissions by at least 80% by 2050—the goal of the global cities that make up the Carbon Neutral Cities Alliance.

CNCA Cities’ Long-Term and Interim GHG Reduction Targets



Achieving deep decarbonization is a daunting task with few clear roadmaps, and leading global cities have pursued this in relative isolation from each other. That's why we created the Carbon Neutral Cities Alliance. CNCA was designed as a venue for vanguard cities to work together in practical and mutually beneficial ways to address significant decarbonization challenges. By sharing resources and ideas and collaborating on strategic approaches, CNCA cities can accelerate progress in meeting their aggressive goals; develop more rigor and consistency with which these plans are developed; garner support among key stakeholders critical to their success; and inspire other cities to reach for similarly aggressive goals by providing them with tested, "leading edge" know-how.

## The State of Urban Deep Decarbonization Planning

A growing number of cities around the world are adopting "80x50" or carbon neutrality goals and undertaking deep decarbonization strategizing and implementation. Many have been successful in reducing carbon emissions on the way to meeting their short-term goals, and these reductions are occurring even as most of the cities' economies and populations have been growing (see table on the next page).

Deep decarbonization planning is starting to emerge as a sophisticated, data-driven, adaptive, performance management approach increasingly integrated with other city planning processes. The Framework synthesizes these approaches into an overarching "strategy architecture," and applies it to the four major urban carbon emissions systems: energy supply, building energy efficiency, transportation and solid waste.

## Decarbonizing Key Urban Systems

### ENERGY SUPPLY

The energy-supply profiles and situations of cities vary considerably; however despite these differences, cities tend to share a set of general energy supply system conditions, a vision for what the redesigned system will look like, and common barriers to system change. The Framework's

"Transforming Energy Supply Systems" chapter discusses the ways leading cities are working to:

- ▶ Decarbonize imported electricity;
- ▶ Increase local production of renewable power;
- ▶ Reduce demand for and consumption of electricity;
- ▶ Eliminate fossil-fuel heating sources;
- ▶ Pursue "Utility of the Future" models;
- ▶ Enable smart grids; and
- ▶ Integrate citywide energy management.

### BUILDING ENERGY EFFICIENCY

Cities' building energy efficiency profiles also vary, as do their regulatory authority over building codes and standards. However, the basic methods for building-level Energy Conservation Methods (ECM) are broadly applicable to different climatic conditions, power sources, heating and cooling, windows and lighting, and the building envelope. The Framework's "Transforming Building Energy Efficiency Systems" chapter discusses the ways leading cities are working to:

- ▶ Transform existing buildings into highly efficient and renewably-powered structures;
- ▶ Incentivize and require net zero or renewable energy positive new buildings;
- ▶ Increase the availability of building energy performance information in the marketplace;
- ▶ Advance/require performance-driven management of building energy; and
- ▶ Grow the "green buildings" economic sector.

### TRANSPORTATION

In most cities the dominant mode of mobility is fossil-fuel vehicles; transportation is usually one of the city's top two carbon-emitting systems. In most major cities, the streetscapes, networks of roads, and parking and fueling infrastructures—the overall urban form—have been designed to promote and respond to the needs of cars and trucks at a massive scale. Public transit can also contribute to carbon emissions, because fossil fuels are often the

### Carbon Reduction Performance in Some Alliance Cities

<b>Berlin</b>	Since 1990, GHG emissions have dropped 29%, while GDP has grown 19% and population has increased 1%.
<b>Copenhagen</b>	Since 2005, GHG emissions have decreased 31%, while population increased 15% and the local economy grew by 18%.
<b>London</b>	Since 1990, GHG emissions have decreased 11%, 14% since 2008. Population increased by 600,000 since 2008—the fastest rate in the city’s history. As a result, per-person carbon emissions reduced 30% from 1990 level and 19% since 2008.
<b>Minneapolis</b>	Between 2006-2013, GHG emissions have decreased 9.4%, while population increased 6.5% and the regional GDP increased 22%.
<b>Oslo</b>	Since 2013, GHG emissions have decreased 22%.
<b>Portland</b>	Since 1990, GHG emissions have decreased 14%, while population increased 31% and jobs increased 20%.
<b>San Francisco</b>	Since 1990, GHG emissions have decreased 23%, while population has increased 15% and there has been a 49% increase in the local economy.
<b>Seattle</b>	Since 1990, through 2012, GHG emissions have decreased 4% (after accounting for offsets), while population has grown 23% and the number of jobs increased 14%. On a per-person basis, GHG emissions have declined 22% since 1990 and 6% since 2008.
<b>Stockholm</b>	Between 2011-2013, GHG emissions have decreased by approximately 9%, while population grew by approximately 4% and the local economy grew by approximately 3%.
<b>Sydney</b>	From 2006 to 2012, GHG emissions have decreased 12%, while population increased 16% and GDP grew 23%.
<b>Vancouver</b>	From 1990, to 2014, GHG emissions have decreased 7%, while population has grown 34% and the number of jobs increased 30%. On a per-person basis, GHG emissions have declined 30% since 1990 and 13% since 2007.
<b>Washington D.C.</b>	Between 2006-2013, GHG emissions have decreased 16%, and per capita emissions 24%, while population increased 11%, employment grew 8%, and GDP grew 9%.

energy source for buses and trains, or because electricity used to power transit systems is typically produced from fossil fuels. Finally, city government vehicle fleets and private taxi fleets licensed by cities, while just a small portion of a city's total mobility, are another important source of carbon emissions. The Framework's "Transforming Transportation Systems" chapter discusses the ways leading cities are working to:

- ▶ Shift to a radically different mode share;
- ▶ Provide an array of modern, affordable, accessible mobility choices;
- ▶ Foster "market dominance" of clean technologies and fuels;
- ▶ Move quickly toward complete, connected, regionalized mobility systems; and
- ▶ Change the way they think about and advance alternative urban forms.

## SOLID WASTE

In many leading-edge cities, the approach to solid waste system transformation starts with the goal of "zero waste" — waste recovery systems that prevent waste, reduce and reuse materials, recycle and compost, recover energy in ways that don't release carbon emissions, and affect "upstream" purchasing decisions to consume less and consume smartly. The Framework's "Transforming Solid Waste Systems" chapter discusses the ways leading cities are working to:

- ▶ Get to "zero waste;"
- ▶ Promote sustainable consumption; and
- ▶ Incentivize and require producer responsibility.

## Institutionalizing Deep Decarbonization Planning and Implementation

Cities face many challenges as they work to implement their strategies for decarbonizing urban systems, and often this requires rethinking institutional structures, operational plans and budgets, and the way cities work with the community and business sectors. The Framework's final chapter discusses the ways leading cities are working to:

- ▶ Organize oversight and accountability in city government;
- ▶ Build technical capacity and stimulating innovation;
- ▶ Engage stakeholders and the community;
- ▶ Influence other levels of government;
- ▶ Fund climate action plans;
- ▶ Stimulate innovation in city government; and
- ▶ Sustain long-term endeavors.

These models are crystallizing in leading-edge cities worldwide. Long-term systems transformation requires both leadership by the city's top elected and management officials, and "out of the box" thinking about the way cities provide services, invest in infrastructure, and engage with stakeholders. Cities must innovate, because few proven solutions exist and because any solution has to be adapted to the city's specific context. In the pages that follow, visionary leaders from vanguard cities share their lessons and strategies for deep carbon reductions, including new practices that cry out for standardization and replication around the world. These pioneers illuminate a future path that engages residents, reduces disparities, and protects public health while addressing the threats of climate change.

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# INTRODUCTION

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## Purpose of the Planning Framework

This report provides municipal leaders with a detailed synthesis of the processes, strategies, practices, tools, and institutional structures used by leading-edge cities worldwide to plan long-term, deep reductions in carbon emissions. The Long-Term Deep Carbon Reduction Planning Framework 1.0 (“Framework”) draws almost entirely from the work of the cities in the Carbon Neutral Cities Alliance (CNCA or “Alliance”). The Framework focuses exclusively on long-term and deep reductions, which require transformative rather than incremental approaches. It is intended to serve as an initial streamlined template—not a standardized model or how-to workbook—that cities can use to take a more robust, consistent, and comprehensive approach to developing deep carbon reduction plans. It also identifies specific strategic challenges that cities continue to face in making further progress on deep carbon reductions. The cities of the Alliance identified the value of creating a framework that brings together what cities have tried and learned at the front lines of carbon reduction, and contributed their knowledge to its development.

The Alliance anticipates that the streamlined Planning Framework will contribute directly to the efforts of other cities engaging in deep carbon reduction planning, and position Alliance cities to provide input more efficiently and effectively into that process. This is “Version 1.0”—the Alliance plans to update and refine it over time, and to develop additional tools to further support the deep carbon reduction planning work of cities around the world.

## The “80x50” Challenge

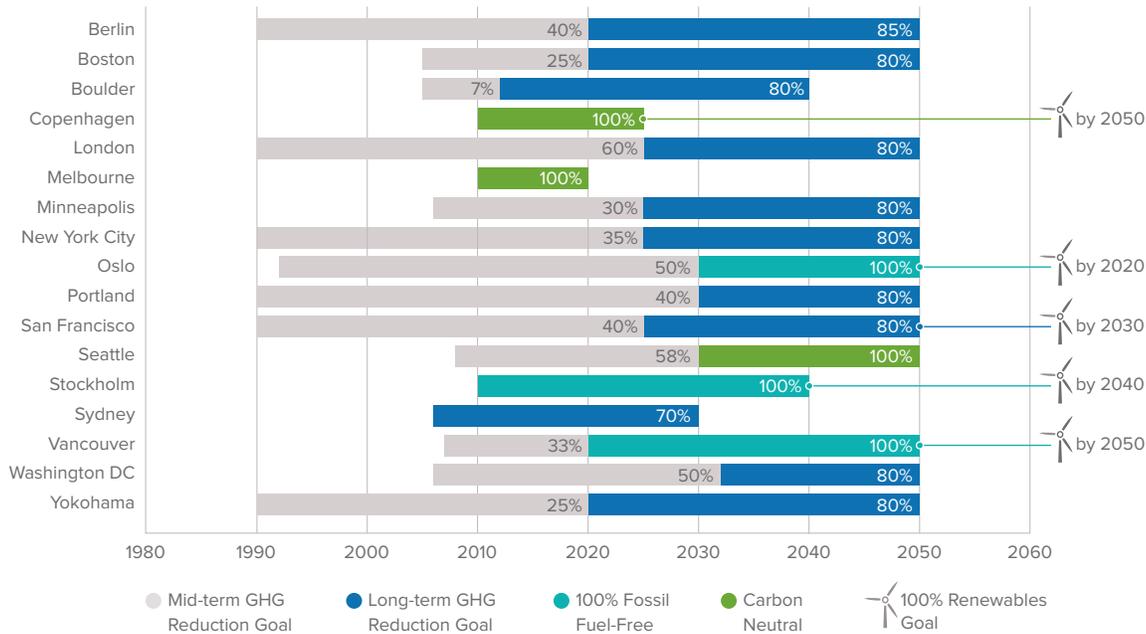
A growing number of cities worldwide have committed to reduce carbon emissions within their boundaries by at least 80 percent or more by 2050 or sooner (“80x50”), in line with consensus scientific analysis of climate change imperatives. Most cities’ climate action plans focus on interim goals on the way to 80x50—relatively shorter time horizons, such as 2020 or 2030, accompanied by incremental reduction targets of 20-30 percent. No city has detailed strategies and plans for getting all the way to the 80x50 target yet, and there are large gaps in what cities know about exactly what will need to be done to reach the ambitious 2050 targets. There is wide recognition among the cities that doing so will require a fundamental, transformational redesign of core systems and the development of new technologies. This was underscored in **PORTLAND’S** 2015 climate action plan, for example: “With total local carbon emissions 14 percent below 1990 levels, Portland and Multnomah County have made notable progress. These local achievements, however, underscore the magnitude of the challenge ahead. Even in Portland and Multnomah County, where climate-friendly planning, policies and programs have prevailed over the past 20 years, emission reductions will need to accelerate substantially to achieve the goal of an 80 percent reduction by 2050.”<sup>1</sup>

1 City of Portland, “Climate Action Plan: Local Strategies to Address Climate Change,” June 2015, p. 14.

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It is possible to achieve many of the interim carbon reduction targets through continuous improvement in existing systems. But achieving “80x50” reductions will require transformative and systemic changes in many core city systems.

## CNCA Cities' Long-Term and Interim GHG Reduction Targets



### THE NEED FOR TRANSFORMATION

A few cities have commissioned studies that describe long-term “road maps,” scenarios — not plans — for arriving at the 80x50 target. And as more and more cities plan-implementation-and-learn, the challenging strategic, technical, and political landscape through which they will have to navigate to 2050 goals is becoming more visible. What is clear, though, is that transformative strategies, not just more of the same, will be needed to reach the goal.

- ▶ **NEW YORK CITY'S** 2050 road map study, “Pathways to Deep Carbon Reductions,” perhaps the most extensive analytic effort undertaken to date, was designed to “evaluate the potential for achieving deep long-term carbon reductions in a way that is grounded in practical realities — particularly the complexity and uniqueness of New York City’s built environment and infrastructure — and is thoughtful about economic impacts.”<sup>2</sup>

- ▶ Other Alliance cities that have produced long-term road maps include **BERLIN, COPENHAGEN, LONDON,** and **STOCKHOLM.** (See links at end of this section.)

### RESETTING TARGETS

Some leading-edge cities — **STOCKHOLM, WASHINGTON, D.C.,** and **NEW YORK CITY,** for example — concluded that their interim targets and progress, while ambitious when they were set a few years earlier, were not ambitious enough to ensure that 80x50 would be reached. They reset their targets by either accelerating the timetable, increasing the reduction target, or both.

### WHAT IS MEANT BY “TRANSFORMATIVE”

A transformative strategy is a way to fundamentally redesign a city’s large-scale carbon-emitting sector or system such as electricity, transportation, buildings, and waste, so that within two to three decades it operates with no or few carbon emissions.

<sup>2</sup> New York City, “New York City’s Pathway to Deep Carbon Reductions,” December 2013, p. 5.

## LARGE, COMPLEX SYSTEMS

These systems are extremely complex technically; contain enormous financial assets and revenue streams; serve tens of millions of people; are driven by a combination of market dynamics, government regulations, cultural norms, and professional practices; and span city, state/province, regional, and national scales. Their business models are anchored in the economics of relatively cheap energy and ever increasing consumption. Many of their technologies are based on fossil-fuel combustion. They are deeply woven into the urban form.

## THE ART OF SYSTEM CHANGE

System transformation requires multiple strategies, alignment of stakeholders around an ambitious carbon emissions goal, a vision for what the redesigned system will look like, policy decisions at multiple levels of government, enormous capital investments by government and the private sector, and behavior changes by enterprises and individuals. All these components have to be balanced while meeting system performance requirements such as service availability, reliability, and affordability, which have implications for previous investments (in utilities or property, for instance) and on future costs of essential services. These changes have to be sequenced and sustained for several decades in the face of uncertainties brought on by election cycles, new technologies, and energy market volatility. Culture change, in particular, can be a slow-moving transition on the way to a “tipping point” in which people’s expectations and habits have become radically different.

## Learning from Leading-Edge Cities

The content of this Framework is based on the latest climate action plans of Alliance cities (as of August 2015), as well as interviews with senior government officials responsible for climate and sustainability in those cities, who between them have a total of more than 150 years of experience in climate action planning. The cities share many characteristics, but also differ in important ways, allowing the Framework to identify both converging trends in planning and diverging factors. Some cities have engaged in climate action planning for as many as 20 years and have been through as many as four or five cycles of planning and improvement based on monitored performance. A close look at their plans and planning processes reveals quite a few similarities. Thus, the Framework presents promising, tested, and increasingly prevailing practices that are evolving into a somewhat consistent and stable methodology for long-term climate action planning. But it does not offer a how-to formula for conducting long-term, deep carbon reduction planning in a particular city.

## TRACK RECORD

Alliance cities have been successful in reducing carbon emissions and are mostly on track with their short-term/interim goals. Reductions are not just due to national/global economic slowdown and/or to policies at other levels of government. Reductions are occurring even as most of the cities’ economies and populations have been growing—a significant sign that urban growth is becoming uncoupled, at least partly, from the generation of carbon emissions. Below are reports from some Alliance cities:

## Carbon Reduction Performance in Some Alliance Cities

<b>Berlin</b>	Since 1990, GHG emissions have dropped 29 percent, while GDP has grown 19 percent and population has increased 1 percent.		
<b>Copenhagen</b>	Since 2005, GHG emissions have decreased 31 percent, while population increased 15 percent and the local economy grew by 18 percent.	<b>Seattle</b>	Since 1990, through 2012, GHG emissions have decreased 4 percent (after accounting for offsets), while population has grown 23 percent and the number of jobs increased 14 percent. On a per-person basis, GHG emissions have declined 22 percent since 1990 and 6 percent since 2008.
<b>London</b>	Since 1990, GHG emissions have decreased 11 percent, 14 percent since 2008. Population increased by 600,000 since 2008—the fastest rate in the city’s history. As a result, per-person carbon emissions reduced 30 percent from 1990 level and 19 percent since 2008.	<b>Stockholm</b>	Between 2011-2013, GHG emissions have decreased by approximately 9 percent, while population grew by approximately 4 percent and the local economy grew by approximately 3 percent.
<b>Minneapolis</b>	Between 2006-2013, GHG emissions have decreased 9.4 percent, while population increased 6.5 percent and the regional GDP increased 22 percent.	<b>Sydney</b>	From 2006 to 2012, GHG emissions have decreased 12 percent, while population increased 16 percent and GDP grew 23 percent.
<b>Oslo</b>	Since 2013, GHG emissions have decreased 22 percent.	<b>Vancouver</b>	From 1990, to 2014, GHG emissions have decreased 7 percent, while population has grown 34 percent and the number of jobs increased 30 percent. On a per-person basis, GHG emissions have declined 30 percent since 1990 and 13 percent since 2007.
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<b>San Francisco</b>	Since 1990, GHG emissions have decreased 23 percent, while population has increased 15 percent and there has been a 49 percent increase in the local economy.		

Source: Cities of Berlin, Copenhagen, London, Minneapolis, Oslo, Portland, San Francisco, Seattle, Stockholm, Sydney, Vancouver and Washington DC.

## SIMILARITIES AMONG CITIES

Most Alliance cities are among the world's wealthier cities, with highly evolved physical infrastructures, and are located in democratically governed nations. They are similar in other ways:

- ▶ Most are coastal cities and are in temperate climates.
- ▶ Most are particularly carbon intensive cities due to their climates, geographies, access to fossil fuels, and extended heating seasons.
- ▶ Most have seen population and economic growth in the past decade and predict these trends will continue.
- ▶ Many exist in a policy context in which a state/province and/or national level of government has imposed a price on carbon emissions, either through a tax or an emissions trading scheme or both.
- ▶ Most face similar "wild cards" about which long-term planners can only make educated guesses. These include the development of new technologies that reduce carbon emissions; the volatility of prices and markets for energy; and political turbulence that makes establishing public policies that crucially affect carbon emissions and reduction difficult.

## KEY DIFFERENCES BETWEEN CITIES

Alliance cities also differ in several important ways:

- ▶ The main characteristics of their climates range substantially (e.g., hot vs. cold, dry vs. wet), based on their climate zone and local factors such as geography.
- ▶ City size varies from
  - Mega-cities (London, 8.6 million; New York City, 8.4 million; Yokohama, 3.7 million; Berlin, 3.5 million) to
  - Mid-size cities (Stockholm, 897,000; San Francisco, 852,000; Oslo, 648,000) to

- Small cities (Sydney, 198,000; Melbourne, 122,000; Boulder, 99,000).
- ▶ Their sources of carbon emissions differ quite a bit, depending on historical factors such as how their supply of electricity is generated.
- ▶ The degree of control and potential influence that they have over various sources of carbon emissions depends on particular local/national governance, markets, and other factors.
- ▶ National policies differ and this affects enabling conditions and support for local efforts. For example:
  - Denmark has a national goal of 100 percent renewable energy by 2050 and national legislation has made it illegal to send waste to a landfill if it can be incinerated.<sup>3</sup>
  - The German Federal Government has goals for the nation's proportion of renewable energy in the future.
  - Canada has committed to carbon reductions but consistently missed the targets and appears to be supporting ongoing expansion of fossil fuels, which will continue to drive-up national carbon emissions.
- ▶ City demographics, such as age of the population, ethnic and racial diversity, also pose important differences.
- ▶ **BERLIN'S** 2050 road map noted, for example, that 54 percent of its 2 million private households are single-person households, a very high percentage compared to other German and international cities. "The ongoing trend towards smaller household sizes has an increasing effect on energy consumption because, among other things, each small household requires its own basic set of equipment."<sup>4</sup>

3 City of Copenhagen, "Copenhagen: Solutions for Sustainable Cities," p. 26-27.

4 City of Berlin, "Climate-Neutrality Berlin 2050: Results of a Feasibility Study," March 2014, p. 12.

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## Resources

### Most Recent Climate Action Plans of Alliance Cities

<b>Berlin</b>	“Climate-Neutrality Berlin 2050: Results of a Feasibility Study”
<b>Boston</b>	“2014 Climate Action Plan Update”
<b>Boulder</b>	“Boulder’s Climate Commitment 2015 [Draft]”
<b>Copenhagen</b>	“Copenhagen Energy Vision 2050;” “CPH 2025 Climate Plan (2012)”
<b>London</b>	“2020 Vision: The Greatest City on Earth”
<b>Melbourne</b>	“Net Zero Emissions By 2020: Update 2014”
<b>Minneapolis</b>	“Climate Action Plan (June 2013)”
<b>New York City</b>	“New York City’s Pathways to Deep Carbon Reductions (December 2013)”
<b>Oslo</b>	“Environment and Climate Report 2013”
<b>Portland</b>	“Climate Action Plan 2015”
<b>San Francisco</b>	“Climate Action Strategy 2013 Update;” “San Francisco Climate Action 0 50 100”
<b>Seattle</b>	“Getting to Zero: A Pathway to a Carbon Neutral Seattle (2011);” “Climate Action Plan (June 2013)”
<b>Stockholm</b>	“Roadmap for a Fossil Fuel-Free Stockholm 2050”
<b>Sydney</b>	“Sustainable Sydney 2030: Community Strategic Plan (2014)”
<b>Vancouver</b>	“Greenest City: 2020 Action Plan;” “Renewable City Strategy 2015-2050”
<b>Washington DC</b>	“Sustainable D.C.”
<b>Yokohama</b>	“FutureCity Initiative” (2012), “Yokohama Action Plan 2013-2017“

## OTHER RESOURCES

<p><b>Carbon Neutral Cities Alliance</b></p>	<p>The Urban Sustainability Directors Network</p>	<p>Cities striving for carbon neutrality recognize that averting the worst impacts of climate change will require cutting GHG emissions by at least 80% by 2050.</p>
<p><b>Scan of Leading Edge Thinking and Practice on Carbon-Neutral Communities</b></p>	<p>Innovation Network for Communities</p>	<p>The project identifies and details 9 core strategies that need to be implemented at scale in a developmental way over the next four decades for cities to achieve 80x50 goals. The project report also identifies opportunities for collaboration and networking among cities to accelerate their progress towards these goals.</p>
<p><b>Measuring Up 2015: How US Cities Are Accelerating Progress Toward National Climate Goals</b></p>	<p>World Wildlife Fund &amp; ICLEI</p>	<p>A scan of what leading-edge cities in the U.S. are doing to reduce carbon emissions, with a focus on Atlanta, Minneapolis and Portland.</p>
<p><b>“Climate Action in Megacities: C40 Cities Baseline and Opportunities”</b></p>	<p>Arup</p>	<p>A comprehensive analysis of what the mayors of the <b>C40 megacities</b> are doing to tackle <b>climate</b> change</p>
<p><b>“Pathways to Deep Carbonization,” September 2014</b></p>	<p>Institute for Sustainable Development and International Relations and Sustainable Development Solutions Network</p>	<p>This 2014 report by the Deep Decarbonization Pathway Project (DDPP) summarizes preliminary findings of the technical pathways developed by the DDPP Country Research Partners with the objective of achieving emission reductions. The DDPP is a knowledge network comprising 15 Country Research Partners, and several Partner Organizations who develop and share methods, assumptions, and findings related to deep decarbonization.</p>
<p><b>Transform Communities’ Energy Systems</b></p>	<p>Rocky Mountain Institute</p>	<p>By 2050, we need all U.S. communities to have transformed how they use energy in transportation, industry, buildings, and electricity. To achieve this, we need to work with individual communities to create beacons of success and share the models that will enable other communities to follow a similar path.</p>
<p><b>Sustainable Transportation Energy Pathways: A Research Summary for Decision Makers</b></p>	<p>UC Davis, Institute of Transportation Studies</p>	<p>This chapter explores how such deep reduction targets (50 to 80 percent) could be met in the transportation sector by 2050, with a focus on California and the United States as a whole. It presents a framework for understanding emission reductions in the transportation sector, lays out the major mitigation options for reducing emissions, and presents scenarios to explore how deep reductions could be achieved.</p>

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**BACKGROUND**

## The Leading Edge of Climate Action Planning

Starting about 25 years ago, as mounting scientific evidence signaled a new environmental imperative, a small number of cities worldwide initiated the first versions of planning to reduce carbon emissions. At that early stage, relatively little technical expertise existed, useful data was scarce, and most residents in cities knew very little about the climate threat. Of necessity, climate action planning was mostly about making a public commitment to address climate change and instigating some initial actions, more than it was about exhaustive analysis and comprehensive, high-leverage strategies to achieve substantial impact. Since then, however, a growing number of cities have not only recognized the climate problem, they have acted strategically: publicly adopting ambitious goals, building technical capacity and information, developing “political will,” and undertaking rigorous planning processes.

Climate action planning has emerged as a sophisticated, data-driven, adaptive, performance management approach that increasingly is integrated with other city planning processes and tied to budget and capital outlay processes. This planning has several major characteristics:

### POLITICAL CONTINUITY

As leading-edge cities have progressed through several cycles of climate planning and action, climate plans and the planning process have survived local election cycles, shifts in national policies, the advent of new technologies, and other contextual changes. At the same time, citizens have become more informed about climate change, more convinced climate change has strong scientific backing, and increasingly supportive of efforts to reduce carbon emissions.

### DEEP TECHNICAL ANALYSIS

Leading-edge city planners measure carbon emissions on an ongoing basis, establishing an ability to track and report progress on an annual or five-year basis. They conduct deep technical analysis of each carbon emitting sector and/or source, have tested a variety of carbon reduction strategies and actions, and are able to compare potential impacts and costs of using a variety of reduction technologies and approaches. A rich pool of private sector consultants/firms has also developed to support this analytic work.

### STAKEHOLDER ENGAGEMENT

Leading-edge cities increasingly engage their city’s stakeholders and residents, as well as surrounding communities, in climate action planning. They have evolved how they frame climate planning and action to their communities, linking carbon reduction to broader city sustainability and other important aspects of city life (though much more of this needs to be done, as discussed later in the report).

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Deep decarbonization planning is starting to emerge as a sophisticated, data-driven, adaptive, performance management approach increasingly integrated with other city planning processes.

## PLANNING FOR INFRASTRUCTURE TURNOVER

Leading-edge cities increasingly anticipate the long-term “replacement rate” of energy facilities, vehicle purchasing, energy retrofitting in buildings, and other factors that will drive carbon reduction planning timetables and strategies. In some cases, “replacement” means the introduction of quite different technologies or types of facilities, such as microgrids for energy supply instead of centralized generating facilities, or electric vehicles.

## PLANNING AND MEASUREMENT SYSTEMS ESTABLISHED

Cities are aligning around carbon planning frameworks that allow for consistency between city carbon metrics and are more consistently using the Community Development Protocol (CDP), a global environmental disclosure system (described in more detail later in the report), or other common reporting systems to track ongoing emissions.

# Long-Term Climate Action Planning is Different from Traditional Planning

Although city planning is a long-established practice, deep carbon reduction planning brings new aspects into the urban planning realm:

## MEASURABLE TARGETS

The planning starts with a firm, measurable target supported by scientific analysis (e.g., 80 percent reduction in GHGs by 2050, or “80x50”).

## A DISTANT HORIZON

The planning embraces a time horizon that is far longer than many city decision-making processes, including budgeting. It transcends local election cycles and, therefore, is likely to need the embrace of multiple city government administrations. Further, it must be sustained through multiple generations of city residents; today’s children are tomorrow’s voters, consumers, business owners, and elected officials.

## UNCERTAINTY

The planning includes five significant elements of uncertainty:

- ▶ **Climate Science**—Climate science projections are based in large part on assumptions and modeling rather than historical record (with the exception of ice coring which provides historic data that is used to build some models). Long-term planning requires adaptation of strategies and actions, which increases risks involved in making particular decisions—large infrastructure investments, for example.
- ▶ “Preparing for the impacts of climate change is a complex challenge,” noted **SEATTLE’S** climate plan: “Climate science is evolving and is complicated by the uncertainty of future global emissions levels. Therefore, the City’s preparedness strategy needs to be an evolving one as well. The systems, plans, and infrastructure put in place to enhance resilience to climate impacts must be grounded in the best available science of the time and frequently re-evaluated as new information becomes available.”<sup>5</sup>
- ▶ **Predicting Impact of Strategies**—Difficulties are involved in estimating the expected impacts of specific strategies and actions to reduce emissions, due to lack of cause-and-effect predictability and lack of usable data.
- ▶ **Dependence on Decisions by Other Levels of Government**—As cities typically plan and implement carbon reduction strategies and actions over which they have the most control, what is involved in the longer term is less under the city’s direct control. But other levels of government may not take anticipated policy actions or may change policies.
- ▶ **MELBOURNE**, for instance, in developing its strategies for reducing the city’s reliance on coal for energy, assumed that “Australia would put a price on carbon and international policy would be in place to drive significant emissions reductions,” but an Australian pricing mechanism was repealed by a new national administration.<sup>6</sup>

5 City of Seattle, “Seattle Climate Action Plan,” June 2013, p. 54.

6 City of Melbourne, “Zero Net Emissions by 2020: Update 2014,” 2014, p. 2.

- ▶ **SAN FRANCISCO'S** 2013 climate action plan noted that the city's largest reduction in carbon emissions depended in part on state-level policies; "a decreasing emissions intensity of the electricity consumed in San Francisco" was due "to the State of California's Renewables Portfolio Standard and the closure of two of the state's dirtiest and most inefficient fossil fuel power plants in San Francisco's southeast neighborhoods," which was spearheaded by the city, but contingent upon approval from the state's Independent System Operator (ISO).<sup>7</sup>
- ▶ **YOKOHAMA** has adopted a goal of reducing CO<sup>2</sup> emissions by 80% by 2050, well ahead of the national government's target of reducing GHGs to 18% below 1990 levels by 2030.
- ▶ Elements of **SEATTLE'S** carbon neutrality plan require regional roadway pricing reform, which is not under the city's direct control.
- ▶ **Unpredictable Events** — "Wild cards" emerge, such as the availability of cheap natural gas, heightened concerns about the safety of nuclear power, or the potential development and marketability of transformative technologies.
- ▶ Following the devastating earthquake and tsunami in Japan in 2011, **YOKOHAMA** revised and strengthened its global warming action plan.
- ▶ In its plans, **COPENHAGEN** reflected on the uncertainty of solutions in long-term efforts to reduce energy consumption: "New technological solutions will continue to be tested and knowledge sharing, new organization and funding models will need to be designed." And for transforming transportation: "It is difficult to project how mobility will develop during the period up to 2050, but new solutions are likely in this area."
- ▶ **SYDNEY**, analyzing the many renewable energy technologies needed to replace fossil fuel energy: "Currently, the prevailing renewable energy technologies in Australia are onshore wind and solar. Both of these resources provide important contributions towards renewable energy, but largely only operate intermittently due to variations in climatic conditions and time of day. Therefore, we need to include less intermittent or non-intermittent renewable energy sources such

as marine, geothermal, solar thermal and renewable gas resources in the renewable energy mix if we are to avoid fossil fuel-fired spinning reserve backing up intermittent renewable energy technologies. More recently, 'power to gas' technologies have also been deployed in Europe to capture surplus renewable electricity that would otherwise have to be switched off when renewable electricity generation exceeds demand, particularly with a greater penetration of solar and wind. Using a combination of these renewable energy resources and conversion technologies would enable us to develop a renewable energy system that would genuinely replace fossil fuel base and peak load power generation.<sup>8</sup>

- ▶ **Funding** — Funding to support a city's deep decarbonization strategies is also a significant element of uncertainty. For example, **SEATTLE'S** plan has a section focused on funding for transport to implement modal plans and meet maintenance needs. Some funding sources would be through local levies, but many of the funding sources required to implement the city's decarbonized transportation system requirements are not within the direct control of city.

### SYSTEM-CHANGING STRATEGIES

Planning requires developing detailed strategies for transforming the carbon performance of key urban systems, including energy supply, buildings, transportation, land use, water, waste and food systems. These strategies need to take into consideration the political and social drivers of change, as well as the technologies that are capable of delivering deep decarbonization. They also have to cope with the fact that effective strategies require a high level of coordination and even integration among city departments and agencies that traditionally have been siloed and allowed to function on their own. An ambitious carbon reduction approach involves "horizontal" strategies that link across silos.

### CITIES' OTHER GOALS

Although long-term planning focuses on GHG reduction, it must recognize, consider, and perhaps decide on trade-offs in the ways that GHG reduction strategies might negatively affect or enhance other city priorities.

7 San Francisco, "Climate Action Strategy, 2013 Update," October 2013, p. iv.

8 City of Sydney, "Decentralised Energy Master Plan Renewable Energy, 2012-2030," December 2013, p. 2-3.

Energy-supply systems, for example, typically have some or all of the following goals that are not directly about decarbonizing the supply but cannot be ignored: the system should be reliable, affordable, predictable, innovative, just, and more. A city may find, for instance, that introducing energy microgrids that are powered by natural gas will lower energy costs, increase resilience, and reduce carbon emissions, but not eliminate emissions.

- ▶ In 2010, **YOKOHAMA** was nominated by the Japanese Ministry of Economy, Trade and Industry as one of the country's "Next-generation Energy and Social Systems Demonstration Areas." Since then, the city has been promoting the "Yokohama Smart City Project (YSCP)." In collaboration with private energy, electronics, and construction companies, the city developed a system for increasing the use of distributed renewables and electric vehicles, and optimizing the energy supply-demand balance in certain neighborhoods.

The goals of transportation systems may include affordability, customer satisfaction, safety, reduced noise, and improved financial sustainability—all relevant perhaps to a decarbonization strategy, but not directly about reducing carbon emissions.

## The Benefits of Long-Term Planning for Climate Action Are Becoming More Evident

Given the three- to four-decade time horizon for long-term climate planning, there have been concerns about the potential value of undertaking extensive planning for long-term deep decarbonization. Experience in leading-edge cities suggests several ways that such long-term planning, rather than simply looking ahead five or even 10 years, has been helpful.

### MAINTAINING FOCUS

Planning over the long term gives cities a way to keep the community focused on the ultimate GHG reduction target and, by tracking and reporting on progress, provides a "reality check" on whether short-term efforts are proving sufficient.

### TACKLING LONG-TERM STRATEGIES

Long-term planning helps cities to make decisions about actions that will take a long time to implement, such as expansion of public rail transit, or gaining more control/influence over electricity supply, and therefore are important to determine and start implementing at the earliest possible opportunity. **NEW YORK CITY**, for example, managed by 2013 to reduce citywide carbon emissions by 19 percent from 2005 levels, but—as the city's long-term strategy for achieving an 80 percent GHG reduction by 2050 "One City, Built to Last" recognized: "The majority of the GHG reductions we have achieved so far were the result of switching from coal and oil to natural gas for electricity generation and other improvements to utility operations. Together, these account for more than 80 percent of the reductions. These strategies cannot be replicated, and future reductions will be much more difficult to achieve."<sup>9</sup>

### AVOIDING SHORT-TERM MISTAKES

Planning for the long term helps cities avoid short-term decisions that could preclude longer-term achievement, since a number of decisions that will be made in the short term will have long-term impact. In other words, it forces consideration of whether the city's shorter-term strategies and actions really are putting it "on a path" to achieve the longer-term goal. For example, **VANCOUVER'S** neighborhood energy system uses sewage heat recovery for 70 percent of the heat provided, but still relies on natural gas for 30 percent. For the city to reach its long-term carbon-emissions reduction target, this natural gas must be converted to renewable fuels, so the city must make sure in the short term that such a conversion will be feasible.

### READINESS

Planning long term prepares stakeholders and the public for some of the more difficult strategies and actions that may lie further down the road, such as mandates and expenditures that likely will be needed.

### NEED FOR INNOVATION

Planning for the long term signals the need for innovative, out-of-the-box thinking, since it is understood that the long-term targets cannot be reached through business as usual and incremental improvement.

<sup>9</sup> New York City, "One City, Built to Last," p. 6.

## CONSISTENCY AND PREDICTABILITY

Planning long term provides signals that assure the private sector that policies will not come and go, creating greater predictability for the private sector, thus fostering greater private sector engagement and commitment, and more sustainable public-private partnerships.

## ALIGNMENT WITH CLIMATE ADAPTATION

Increasing and more visible climate changes and their effects on cities are making it clear that cities must plan, for long-term, major adaptations. Planning adaptation can align well with long-term decarbonization plans.

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## Resources

<b>Bounce Forward: Urban Resilience in the Era of Climate Change</b>	The Kresge Foundation	Assesses the concept of urban resilience in the face of climate change, examining what's already known and what remains to be explored. The paper is based on a survey of existing literature and the thinking of organizers, researchers, planners and other urban change agents.
<b>Weather We Don't Recognize: How climate change is affecting the Midwest's weather and how communities are responding</b>	Island Press and the National Wildlife Federation	Summarizes the major findings of the 2014 National Climate Assessment for the Midwest, and highlights how communities are responding to the impacts of climate change.
<b>The contribution of urban-scale actions to ambitious climate targets</b>	Peter Erickson and Kevin Tempest (C40)	New and continued efforts are needed to strengthen and extend the ambition of current national pledges to reduce greenhouse gas (GHG) emissions and to close the gap between the current emissions pathway and a trajectory consistent with a 2-degrees Celsius target. In this working paper, we argue that cities have an important role to play in deepening the ambition of global climate targets.

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**RATIONALE  
FOR  
PLANNING**

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## The Carbon Reduction Imperative for Cities

Leading-edge cities describe a number of reasons they have decided to respond ambitiously to the carbon reduction challenge:

### CITIES ARE THE LARGEST PLACE-BASED SOURCE OF GHG EMISSIONS

Although the production of carbon emissions is a global phenomenon, cities are responsible for about two-thirds of global carbon emissions. They take up only 2 percent of the earth's land mass, but they are responsible for 80 percent of energy use, and this will increase as more people move to cities during this century. Thus any real effort to significantly reduce emissions needs to involve cities. **BERLIN'S** road map noted that city's CO<sub>2</sub> emissions equal those of the countries of Croatia, Jordan or the Dominican Republic. The total annual CO<sub>2</sub> emissions of **NEW YORK CITY** approximately correspond to those of the country of Bangladesh. **LONDON'S** are almost equal to those of the country of Ireland. "These figures alone show that if cities employ active climate policies, it will have a global impact."<sup>10</sup> **COPENHAGEN'S** plan stressed the importance of the city assuming "its share of the responsibility for climate change."<sup>11</sup>

Globally, more and more people are expected to be living in cities—which could further drive up the cities' share of global emissions.

### REDUCING VULNERABILITIES

Cities are highly vulnerable to the effects of climate change (e.g., sea level rise, extreme heat, increasingly severe storms, drought). Climate change has been called the "existential crisis" of our time; therefore cities should do everything they can to forestall future climate changes and ensuing unmanageable disruptions. This means continuing to reduce carbon emissions to forestall even more climate volatility, not just adapting to the potential effects of climate change. In many cities, the impacts of climate change already are being felt: changing precipitation patterns alone are affecting stream flow, groundwater recharge, flooding, increased risk of wildfire, drought, and invasive plant and animal species.

- ▶ **MINNEAPOLIS**, an inland city, is not threatened by sea level rise, but scientists have identified other climate trends likely to create difficulties, some of which already are underway and all of which add up to a challenging prospect, according to city plans:
  - Since the 1941-1970 period, average annual precipitation in the Twin Cities has increased 20 percent, in part due to a significant increase in very heavy precipitation events.

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Avoiding significant climate change requires reimagining and reinventing our cities, which account for nearly three-quarters of humanity's GHGs.

10 City of Berlin, "Climate-Neutrality Berlin 2050: Results of a Feasibility Study," March 2014, p. 4-5.

11 City of Copenhagen, "Copenhagen: Solutions for Sustainable Cities," p. 46.

- Average air temperatures have risen at an increasing rate, with the greatest warming taking place at night and in winter months, a trend consistent with higher concentrations of greenhouse gases in the atmosphere.
- “Minnesotans should expect more difficult summers, with intense heat waves increasingly common, more prevalent water- and insect-borne diseases, and a greater number of days with low air quality. Floods and droughts alike may be more severe as precipitation events become stronger and summertime evaporation increases. Agriculture and forestry will both face new challenges from changing patterns in weather and ecological systems. Native species will face new pressures and threats as well. Neighborhoods with fewer trees have less shade, and impervious surfaces mean more water enters the stormwater system.”
- “The increase in extreme heat events will likely be challenging for Minneapolis. If emissions continue to rise at the current rates, by the end of the century the Minneapolis-Saint Paul area is expected to experience nearly 70 days over 90°F, and 28 days over 100°F each year... In the 1960-1990 period, Minneapolis-Saint Paul averaged only 11 days over 90°F each year, and less than two days over 100°F. The increase in extreme heat events could result in an increase in heat-related deaths and heat-related illnesses. Ozone pollution, which exacerbates lung diseases such as asthma, is also expected to rise in conjunction with temperatures.”<sup>12</sup>

► **SAN FRANCISCO**, like many other Alliance cities, also detailed the way that climate change has already changed local conditions: “San Franciscans are facing a reality where climate change is already affecting their lives. Sea level rise, reduced snowpack and more fires in the Sierra Nevada Mountains, and extreme weather events, particularly heat waves and intense rainstorms that cause flooding, are among the factors influencing the livelihood of the entire Bay Area. The most recent scientific projections show sea level increasing by 11 to 19 inches by 2050 and 30 to 55 inches by 2100. Runways at San Francisco International Airport, pri-

mary transportation arteries such as Highway 101, and miles of shoreline and parks are particularly at risk. A rise-in-sea-level scenario eventually could result in an estimated \$62 billion of infrastructure damage. By mid-century, San Francisco could see three to four times as many extreme heat days as occurred in 2013, with related increases in hospitalizations and deaths, especially for the elderly, the very young, and other vulnerable groups such as those living in low-income neighborhoods.”<sup>13</sup>

► In **YOKOHAMA** temperatures have risen 2.7°C in the past 100 years, and recent years have seen a 50mm increase in average rainfall.

## CITIES AS SOLUTIONS

Cities are an essential part of a worldwide “low carbon future” because their population and economic density creates efficiencies, comparative advantages, and unique opportunities for investing in, mobilizing, taking advantage of, and achieving large-scale carbon reduction. Inherently, city living can create lower per-capita carbon emissions due to the locational efficiencies of proximity, density, smaller dwelling sizes, and other factors.

► **SEATTLE’S** plan explained that “the design of cities — how we use our land, how we design our buildings, how we get around — significantly impacts the amount of energy we use and greenhouse gas (GHG) emissions we produce. In the next 20 years, we expect another one and a half billion residents in the world’s cities, many of them in the developing world. Therefore, it is critical that cities like Seattle demonstrate that it is possible to dramatically reduce GHG emissions, while creating more vibrant and prosperous places to live and do business.”<sup>14</sup>

► Some cities have developed “carbon budget” scenarios that start to describe key aspects of low-carbon urban life in the future. **PORTLAND** calculated that to achieve its per-person carbon emissions goals for 2050, “residents must meet all of their needs while using 62 percent less electricity than they do today and driving 59 percent fewer miles per day.”<sup>15</sup>

<sup>12</sup> City of Minneapolis, “Minneapolis Climate Action Plan,” June 2013, p. 4-5.

<sup>13</sup> City of San Francisco, “Climate Action Strategy, 2013 Update,” October 2013, p. v.

<sup>14</sup> City of Seattle, “Seattle Climate Action Plan,” June 2013, p. 2.

<sup>15</sup> City of Portland, “Climate Action Plan,” June 2015, p. 19.

## CO-BENEFITS TO CITIES FOR INVESTING IN DECARBONIZATION

Local, deep carbon reduction strategies and actions can have numerous positive “side effects” on a city, improving its quality of life—economic development, affordability, public health, equity, resilience, energy security, and environmental protection—for multiple generations of citizens and businesses, and providing comparative advantage.

- ▶ “When you invest in sustainability,” **COPENHAGEN’S** plan noted, “the returns are measured in more than just environmental terms. Building up a bicycle infrastructure, for example, leads to higher rates of ridership, which in turn leads to improved health as well as a decrease in CO2 emissions. Investing in sustainability also has financial benefits. Cleaning the water in our harbour improved the marine environment, and it also benefited business, tourism and real estate prices. And an integrated public transport system not only reduces traffic congestion, it also saves us billions of euros and keeps the city efficient and competitive.”<sup>16</sup>

## Framing the Story: Visions for Decarbonized Cities of 2050

No single storyline works for every city, because of contextual differences, but leading-edge cities are converging on some basic themes in describing their cities’ decarbonized futures.

### VISION FOR THE CITY’S FUTURE

Cities have developed a proliferation of similar visions for the city’s future, including “smart,” “livable,” “green,” “sustainable,” “innovative,” “modern,” “competitive,” “prosperous,” “connected.” These visions often are extended into descriptions of neighborhood- and district-scale visions for the post-carbon era. The visions may be part of the city’s branding itself on national and global stages, which can support efforts to attract and keep young talent in the city

- ▶ **COPENHAGEN:** “A green, smart and carbon neutral city.” “By 2025 we will be able to call ourselves the world’s first carbon neutral capital.”<sup>17</sup>
- ▶ **SEATTLE:** Seattle’s goal is to be Carbon Neutral and Climate Ready: “A carbon neutral Seattle will be a more socially and economically just city, a healthier city and a more prosperous city.”<sup>18</sup>
- ▶ **SYDNEY:** “Keeping Sydney globally competitive is central to Sydney’s and Australia’s future. The City must focus on the global economy and sustained innovation to ensure continuing prosperity.” The city’s future would be “an acknowledged global city with natural assets, a strong economy and globally competitive businesses... A globally competitive City [that] expands opportunities for residents, business, workers and the broader society.”<sup>19</sup>
- ▶ **PORTLAND’S** vision is to be “Prosperous, Connected, Healthy, Resilient and Equitable.” Its climate action plan reported that “an 80 percent reduction...requires reimagining our community. It means transitioning away from fossil fuels while strengthening the local economy and shifting fundamental patterns of urban development, transportation, buildings and consumption.”
- ▶ **VANCOUVER** has made “becoming the greenest city in the world” a defining strategy for the municipality that permeates many aspects of city planning and operations. The topic of “climate leadership” is one of 10 goal areas for the city to achieve its vision.<sup>20</sup>

16 City of Copenhagen, “Copenhagen: Solutions for Sustainable Cities,” p. 4.

17 City of Copenhagen, “CPH 2025 Climate Plan,” 2012, cover.

18 [http://www.seattle.gov/Documents/Departments/OSE/CAP.Update.Report\\_Final.Screen.Pages..pdf](http://www.seattle.gov/Documents/Departments/OSE/CAP.Update.Report_Final.Screen.Pages..pdf)

19 City of Sydney, “Corporate Plan 2013-2016,” p. 30.

20 City of Vancouver, “Greenest City 2020 Action Plan Update,” June 2015, p. 3.



Source: City of Vancouver, “Greenest City 2020 Action Plan Update.”

### CITY SUSTAINABILITY

Cities integrate decarbonization into a broader issue framework, often headlined as “sustainability.”

- ▶ **PORTLAND:** “The intertwined challenges of climate change, social inequity, economic volatility, degraded natural systems and the rising cost of living demand an integrated response that goes far beyond cutting carbon.”<sup>21</sup>
- ▶ **WASHINGTON, D.C.’S** sustainability plan: “We must plan for a city that is sustainable—not just environmentally, but economically and socially as well. We must continue our investments to revitalize neighborhoods, expand transportation choices, better our health, restore rivers and parks, and improve our schools. By setting ambitious goals for our built environment, energy, food, nature, transportation, waste, and water as well as for our economy, public health, community equality, and climate, we strengthen the District’s commitment to the core values of quality of life, economic growth, and equal access to opportunity. With our vision for a sustainable city and strategic action to achieve our goals, we will continue to attract employers, investment, and job growth in existing fields and emerging sectors of a green economy. We also will ensure that the District is a healthier, more livable place for our families to grow and thrive for generations to come.”<sup>22</sup>

21 City of Portland, “Climate Action Plan,” June 2015, p. 3  
 22 Washington, D.C., “Sustainable DC Plan,” 2012, p. 5.

▶ **YOKOHAMA’S** “FutureCity” initiative aims to create a vibrant, well-balanced and prosperous city that “everyone wants to live in” by tackling diverse challenges including issues related to climate change and an aging population. Yokohama’s population has grown by 350 percent in the past 60 years, and the volume of energy consumption continues to rise as a result. Moreover, the number of people over the age of 65 will reach one million by 2029. To address these challenges, FutureCity Yokohama will address 42 issues in five categories: “low carbon and energy conservation”, “water and environment”, “super-ageing society”, “creativity” and “challenge.”<sup>23</sup>

## Co-Benefits for Cities’ Constituents

Many “co-benefits” can be generated in the process of carbon reduction. This allows cities to frame the carbon reduction conversation around what people care about (e.g., health, saving money, livability). **SEATTLE’S** plan identified several of these: “While reducing GHG emissions is the primary purpose of this plan, it is important to note that these strategies provide a number of other community benefits. Residents who can meet many of their daily needs by walking, bicycling, or riding transit also benefit from lower overall household costs, improved health, thriving local business districts, and increased opportunities for housing and jobs. The city’s economy also benefits from reduced fossil fuel use in the transportation system. In 2011, [the State of] Washington’s petroleum consumption drained nearly \$15 billion out of the state economy, more than \$2,000 per person. Money spent on cars and gasoline creates less than half as many local jobs as money spent on other goods and services.”<sup>24</sup>

23 <http://www.city.yokohama.lg.jp/ondan/english/futurecity/>  
 24 City of Seattle, “Seattle Climate Action Plan,” June 2013, p. 16.

Among the co-benefits cities have recognized:

### Co-Benefits of Deep Decarbonization

Making the city an attractive place for businesses and people to locate

Stimulating local business/economic development/job creation opportunities

Creating cost savings for consumers/households and businesses

Keeping energy dollars local

Improving public health

Improving environmental quality

Increasing “energy security” and reducing exposure to energy price increases.

Improving livability/quality of life

- ▶ **Making the city an attractive place for businesses and people to locate**—Efficient transportation, clean air, parks, and walkable communities—qualities of a low-carbon city—make the city a place in which companies can attract and retain talented employees.
- ▶ **Stimulating local business/economic development/job creation opportunities.**—The shift to low carbon generates significant market opportunities, including: green and sustainable real estate; low/no-carbon technologies, including renewable energy supply and electricity microgrids; energy efficiency services (e.g., weatherization, electricians, engineers, builders); construction sector spending; and a “clean” technology sector.

- ▶ **COPENHAGEN** related that in 2009 the city had 11,000 jobs in its green sector. “Our ambition is to make Copenhagen an international centre for cleantech companies . . . Danish companies will have a unified platform to demonstrate and showcase green, Danish technologies.” The city’s green economy benefited from growth of the Danish wind turbine industry into a multibillion Euro industry with more than 350 companies producing turbine towers, blades, generators, gear boxes, and control systems.<sup>25</sup>
- ▶ **LONDON** reported in 2014 that its “Low Carbon and Environmental Goods and Services sector” grew more than 5 percent in two years, employed over 163,500 people and was “set to grow by over six percent until the end of the decade.”<sup>26</sup>
- ▶ **PORTLAND** reported having 12,000 jobs in green building and infrastructure design and construction, wind and solar power developers, photovoltaic manufacturers, biodiesel producers. Since 2001, this sector has grown faster than others. “Portland is home to some of the nation’s leading developers, builders, architects, engineers and product manufacturers in the green building and green infrastructure industries. In addition, a critical mass of clean energy firms, such as wind developers, photovoltaic manufacturers, biodiesel producers and energy efficiency consultants call the region home. Portland is also a national leader in innovative bicycling products and services. These businesses offer economic benefit to the community by creating skilled and semi-skilled, well-paying jobs while contributing directly to local environmental quality. For example, Oregon’s rapidly growing clean energy sector is showing strong demand for trained workers, from solar installers to wind turbine technicians. Bicycle manufacturers and shops contribute \$90 million annually and add 1,500 jobs to the local economy.”<sup>27</sup>

25 City of Copenhagen, “CPH 2025 Climate Plan,” 2012, p. 5.

26 kMatrix, “London’s Low Carbon Market Snapshot - 2013,” August 2013, p. 4.

27 City of Portland, “Climate Action Plan,” June 2015, p. 52.

## Economic Impacts of Climate Action in Portland

**Direct Job Creation.** Carbon-reduction activities like energy efficiency improvements in homes and commercial buildings create jobs for contractors, electricians and other building-sector trades.

**Traded-Sector Competitiveness.** By meeting local demand for low-carbon solutions, firms develop expertise that makes them competitive nationally and internationally.

**Commercialization of Emerging Technologies.** As early adopters of low-carbon products and services, the city can provide crucial market support for innovative solutions and entrepreneurial business opportunities.

A Desirable Community. Many of the same qualities that accompany lower carbon emissions — efficient transportation, clean air, nearby parks and walkable neighborhoods — also make the city an attractive place for firms to locate. Locating in a region with a high quality of life and vibrant community helps companies attract and retain talented employees.

Source: City of Portland, “Climate Action Plan.”

- ▶ **Creating cost savings for consumers/households and businesses**—A main feature of this is the use of energy-saving appliances and durable, repairable goods; energy-efficient homes and vehicles. Another is promotion of the “sharing economy.” The affordability of residential housing is particularly important to many cities, and can benefit from climate action, as **NEW YORK CITY** noted: “Reducing energy use in our buildings can also help address our affordable housing crisis. Increasing utility costs are one of the primary contributors to the growing share of New Yorkers who are becoming rent-burdened. Improving efficiency in our residential buildings can help mitigate rising housing costs. In addition, our public housing has significant untapped energy-saving potential. Investments in efficiency in these buildings would help improve the quality of our public housing stock.”<sup>28</sup>
- ▶ **Keeping energy dollars local**—Dollars spent on fossil-fuel energy sources not produced locally are redirected

to pay for efficiency improvements, non-fossil fuel energy, increased spending on labor and materials locally.

- ▶ **Improving public health**—This includes the health benefits of reduced air pollution; the physical activity of walking and biking, which impact obesity, chronic disease, and reduced risk of crash-related injury, etc.; improved nutritional quality; and reduced risk of heat-related illness.
- ▶ **Improving environmental quality**—Improvements include the urban forest canopy, natural areas, biodiversity corridors, blue ways, green roofs; air quality; and water quality.
- ▶ **Increasing “energy security” and reducing exposure to energy price increases**—Renovating homes to reduce energy consumption not only cuts bills but safeguards against rising energy prices in the future.
- ▶ **Improving livability/quality of life.**—These co-benefits include easy access to walkable and bikeable neighborhoods; shorter commute times between home, work, and school; increased choices for transportation; reduced noise; increased household spending on education, health services, and leisure activities; and increased access to trees, water, and other green infrastructure.
- ▶ **Resident engagement**—Large numbers of city residents become excited to see that their local community is taking ambitious climate action, and residents build community among themselves to become a personal part of taking climate action.

## Messaging

Cities try to manage the local conversation about carbon-emissions reduction to build awareness, understanding and buy-in.

- ▶ **An explicit focus on carbon reduction**—In some cities, carbon reduction alone can be an important motivator for people. **COPENHAGEN’S** 2025 plan said that “Copenhagensers want to help make a difference in favour of the climate. They choose their bikes—not just in sunny weather—they separate their household waste, they energy retrofit their homes and adopt an

<sup>28</sup> New York City, “One City, Built to Last,” p. 7.

energy-efficiency lifestyle.”<sup>29</sup> Some cities have found that they can talk about carbon reduction now, but couldn’t just a few years ago, because residents have either experienced climate disruptions or seen the benefits of GHG reductions directly—or heard about them—and believe mitigation is needed.

► **Using other concepts**—Some cities have moved the language away from carbon reduction, which they feel is too conceptual, technical, and complicated for general understanding and use—turning, for example, to “fossil-fuel free” or “100 percent renewable energy.” **VANCOUVER** has found that changing some of the city’s framing to 100 percent renewable energy helped residents and businesses to feel excited by the positive approach and want to be a part of it.

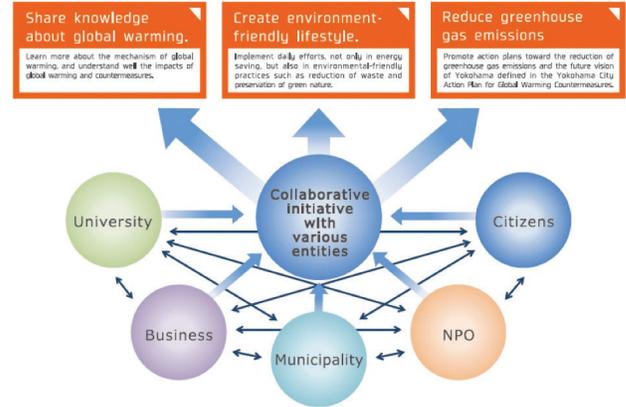
► **Changing the frame**—Some cities shift the framing of carbon reduction:

- From the potential of increased costs to the potential of investment opportunities. **PORTLAND**: “Vast amounts of money will be saved and made during the transition to a low-carbon community . . . we have an unparalleled opportunity to make the switch in ways that create jobs and benefit all residents.”<sup>30</sup>
- From a potential burden on the economy to potential opportunities for the economy: **COPENHAGEN**: “A global switch to a greener economy will generate a demand for technology, know-how and efficient solutions. Copenhagen is ready to meet the challenges and to make the city available as a green lab.”<sup>31</sup>

► **Emphasizing positive, collective effort**

- **BERLIN**: “A key task is to take away peoples’ feeling that they are making a ‘sacrifice’ with their eco- and climate-friendly behaviour; one that might even be ineffective, since they are alone in behaving this way. Instead, the positive collective effect of individual activity must be made more visible.”<sup>32</sup>

- **YOKOHAMA** has 3.7 million residents and 110,000 business operators. The city’s model for promoting its carbon reduction initiatives in cooperation with various stakeholders:



Source: City of Yokohama

## The Difference a City’s Context Makes

A number of factors affect a particular city’s approach to framing and strategizing for deep, long-term carbon reductions.

- **Climate**—A City’s climate zone and geographic and physical features affect the ways that climate change impacts particular cities. This is especially important in driving the need for heating and cooling, or neither, which strongly affects carbon intensity and potential strategies.
- **A City’s Carbon Emissions Sources**—The emissions profile affects which strategies will be most important for a particular city to use and the difficulties the city will encounter. For example, **OSLO’S, SEATTLE’S** and **VANCOUVER’S** electricity supplies are nearly 100 percent carbon neutral (mostly hydropower, plus some nuclear and wind), while most cities have a large percentage of electricity supply generated from coal

29 City of Copenhagen, “CPH 2025 Climate Plan,” 2012, p. 9.

30 City of Portland, “Climate Action Plan,” June 2015, p. 9.

31 City of Copenhagen, “CPH 2025 Climate Plan,” 2012, p. 10.

32 City of Berlin, “Climate-Neutrality Berlin 2050: Results of a Feasibility Study,” March 2014, p. 24.

- ▶ **Trends in City's Economy and Population**—Population growth will naturally drive increased energy consumption, so to reach an 80x50 goal cities with growing populations will have to actually reduce even more emissions than if they were to experience no population growth.
- ▶ **Energy Costs**—In cities with very low-cost electricity derived from fossil fuels, it is difficult to promote energy efficiency or investment in alternative fuel sources because the financial payback on investments can be quite long and it is difficult for more expensive renewable sources to compete in the marketplace. For example, **VANCOUVER'S** natural gas prices have been cut in half in the last few years, which makes it much harder to make a business case for investing in renewable energy. At the same time, energy markets display a great deal of volatility and the price advantage of fossil fuels over renewables has been eroding.
- ▶ **Local Economic Structure**—The types and sizes of businesses and types of local jobs influences cities' abilities to make changes. In **VANCOUVER**, for example, there are very few large businesses; 90 percent of businesses have fewer than 50 employees, and 70 percent have fewer than 10 employees. The approach in a city with a large percentage of blue collar jobs may be very different from that of a city with a large percentage of white collar jobs
- ▶ **Local Politics.**—The level of political support for climate action varies by city. In some cities, it is deeply engrained in the political structure and control, including parties that are organized around a green agenda. In others, it is less institutionalized and may be more controversial.
- ▶ **Policy Contexts at "Higher Levels" of Government**—National and state/province levels of government usually have significant control—through regulations, subsidies, and other means—over substantial sources of carbon emissions at the local level.

## What Cities Do/Don't Control

Carbon reductions can be difficult for cities to achieve because they may not have the jurisdictional authority needed to issue a policy or implement a program. Often control is shared with other local jurisdictions or held by other levels of government. Some cities control their building codes, others don't. Except in cities with municipal utilities, energy supply is usually controlled either by a private utility or by higher levels of government. Transportation policies are often set at regional, state/province or national levels. Solid waste haulers and treatment facilities are often not controlled by local government, but some cities can have substantial discretion in how solid waste policies are implemented.

At the same time, cities do not control commodities prices or how national governments encourage/prevent new energy sources from emerging in particular sectors.

It is important to understand what communities can impact and how to do it. Communities find they need to manage at least three sets of intergovernmental relationships: among communities in the metropolitan region; between community and state/province level; and between local and national government. But within specific systems, such as energy supply, various institutions, such as regional bodies of multiple jurisdictions, may hold authority for decision-making.

The 2014 C40 Cities report, "The Power to Act," based on a survey of its city members, framed city control in four categories:

1. Own and Operate
2. Set and Enforce Policies
3. Budgetary and Revenue Control
4. Set Vision

"The outcomes," C40 reported, "show a trend of increasing and expanding climate action in cities, with mayors taking action where they have the most power, and creating innovative solutions where they do not."

SYSTEM	PERCENTAGE OF C40 CITIES WITH “STRONG POWER” TO...			
	Own/Operate	Set/Enforce Policies	Control Budget	Set Vision
Energy Supply	27%	32%	15%	25%
Energy Efficiency	57%	68%	29%	39%
Transportation	53%	54%	35%	44%
Waste Management	53%	56%	35%	44%

Source: C40, “Powering Climate Action” hyperlink: [http://c40-production-images.s3.amazonaws.com/other\\_uploads/images/295\\_Powering\\_Climate\\_Action\\_Full\\_Report.original.pdf?1435760139](http://c40-production-images.s3.amazonaws.com/other_uploads/images/295_Powering_Climate_Action_Full_Report.original.pdf?1435760139)

Although this data was from a wide range of cities in different national contexts, it suggested several tendencies:

- ▶ For each system from about 40 to 70 percent of cities do not have strong power to control the system.
- ▶ The system over which cities have least direct control is their energy supply.
- ▶ The system over which they have the most control is energy efficiency, due to their ability to set and enforce policies.
- ▶ Across all of the systems, the cities least powerful source for control is budgets, followed by the power to set the vision.

**GAINING INFLUENCE**

Many sources of carbon emissions are not controlled directly by cities, so they have to figure out how to strongly influence decision-makers in other levels of government and the private sector. They also have to influence privately owned electricity utilities, as well as their own residents’ behaviors. Different cities have different degrees of control and influence, but all are pursuing ways of exercising and increasing their influence. This is discussed in greater detail in Section 14.

## Resources

<b>Copenhagen Green Economy Leader Report (2014)</b>	Copenhagen	Evaluates Copenhagen as a green economy leader through its green economy drivers, lower carbon, energy and resources, urban form, transport and accessibility, and innovation and business.
<b>Yokohama: “FutureCity Initiative (2012)</b>	Yokohama	Yokohama’s “FutureCity” action plan.
<b>Powering Climate Action</b>	C40	A comprehensive survey of the powers and governance approaches used by cities to deliver climate action. It spans all global regions, all urban sectors, and unlike any other study, is built on 123,078 data points reported directly by 66 C40 cities.
<b>From Boom to Bust? Climate Risk in the Golden State</b>	Risky Business Project	A collection of business and policy leaders dedicated to publicizing the economic costs of unabated climate change. The group is chaired by environmentalist donor Tom Steyer, ex-New York City Mayor Michael Bloomberg and Henry Paulson Jr., a former Treasury Secretary.
<b>Connecting on Climate: A Guide to Effective Climate Change Communication</b>	EcoAmerica (from the MomentUs site)	Comprehensive climate communications guide based on social science research.
<b>Thousands of Individual Actions Add up to a Sea of Change</b>	Bloomberg Philanthropies	Today, more than 4,700 measurable climate change actions are in effect in the nearly 70 C40 cities, with almost 1,500 further actions under active consideration.



**PRINCIPLES**

## Common Principles for Deep Carbon Reduction Planning:

- Use best available science
- Embrace the unfamiliar
- Lead by example
- Make carbon reduction everyone's responsibility in government
- Seek strategies that produce co-benefits
- Get "all hands on deck" in the community
- Base decisions on data—the essence of performance management and accountability
- Don't hesitate: Set transformation into motion as soon as possible
- Integrate climate targets into other city plans
- Anticipate where your strategies will need to go
- Embrace social equity in climate action

## Basic Ideas for Organizing a City's Long-Term, Deep Carbon Reduction Planning

Over time, cities have been developing and using a set of organizing principles to guide their climate action planning and implementation.

### USE THE BEST AVAILABLE SCIENCE

Set long-term targets consistent with latest scientific analysis of the climate change challenge: i.e., 80 percent reduction by 2050.

### EMBRACE THE UNFAMILIAR

Carbon-emissions reduction has many unknowns, and success is not guaranteed. But inaction in the face of uncertainty or the lack of perfect solutions is not an option. What's required is leadership, the commitment to goals and the sustained determination to achieve them. At the same time, cities have to draw strong connections for residents and stakeholders between climate action and the city's other goals and strategies, stressing the similarities to help address anxieties about large-scale change.

### LEAD BY EXAMPLE

Local government should model deep carbon reduction planning in its own facilities and operations—embracing ambitious targets, strategies, and actions, and publicizing results. Thus, many climate action plans specifically identify the city government or municipal carbon emissions (as opposed to community-wide emissions) establish ambitious carbon reduction targets, and detail strategies and actions. Even cities where local government operations amount to as little as 1 percent of total carbon emissions have established aggressive policies and continuous improvement practices to reduce energy use—using procurement and green building policies and, in the process, reducing energy bills substantially and investing the savings in further carbon reduction.

- ▶ **OSLO:** "If we are to reach our targets, it is essential that we cooperate with our citizens, organisations and the business community. It is equally important that the municipality leads by example. We are pleased to present this report, which shows real progress in our efforts to follow up on the environmental targets we have agreed upon. These results give the City of Oslo the credibility it needs to encourage our citizens, the business community and national authorities to follow our lead—for instance, by phasing out fossil heating and converting to zero-emission vehicles."<sup>33</sup>

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33 City of Oslo, Environment And Climate Report 2013, p. 3.

## MAKE CARBON REDUCTION EVERYONE'S RESPONSIBILITY IN GOVERNMENT

Don't just look to the city's environment department or agency to lead the charge on carbon reduction. Efforts should be comprehensive and "horizontal" across city departments, not restricted to a single silo or two that won't have the authority or knowledge to mount and sustain the sort of effort that's needed. To drive and coordinate efforts, cities typically locate authority for carbon reduction in an office involving elected officials and/or top management, even as responsibility for specific strategies and actions may be distributed throughout the system.

## SEEK STRATEGIES THAT PRODUCE CO-BENEFITS

Use carbon reduction efforts to enhance the quality of life for city residents and businesses through energy equity, environmentally and economically sustainable development, and other triple bottom line impacts.

## GET "ALL HANDS ON DECK" IN THE COMMUNITY

Ensure inclusive and meaningful engagement of stakeholders and citizens in the community in planning and implementation. Among other things, this means ensuring that everyone has equitable opportunities to participate and benefit.

- ▶ **PORTLAND:** "Businesses and residents ultimately determine our success\_ Across the community, small daily choices and behaviors, such as whether to take the bus or drive, add up\_ When you insulate a house, upgrade the lighting system in a commercial building or buy a fuel-efficient vehicle, these individual decisions add up to meaningful reductions in carbon emissions."<sup>34</sup>
- ▶ **SEATTLE:** Achieving carbon neutrality "will require action from everyone in our community- local government, residents, businesses, industry, building owners, utilities, and many others — as well as action at the state, federal, and international level."<sup>35</sup>

## BASE DECISIONS ON DATA — THE ESSENCE OF PERFORMANCE MANAGEMENT AND ACCOUNTABILITY

Invest in a data-driven performance-management infrastructure and culture in the city to measure-monitor-and-manage carbon reduction over the long term. Monitor progress annually and based on results and new developments, revisit goals and strategies. Political considerations inevitably affect target setting, but targets should be supported by analysis.

## DON'T HESITATE: SET TRANSFORMATION INTO MOTION AS SOON AS POSSIBLE

As **COPENHAGEN** noted, "The transformation takes place gradually over a long time period." That's why it should be set in motion as soon as possible. Some of the strategies and actions for carbon reduction are relatively expensive and take time to have impact (e.g., rail infrastructure) and therefore often start as development/pilot projects and should commence as soon as possible.

## INTEGRATE CLIMATE TARGETS INTO OTHER CITY PLANS

Integrate climate action planning with other city plans, and integrate carbon reduction planning with adaptation and resilience planning. **SEATTLE'S** Comprehensive Plan, Bicycle Master Plan and Transit Master Plans are good examples of plans that incorporate the city's climate targets.

## ANTICIPATE WHERE STRATEGIES WILL NEED TO GO

Start carbon reduction strategies with efforts to enable/incentivize voluntary behaviors before establishing mandates that require behaviors. Few if any cities turn immediately to mandatory policies that require changed behaviors by individuals/households or businesses — because these are very likely to meet with opposition and resistance and, if voluntary initiatives work well, could be unnecessary. (In some cases, cities have existing regulations/mandates in

34 City of Portland, "Climate Action Plan," June 2015, p. 15.

35 Seattle CAP p 3.

place and choose to ratchet them up gradually to higher standards.) Instead, cities see voluntary initiatives as paving the way for mandatory efforts that might be needed, because they increase the community’s awareness of what behaviors are needed. In addition, cities can signal that if voluntary efforts don’t achieve the necessary reductions in emissions, they will have to turn to mandates—a way of signaling that the opportunity for voluntary action should not be ignored.

- ▶ **NEW YORK CITY**, for instance, in its published strategy for increasing energy efficiency of buildings, announced that it would “Develop interim energy performance targets for existing buildings to be met through both voluntary reductions and new regulations, such as performance standards and measure-based mandates, which would be triggered if adequate reductions are not achieved.”<sup>36</sup>

#### EMBRACE SOCIAL EQUITY IN CLIMATE ACTION

- ▶ **PORTLAND** is one of a number of cities that have embedded equity considerations into its action planning processes and made it explicit in the plan recommendations: “Communities of color and low-income populations have historically been under-served by programs and investments and under-represented in decision making on climate policy. Lack of low-carbon, safe transportation options, inefficient housing and the inability to afford healthy food are examples of disparities experienced by these communities that result in fewer benefits from climate action opportunities. These inequities primarily result from ongoing institutional racial bias and historical discriminatory practices that have resulted in the inequitable distribution of resources and access to opportunities.”<sup>37</sup>

- ▶ **NEW YORK CITY** articulated its version of an equity principle in its strategy for boosting energy efficiency of buildings: “Ensure benefits are shared by New Yorkers in every neighborhood. The City will promote energy efficiency and renewable energy across more communities and building sectors, including affordable housing and small and mid-sized buildings. The City will also create new programs so local workers benefit from the job growth and economic activity that result from efficiency investments.”<sup>38</sup>
- ▶ **SEATTLE’S** plan identified “How can we enhance equity through climate action” in each of the plan’s sectors.<sup>39</sup>

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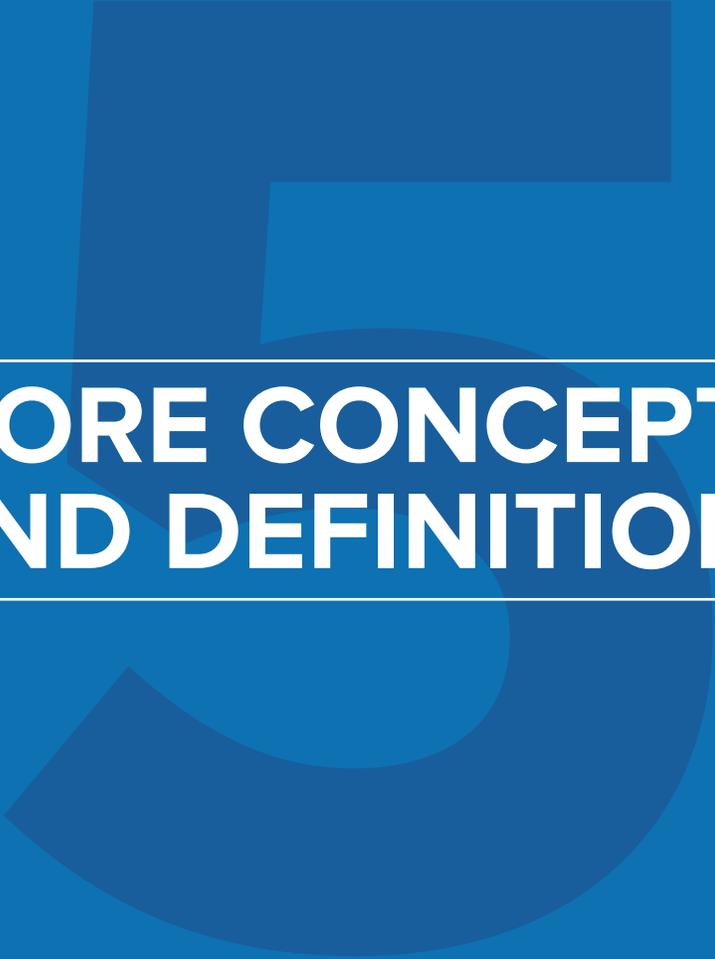
36 City of New York, “One City, Built to Last,” p. 10.

37 City of Portland, “Climate Action Plan,” June 2015, p 43.

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38 City of New York, “One City, Built to Last,” p. 13.

39 [http://www.seattle.gov/Documents/Departments/OSE/2013\\_CAP\\_20130612.pdf](http://www.seattle.gov/Documents/Departments/OSE/2013_CAP_20130612.pdf)



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**CORE CONCEPTS  
AND DEFINITIONS**

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## The “Goal” of Carbon Emissions Reduction

The most important concept around which cities have somewhat different ideas and terms is the goal of carbon emissions reduction (whether at the level of a facility, enterprise, household, city, state/province, or nation).

## “Amount of Local Carbon Reduction by Date Certain”

This goal uses measurement of carbon emissions produced—an assessment, inventory, and periodic monitoring—and establishes an overall reduction target in emissions against a baseline level; for example, an 80 percent reduction by 2050 from 1990 levels, with an interim goal of a 40 percent reduction by 2030. A second way of expressing this absolute emissions reduction goal is as a per-person goal, something that most cities do because it allows them to take into account population growth or loss over the years.

- ▶ The following example is from **PORTLAND'S** 2015 Climate Action Plan:
  - Long-term Goal: 80 percent reduction x 2050 based on 1990 level<sup>≠</sup>
  - Between 1990 and 2013, city reduced emissions 14 percent despite a 31 percent increase in population. Per person reduction was 35 percent.
  - Interim target: 40 percent reduction by 2030.

Nearly every leading edge city has adopted the 80x50 goal, but some cities also articulate other versions of their deep carbon reduction goals.

### “FOSSIL-FUEL FREE” AND “100 PERCENT RENEWABLE ENERGY”

This goal focuses on emissions due to combustion of fossil fuels—most, but not all, of greenhouse gases. Some cities use this goal because they believe it is easier to understand than a carbon emissions goal and is more inspirational than a carbon emissions goal. Some cities have adopted this goal as strictly an electricity target, while others intend it to be for all fuel sources. For other cities this may not be a feasible goal due to their energy-supply context.

- ▶ **STOCKHOLM'S** goal of being “fossil-fuel free by 2050” referred to “the energy used within the geographical boundary”. This involves meeting the energy needs for transport, heating, and electricity from renewable sources. It identifies seven fossil fuels in use: coal for production of district heating and electricity; oil for heating boilers in buildings, district heating, industry, and shipping; natural gas for heating boilers, cooking stoves, and vehicles; petroleum for road vehicles; diesel for road vehicles, construction machinery, and shipping; aviation fuel; and fossil-fuel based plastic in the waste supplied to heating plants.

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Carbon Neutral City =  
The *net* greenhouse gas  
emissions associated with  
a city is zero

## “CARBON NEUTRALITY” AND “ZERO NET EMISSIONS”

Being carbon neutral or achieving zero net emissions means that the *net* greenhouse gas emissions associated with a city (or organization or facility) is zero. It can be achieved in several ways or a combination of them.

- ▶ **Generating excess renewable energy and providing it to consumers outside of the city.** For instance, **COPENHAGEN** planned by 2025 to offset some of its carbon emissions by providing excess wind power to the electricity grid. This is also called “energy positive,” typically to describe a building that produces more energy than it consumes, sending excess into the electricity grid. “Energy neutral” refers to a building that produces as much energy as it consumes, calculated on a net basis for one year.
- ▶ **Purchasing carbon offsets, which are tradable units that represent abatement of greenhouse gas emissions.** An offset represents the rights to a greenhouse gas reduction, which a city (or organization / facility) purchases and then retires so that it cannot be used. For instance, **MELBOURNE’S** plan for 2020 included the purchase of carbon offsets.

## “Transformative Strategy”

A transformative strategy is a way to fundamentally redesign a large-scale carbon-emitting sector or system such as energy, transportation, buildings, and waste in an urban area, so that within two to three decades it operates with no or little carbon emissions.

- ▶ **Complex, Massive Systems.** These systems are extremely complex technically; contain enormous financial assets and revenue streams; serve millions of people; are shaped by a combination of market dynamics, government regulations, cultural norms, and professional practices; and span city, region, and national scales. Their business models are anchored in the economics of relatively cheap energy and ever increasing consumption. Many of their technologies are based on combustion of fossil fuels. They are deeply woven into the urban form.

- ▶ **Strategic Complexities.** System transformation requires multiple strategies, alignment of stakeholders around the carbon-emissions goal, a vision for what the redesigned system would look like, policy decisions at multiple levels of government, enormous capital investments by government and the private sector, and behavior changes by enterprises and consumers. This is achieved while meeting system performance requirements such as service availability, reliability, and affordability. These changes have to be sequenced and sustained for several decades, in the face of uncertainties brought on by election cycles, new technologies, and volatility in energy markets.

## Types of “Plans”

In practice, leading edge cities produce a suite of entwined plans for carbon reduction. There are different depths, scopes, and time frames, integrations with climate adaptation planning, and linkages to traditional city plans. The depth or “granularity” of plans ranges from the “Google Earth” level to the street level. Scopes range from a specific city government department/agency or a specific emissions system/sector to a citywide and all systems focus. Timelines range from 2050 scenarios to shorter term, interim (e.g., 2020, 2030) targets. The integration with adaptation plans ranges from the level of specific infrastructure projects to a broader framework for infrastructure investment in both carbon reduction and adaptation. (Not included in this suite of plans are the implementation and budget plans that are usually developed for each specific action, project, or initiative that a city may undertake.)

### OVERALL CITY SUSTAINABILITY PLAN

This is the plan with the greatest breadth; it includes much more than carbon emissions reduction. Typically, development of these plans involves substantial outreach/communication with the community and engagement of various stakeholder groups.

- ▶ “Sustainable **SYDNEY** 2030: The Vision” — 111 pages. Covers 10 targets or themes for the city, one of which is about reducing greenhouse gases. Others include affordable housing, access to green space, job growth,

and social capital (percentage of people who believe most people can be trusted). These 10 targets translate into 5 Big Moves and 10 Strategic Directions. The vision includes the city's goal of a 70 percent GHG reduction by 2030 based on the 1990 level.

- ▶ “Sustainability D.C.” (**WASHINGTON**)—129 pages. Washington’s plan lays out four priority challenges: Jobs and the Economy, Health and Wellness, Equity and Diversity, and Climate and the Environment. The bulk of the report focuses on proposed Solutions for seven thematic areas: Built Environment, Energy, Food, Nature, Transportation, Waste, and Water. It includes the goal of reducing GHG emissions by 50 percent by 2032.

### “GREEN CITY” PLAN

A green city plan includes the elements of making a green city, focusing mainly on environmental concerns such as air and water quality, green space, and climate change. These plans are less broad than a sustainability plan, as they don’t usually include housing, social or jobs elements other than the elements that directly overlap with green, such as green jobs, or greening affordable housing.

### CARBON-EMISSIONS REDUCTION ROADMAPS TO 2050

These plans present scenarios for achieving the long-term goal, based mainly on extensive technical analysis and assumptions about, for instance: national policies, energy markets, and other factors outside of the city’s direct control. They form the basis for a city’s decisions on what interim targets it will embrace, both for the city as a whole and for particular emitting sectors, and which strategies it may commit to and invest in to achieve the interim targets. As **Stockholm’s** energy system roadmap noted, “There may well be many different ways to achieve the goal of a fossil fuel-free Stockholm. None of them, however, is self-evident or simple to implement. It is also difficult to establish a clear picture of what the future may bring in the form of opportunities and obstacles. The roadmap is therefore to be regarded as a first step along the way, intended as a document for broad consultation and referral. In this way, more good ideas can be assimilated and more points of view can be shared about how we can meet one of this century’s most important and most challenging issues.”<sup>40</sup>

40 City of Stockholm, “Roadmap to a Fossil-Fuel Free Stockholm 2050,” March 2014, p. 2.

### ▶ Road Map for the City as Whole:

- “PlaNYC: **NEW YORK CITY’S** Pathways to Deep Carbon Reductions” (December 2013)—131 pages, includes city’s emissions profile; description of technical methodology; deep dives into each of four sectors (buildings, power, transportation, solid waste) that describe: each sector, its sources of emissions, the potential for emissions abatement, challenges, and strategies; economic analysis of costs and savings (abatement cost effectiveness) of various carbon reduction measures; and necessary capital and operational expenditures.
- Road Map for A Specific Emitting Sector:
- **COPENHAGEN’S** “Energy Vision 2050: A Sustainable Vision for Bringing a Capital to 100 Percent Renewable Energy” (March 2015) - 125 pages, including: the national context, a profile of the city’s energy system, the city’s overall climate action plan, key focus areas for achieving 100 percent renewable energy, the city’s role, multiple scenarios in different emissions sectors, and a set of appendices that describe various assumptions, definitions, calculations, and analytic methodologies.

### CLIMATE ACTION PLAN FOR INTERIM TARGETS

These plans focus entirely on carbon emissions reduction at the whole city level, and describe: the interplay of significant issues within the carbon reduction context; the rationale for climate action; the basic strategies that would be used in emissions sectors; how the community has been engaged in the plan development; and how implementation will be organized. Most of a climate action plan focuses on strategies and actions to achieve interim targets or goals, with a high level of detail about what will be done in the near-term of four or five years. As the **Seattle** 2013 Climate Action Plan explained: “The 2013 CAP provides a coordinated strategy for action that cuts across City functions, and focuses on City actions that reduce GHG emissions while also supporting other community goals, including building vibrant neighborhoods, fostering economic prosperity, and enhancing social equity.”

- ▶ City of **PORTLAND** and Multnomah County “Climate Action Plan 2015” —159 pages, includes: a vision, the long-term and interim carbon reduction goal and chal-

allenges; a section on what has already been accomplished in reduction; what the city does/doesn't control; the city's emissions profile; a specific concern with equity in carbon reduction; a description of a "more prosperous, healthy, and equitable Portland" in the future; for each of six emissions sectors (buildings and energy, urban form and transportation, consumption and solid waste, food and agriculture, urban forest, natural systems and carbon sequestration); the goals, objectives, and actions that will be taken; and sections on climate change preparation/adaptation and local government's operations.

- ▶ **COPENHAGEN** "2025 Climate Plan: A Green, Smart and Carbon Neutral City" —34 pages, focuses on interim target of being carbon neutral by 2025, specific goals and main initiatives in four areas (energy consumption, energy production, green mobility, and the city administration) and discusses how carbon reduction efforts will be used as "leverage for a better quality of life, innovation, job creation and investment in green technologies."
- ▶ The 2014 "**YOKOHAMA** City Action Plan for Global Warming Countermeasures": Sets goals of 16% reduction by 2020, 24% reduction by 2030 and 80% reduction by 2050 using a 2005 baseline year.

## SYSTEM/SECTOR EMISSIONS PLAN

- ▶ **NEW YORK CITY'S** "One City: Built to Last: Transforming New York City's Buildings for a Low-Carbon Future" (March 2015), 112 pages, identifies four strategic objectives for the city's built environment (each with at least a handful of initiatives), which are estimated to reduce GHG emissions produced in heating, cooling, and powering buildings by 30 percent by 2025 - while creating 3,500 construction-related jobs, providing training for more than 7,000 building operators and staff, and generating \$1.4 billion in cost savings for New Yorkers.
- ▶ **SYDNEY:** "Decentralised Energy Master Plan: Renewable Energy, 2012-2030" (December 2013), 142 pages depicting ways in which the city will increase the renewable energy portion of locally generated electricity to 30 percent of the total by 2030 - based on technologies currently available and commercially viable or that could become viable by 2030.

## TECHNICAL APPENDICES

It is not unusual for cities to publish technical documents about a specific sector—detailing the analytic methods and findings that support a roadmap or action plan for the sector.

## INTEGRATION WITH CLIMATE ADAPTATION PLANS

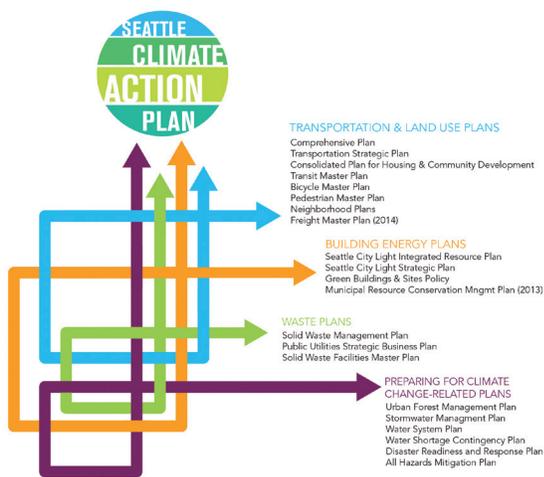
Although typically cities have separated carbon reduction and climate adaptation planning processes, they are increasingly identifying synergies in their strategies and actions for these different goals. As a result, some cities' climate action plans address aspects of adaptation.

- ▶ **PORTLAND'S** 2015 Climate Action plan links adaptation and carbon mitigation: "While addressing the primary cause of climate change—carbon emissions—remains a crucial component of the City and County's climate work, preparing for the impacts of a changing climate, especially for those most vulnerable is also required. The Climate Action Plan integrates both the work to slow the effects of climate change by reducing carbon emissions . . . while also preparing for the impacts we will likely experience." The plan dedicates a section to "Climate Change Preparation," describing local impacts on human and natural systems and the built environment from climate change due to "hotter, drier summers with more high-heat days" and "warmer winters with the potential for more intense rain events." The plan then describes three Objectives and nearly 30 actions to achieve them: Reducing risks and impacts from (1) heat, drought, and wildfire; (2) flooding and landslides; and (3) building city/county staff and community capacity to prepare for and respond to climate impacts.

## LINKS TO/EMBEDDING IN OTHER CITY PLANS

- ▶ **SEATTLE'S** 2013 Climate Action Plan identifies more than 20 other city plans with which it is coordinated:
  - Transportation & Land Use Plans: Comprehensive Plan, Transportation Strategic Plan, Consolidated Plan for Housing & Community Development, Transit Master Plan, Bicycle Master Plan, Pedestrian Master Plan, Neighborhood Plans, Freight Master Plan (2014)

- Building Energy Plans: Seattle City Light Integrated Resource Plan, Seattle City Light Strategic Plan, Green Buildings & Sites Policy, Municipal Resource Conservation Management Plan (2013)
- Waste Plans: Solid Waste Management Plan, Public Utilities Strategic Business Plan, Solid Waste Facilities Master Plan
- Preparing For Climate Change-Related Plans: Urban Forest Management Plan, Stormwater Management Plan, Water System Plan, Water Shortage Contingency Plan, Disaster Readiness and Response Plan, All Hazards Mitigation Plan



Source: City of Seattle, "Seattle Climate Action Plan," June 2013, p. 5.

- ▶ **OSLO'S** "Green Energy From Waste," a 24-page plan for the city's Waste-to-Energy Agency, identifies four ways that the agency will contribute to achieving the city's goal of a 50 percent emissions reduction by 2030.
- ▶ **SAN FRANCISCO:** "Municipal Transportation Agency: Strategic Plan, Fiscal Year 2013-2018," 14-page six-year plan outlines four goals and 16 performance objectives, one of which is to reduce carbon emissions for the public transportation system 25 percent by 2017 below 1990 levels "through the expansion of the bio-fuels program, reducing the emissions of non-revenue vehicle fleets, and identifying greener choices for private vehicles."

## Other Key Terms Used in Long-Term Climate Action Planning.

### "ADAPTIVE MANAGEMENT"

A dynamic planning and implementation process that applies scientific principles, methods, and tools to improve management activities incrementally. Management strategies change as decision-makers learn from experience and better information and as new analytic tools become available. Adaptive Management can involve frequent modification of planning and management strategies, goals, objectives, and benchmarks.

### "EQUITY"

When all individuals have access to the opportunities to satisfy their essential needs, advance their well-being, and achieve their full potential. A 2014 report by the Urban Sustainability Directors Network defined equity in the following way: "Equity in sustainability incorporates procedures, the distribution of benefits and burdens, structural accountability, and generational impact. This includes:

- ▶ *Procedural Equity*— inclusive, accessible, authentic engagement and representation in processes to develop or implement sustainability programs and policies
- ▶ *Distributional Equity*— sustainability programs and policies result in fair distributions of benefits and burdens across all segments of a community, prioritizing those with highest need
- ▶ *Structural Equity*— sustainability decision-makers institutionalize accountability; decisions are made with a recognition of the historical, cultural, and institutional dynamics and structures that have routinely advantaged privileged groups in society and resulted in chronic, cumulative disadvantage for subordinated groups
- ▶ *Transgenerational Equity*— sustainability decisions consider generational impacts and don't result in unfair burdens on future generations."<sup>41</sup>

41 Angela Parks, "An Equity Scan of Local Government Sustainability Programs," 2014, p. i:1.

## Resources

<p><b>City Climate Hazard Taxonomy</b></p>	<p>C40's classification of city-specific climate hazards</p>	<p>The Taxonomy creates a shared terminology of city climate hazards, which serves four primary functions: Driving best practice city adaptation planning and action; Enhancing capacity for city-to-city exchange of effective adaptation approaches, tools and actions; Facilitating collection of robust, applicable city adaptation data; Streamlining city experience of accessing technical and financial assistance.</p>
<p><b>An Equity Scan of Local Government Sustainability Programs</b></p>	<p>Angela Parks/USDN</p>	<p>This report aims to shed light and provide guidance by sharing good practices that local governments can emulate to ingrain equity more fully in their sustainability efforts.</p>

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**MEASURING  
CARBON EMISSIONS**

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# Designing a Local Carbon Emissions Measurement System

Cities face a number of choices when it comes to measuring their carbon, and the choices made by leading edge cities have only just recently begun to converge. The major design elements are:

## BASELINE YEAR

What baseline year to measure goals against? 1990 was the original baseline year used by many cities because of the Kyoto Protocol, but a number of cities have used more recent baseline years (e.g., 2005, 2006, 2007, 2010). About 40 percent of Alliance cities use 1990, with the remainder using 2005-2010 as a baseline. Generally speaking 1990 numbers are not as accurate as newer emission inventories, so some cities refer to 1990, but use a more recent year as the baseline year because the available data from 1990 is limited.

## GEOGRAPHIC BOUNDARY

What geographic boundary to use for the carbon inventory? Cities typically use the boundary of their political jurisdiction. However, some cities are integrated politically with a municipal/regional government or other metropolitan jurisdiction, and they may use a broader geographic boundary. Cities have struggled to deal with emissions generated from port and airport activities that fall within their jurisdiction, but aren't generated as a result of their residents or businesses activities. There hasn't been consistency in how cities deal with this, but this is starting to change. (This is discussed in greater detail below.)

## SCOPE OF EMISSIONS

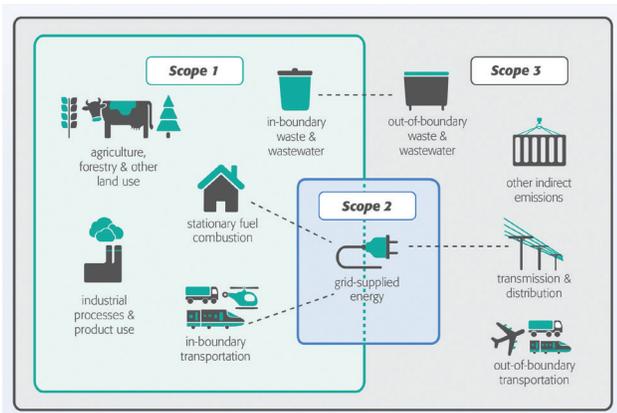
What emissions scope to use (what is in and what is out):

- ▶ **Scope 1:** Direct emissions from sources located within the city boundary.
- ▶ **Scope 2:** Indirect emissions that occur as a result of the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary.
- ▶ **Scope 3:** All other indirect emissions that occur *outside* of the city boundary due to activities taking place within the city boundary.

Cities typically measure Scope 1 and Scope 2 emissions. However, some cities have begun to conduct consumption-based inventories that extend into Scope 3. Measuring Scope 3 emissions is discussed in greater detail below.

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Cities face a number of choices when it comes to measuring their carbon, and the choices made by leading edge cities have only just recently begun to converge.



Source: ICLEI, WRI and C40, “Global Protocol for Community Scale Greenhouse Gas Inventories”, p. 11.

## EMISSIONS SECTORS/SOURCES

What emissions sources/sectors to use? The most widely used inventory model by cities, the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), divides emissions into six main sectors with multiple sub-sectors: Stationary Energy (including residential and commercial buildings); Transportation; Waste; Industrial Processes and Product Use; Agriculture, Forestry, and Land Use; and Other Scopes. The GPC is discussed in greater detail below.

## DATA GATHERING TO CALCULATE EMISSIONS

Cities have options when it comes to the methods they use to gather the activity data that will be multiplied by a standard emissions factor for each type of activity. Activity data is a quantitative measure of a level of activity that results in emissions during a given period of time (e.g., volume of gas used, miles/kilometers driven, tons of waste sent to landfill). An emissions factor is a measure of the mass of GHG emissions produced by a unit of activity. Data can be gathered from many different sources: government departments, statistics agencies, a national GHG inventory report, universities and research institutes, scientific and technical articles, books, journals, and reports, and expert organizations.

- ▶ **Frequency.** How often to update the inventory? Annual reporting is becoming a standard and is required by C40 for membership.
- ▶ **Reporting Model.** What kind of scoreboard to use in reporting progress?

▶ **Third-Party Protocol.** Whether or not to use a third party protocol (e.g. GPC, ICLEI USCP), or to do a customized local version.

- A 2013 study by the Innovation Network for Communities identified 15 different systems for monitoring, reporting, and verifying GHG emissions by various entities including communities, some of them used internationally, some in just the United States or Europe. Few of these protocols include verification by a third party, which assesses the completeness and accuracy of the reported data. Methods for inventorying GHG emissions vary significantly, as may the quality of data.

## Toward Standardization of Measurement: Adopting the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC)

### USE OF GPC IS GROWING

More than 100 cities worldwide have used GPC, which was created by World Resources Institute, C40 Cities Climate Leadership Group, and ICLEI. The GPC was developed to reduce inconsistency between cities’ inventories and allow city-to-city comparisons, and to produce more credible and meaningful information. GPC does not require that cities use a third party to verify their inventory results.

Some leading edge cities have switched their measurement system to the GPC model. **MELBOURNE** is piloting its use with municipal operations only. Meanwhile, some cities use multiple systems for measuring emissions. For instance, **VANCOUVER**, which falls under the jurisdiction of the British Columbia Province’s mandatory carbon reporting, must use the provinces system for measurement and reporting. The city also uses GPC and CDP for inventory and reporting purposes so as to compare to international cities.

A few leading-edge cities have chosen not to switch. Those not using the GPC report they are not doing so for one or more of the following reasons:

- ▶ The city is required by their national government or another higher level of government to report in a certain format, and does not have the time/resources to do two separate reports.
- ▶ The city is using a different reporting format that is more relevant to their local needs.
- ▶ Switching reporting formats would confuse previously reported GHG emissions and reduction targets. The GPC may change the baseline year, add some emissions sources not previously inventoried, and include some sources over which the city has little control. For cities whose GHGs would change in a GPC reporting environment, it's necessary to figure out how to explain this to elected officials, the public and other stakeholders. Some cities, like **PORTLAND**, produce side-by-side reports using the “old” and “new” reporting structures, but this is complicated and time- and resource-intensive.
- ▶ The city is not interested in being able to compare their emissions reduction performance with that of other cities.

### COMPACT OF MAYORS

The Compact of Mayors is a global coalition of mayors and city officials committing to reduce local greenhouse gas emissions, enhance resilience to climate change and track their progress publicly. It is an agreement by city networks—and then by their members—to fight climate change in a consistent and complimentary manner to national efforts. The Compact collects the significant climate action data that cities are already reporting in a consistent, transparent manner and makes that data available in a single place. The Compact builds on existing cooperative efforts, partnering with other initiatives to better measure and communicate the impact of city action.



Particularly important are the Compact's efforts to standardize measurement and reporting. For the first time, the Compact will standardize the way city climate data is reported, establishing a universal approach to data collection. The data can be aggregated to highlight the collective

impact of city actions, which will increase global and investor confidence. And the Compact makes data available to the public. Cities primarily report their climate data/actions through two major platforms—CDP (<http://www.cdp.net>) and Carbons Climate Registry ([carbons.org](http://carbons.org))—both of which are partners to the Compact. The Compact will make this data centrally and publicly available through the Carbons Climate Registry to highlight commitments and allow for easy searchability.

## Emergence of Consumption-Based Measurement

More leading edge cities—**LONDON, PORTLAND, SAN FRANCISCO, SEATTLE AND VANCOUVER**, for example—have experimented with a consumption-based emissions (“Scope 3”) measurement system, which produces a somewhat different picture of a city's emissions and has potential implications for reduction targets and strategies. Proponents of consumption-based emissions inventorying argue that it provides a more accurate accounting of GHGs produced by the people and businesses that live, work, study, operate in the city, accounting for emissions that result from local consumption of goods that were produced elsewhere (e.g., clothes, furniture, food) and services (e.g., health care, banking). It models emissions from the full “life cycle” of goods and services, including their production, pre-purchase transportation, wholesale and retail, use, and post-consumer disposal. It is based on spending by households and government entities, and certain types of purchases made by businesses (e.g., capital and inventory formation), regardless of where in the world the emissions were produced.

**PORTLAND** incorporated data from a consumption-based inventory into its 2015 Climate Action Plan, along with data from the more typical sector-based inventory. “The use of both methods gives a more complete picture of the global carbon emissions for which Portland and Multnomah County bear some responsibility.” The city reported that:

- ▶ The consumption-based emissions total was more than twice the amount of sector-based emissions.
- ▶ More than half of consumption-based emissions came from food, goods, and services, with the remainder

from home energy use and fuels for transportation. For most goods, the majority of emissions occurred during the production stage.

- ▶ Measurement of consumption-based emissions suggests the importance of consumer decisions, according to the 2015 plan: “Individuals, businesses, governments and other organizations will need to meet their needs by choosing products and services with lower emissions across the entire lifecycle. This includes both making informed choices about which products and services to buy as well as utilizing opportunities to rent, share, fix and reuse goods.”
- ▶ **VANCOUVER’S** “Greenest City Action Plan” includes an ecological footprint measurement, which is most significantly influenced by food consumed by residents.

- ▶ **SEATTLE** incorporated a suite of actions residents can take to reduce their own carbon footprint. The “What You Can Do” chapter of its climate action plan focuses on those actions identified by the city’s consumption-based inventory as having the greatest opportunity for reduction potential and over which individuals have more direct control. Actions focused on emissions created in our home, by getting around, eating, and “buying stuff.”<sup>42</sup>

### BARRIERS TO ADOPTION

For the time being, cities that have experimented with consumption-based analysis say that it is difficult to obtain useful data, although it’s getting better, and it takes substantial effort and expense to gather and work with the data.

42 Seattle CAP p. 66-72.

## Resources

<p><b>Measuring Emissions and Creating a Greenhouse Gas Inventory</b></p>	<p>National League of Cities Sustainable Communities Institute</p>	<p>Many cities are conducting inventories of carbon dioxide, methane, and other GHG emissions to serve as the foundation for informed and effective climate action plans. Cities are finding that these projects also save money, reduce air pollution, improve public health and boost a city’s reputation for livability. This guide provides guidance for municipal leaders seeking to take this first step toward mitigating climate change.</p>
<p><b>Open Data Portal</b></p>	<p>C40</p>	<p>The Open Data Portal provides direct, interactive access to the wealth of statistical information provided annually by C40 cities. Through the Open Data Portal, it is possible to access and investigate a number of data sets on C40 cities, including GHG Emissions Inventories, Reduction Targets, and Citywide Risks.</p>
<p><b>Tracking Carbon with Transparency</b></p>	<p>Natural Resource Defense Council</p>	<p>Having a strong, credible, and transparent system for tracking greenhouse gas emissions and the actions of a country is an essential building block of an effective international system to address global warming.</p>

<p><b>Greenhouse gas emissions inventory: First experiences</b></p>	<p>ICLEI, Local Governments for Sustainability</p>	<p>A greenhouse gas inventory serves as a tool to quantify and weigh greenhouse gas emissions (GHG). The Municipality of Montevideo (Intendencia de Montevideo, IM) prepared and presented the results of their first greenhouse gas emissions inventory in June 2010. The inventory, for example, revealed that two-thirds of the city's emissions stem from the burning of fossil fuels. The inventory enables the city's Climate Change Work group to propose policies that promote a low-carbon economy and more efficient use of energy.</p>
<p><b>Global Aggregation of City Climate Commitments</b></p>	<p>C40</p>	<p>Arup and the C40 Cities Climate Leadership Group (C40), in partnership with ICLEI-Local Governments for Sustainability, United Cities and Local Governments (UCLG), UN-Habitat, the UN Secretary-General's Special Envoy for Cities and Climate Change and the World Resources Institute, have assessed existing voluntary carbon commitments of cities around the world. The work aims to demonstrate the robust actions cities are already taking to mitigate greenhouse gas (GHG) emissions.</p>
<p><b>Global Protocol for Community-Scale Greenhouse Gas Emission Inventories</b></p>	<p>C40</p>	<p>To allow for more credible and meaningful reporting, greater consistency in GHG accounting is required. The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) responds to this challenge and offers a robust and clear framework that builds on existing methodologies for calculating and reporting city-wide GHG emissions</p>
<p><b>Sustainable Consumption Institute Flagship Project</b></p>	<p>Stockholm Environmental Institute (SEI)</p>	<p>This project is novel in a number of respects. Firstly, the project will account for emissions not only generated in the nation of consumption, but across the full supply chain. Secondly, it will look at the potential for climate change to disrupt supply chains. Thirdly, it will develop scenarios that couple both mitigation (emission reduction efforts) and climate change adaptation efforts across supply chains.</p>
<p><b>SEI Initiative on Producer to Consumer Sustainability (P2CS)</b></p>	<p>Stockholm Environmental Institute (SEI)</p>	<p>The SEI Initiative on Producer to Consumer Sustainability aims to bring about a step change in the study of contemporary global trade and production to consumption systems, and to help identify new opportunities to promote sustainability.</p>
<p><b>Sustainable Consumption Breakthrough Convening</b></p>	<p>USDN</p>	<p>A convening of municipal sustainability staff, international researchers, policy experts, and NGO representatives to advance the topic of sustainable consumption from the conceptual phase toward actionable programs and policies within a municipal government context. The outcomes of this convening are heavily informing the ongoing work with Sustainable Consumption, which will wrap in 2016. (Innovation Fund, 2015).</p>
<p><b>Understanding Sustainable Consumption</b></p>	<p>USDN</p>	<p>A project to define sustainable consumption, develop metrics, and assess the degree to which sustainable consumption activities contribute to goals of economic prosperity, social equity and environmental health. (Innovation Fund, 2015).</p>

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**SETTING GOALS  
AND TARGETS**

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## Starting Points

A key element of long-term carbon-emissions reduction planning is that the goal and milestones along the way are focused on a measurable outcome, rather than a vague aspirational outcome, like “be sustainable,” which is open to interpretation and, because it may contain numerous indicators, is difficult to measure precisely. The goal—an 80 percent reduction in emissions by 2050—is decades down the road, but a city’s progress toward the goal can be measured and it’s possible to estimate how far the various steps a city might take will move it toward the goal. This underscores the importance of collecting data on emissions and of conducting analysis about the sources of emissions and methods of preventing emissions. It also sets up the model of setting performance targets, both for points in time along the way to 2050 and for a city’s specific emissions systems. Target setting is part of a performance-management approach that leading-edge cities use as the basis for their long-term carbon reduction planning.

### EMBRACING THE 80X50 GOAL

Leading-edge cities have taken the step of committing to an 80x50 or similar goal without being sure how they will achieve it. They’ve made such commitments on the basis that achieving the goal is imperative; however, many other cities require evidence the goal is feasible before it is set. The difficulty, of course, is that there remain a great many uncertainties about what a successful path to 80x50 looks like, and many of the factors that have to be managed are not in most cities’ direct control. Committing to 80x50 is an act of leadership and a commitment to manage toward a goal that probably may not be achieved with a fixed plan, but instead will require iterative experimentation, measurement, and course correction.

A recent report on the use of carbon-emissions pricing mechanisms by cities worldwide found that among U.S. cities, adoption of an 80x50 goal was associated with the city also exploring ambitious approaches to achieving the goal, particularly the adoption of a local carbon tax or emissions trading scheme. “Only a few U.S. cities have actively explored or are exploring the potential of enacting carbon-pricing mechanisms, but there is a strong correlation between a city having already adopted a long-term goal for deep carbon-emissions reduction (e.g., 80 percent reduction by 2050) and having an interest in local pricing mechanisms.”<sup>43</sup>

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For most cities, achieving the goal of reducing GHGs by 80% or more is decades down the road, but the city must start now, and must regularly measure progress toward meeting the goal.

43 INC, “Cities and Carbon-Emissions Pricing,” July 2015, <http://www.in4c.net/files/Cities-and-Carbon-Emissions-Pricing-Final-Report-7.2.15.pdf>

## UNDERSTANDING THE “BUSINESS AS USUAL” EMISSIONS SCENARIO

Cities typically ask, what if we do nothing—how will the city’s level of carbon emissions change? These “business as usual” scenarios invariably show an increase in overall emissions, because the city’s population and economic activity are expected to increase, and this drives up energy consumption. The current pace of decarbonizing energy supply is typically fairly slow, with notable city-led exceptions such as **NEW YORK CITY’S** phase out of fuel oil No. 6 and No. 4, or **VANCOUVER’S** development of district heating and cooling infrastructure fueled primarily by renewable local biomass. They also reveal that, if the growth assumptions turn out to be correct: for the city to achieve an 80 percent reduction by 2050, it will have to reduce emissions per capita and per unit of economic output by more than 80 percent to account for the increased emissions from expanding population and activity.

- ▶ **BERLIN** noted that the “BAU” or “reference scenario usually serves the purpose of providing a contrast to the target scenarios; this helps to estimate the effects of additional climate protection measures.”<sup>44</sup>
- ▶ **STOCKHOLM**, for instance, anticipated a 40 percent increase in population from 2012 to 2050, generating a need for 5,000 new homes a year, 190,000 new homes by 2050, as well as shops, office, schools, hospitals, and demand for travel and goods transportation. As a result, the city expects its total energy needs to increase by 40 percent in that timeframe.
- ▶ **SEATTLE** is expected to receive more than 100,000 new residents and 100,000 new jobs over the next 20 years. If Seattle met this new growth with car-dominated land use and transportation strategies, not only would GHG emissions increase the city wouldn’t have enough space for housing and jobs. New growth, if managed well, can support Seattle’s efforts to create pedestrian-friendly urban centers and neighborhoods, places with a diversity of housing, employment opportunities,

services, recreational opportunities, and convenient transit. Seattle has already seen the climate benefits of transportation and land use strategies that concentrate jobs and housing in complete communities.<sup>45</sup>

## PER-PERSON EMISSIONS

In addition to measuring overall carbon emissions, many cities set goals for their per-capita emissions, as a way of making sure that population growth (and economic activity) are being accounted for in emissions targets.

- ▶ **OSLO** has one of the lowest per-person emissions of any leading-edge city, at 2.2 tonnes of CO<sub>2</sub> per year. By 2030 Oslo is expected to increase to 780,000 inhabitants, which will increase the total real estate floor by 30 percent. However, the increases will only generate a 6 percent increase in energy use, mainly due to more stringent requirements in new and renovated buildings.
- ▶ **STOCKHOLM**, with per-capita emissions of 3.8 tonnes of carbon dioxide annually, calculated that the worldwide per capita emissions should be no more than 1.5 tonnes in order to achieve 80x50 globally. The city’s roadmap for 2050 shows how its per-person emissions can be reduced to 0.4 tonnes.

## Targeting Four Key Systems

Many cities’ climate action plans focus on four large-scale systems that are the main sources of urban carbon emissions: Energy Supply, Building Energy Efficiency and On-site Renewable Energy, Transportation, and Solid Waste. Each of these systems has sub-systems, or niches with some distinct characteristics.

44 City of Berlin, “Climate-Neutrality Berlin 2050: Results of a Feasibility Study,” March 2014, p. 14.

45 City of Seattle, “Seattle Climate Action Plan,” June 2013, p. 16.

## Major Urban Carbon-Emissions Systems & Sub-Systems

<b>Energy Supply</b>	<ul style="list-style-type: none"> <li>• Electricity</li> <li>• Thermal Combustion (Natural Gas, Fuel Oil, etc)</li> </ul>
<b>Building Energy Efficiency and On-site Renewable Energy</b>	<ul style="list-style-type: none"> <li>• Single Family Residential</li> <li>• Multi-Family</li> <li>• Small Commercial</li> <li>• Large Commercial</li> <li>• Industrial</li> <li>• Institutional (Education, Medical/Laboratory, etc.)</li> </ul>
<b>Transportation</b>	<ul style="list-style-type: none"> <li>• Private Vehicles</li> <li>• Commercial Freight</li> <li>• Air</li> <li>• Public Transit</li> <li>• Bicycling</li> <li>• Walking</li> </ul>
<b>Solid Waste</b>	<ul style="list-style-type: none"> <li>• Commodities (Paper, Textiles, Plastics, Metals, etc.)</li> <li>• Organics/Biological Materials</li> <li>• Industrial Waste (Chemicals, etc.)</li> <li>• Construction &amp; Demolition</li> </ul>

### WATER-ENERGY NEXUS

A few other systems, such as water/wastewater, also may be targeted. The amount of energy expended in urban water cities, and the resulting carbon emissions, is only recently coming under closer scrutiny. A large amount of energy is used to pump, convey, treat, and deliver water, in addition to energy consumed to heat water. Water systems also use energy to collect, treat, and discharge wastewater. Studies in the U.S. estimated that 19 percent of California’s energy consumption was water related and that 13 percent of the nation’s electricity consumption was water related.<sup>46</sup>

<sup>46</sup> California Energy Commission, “California’s Energy-Water Relationship,” November 2005, p. 1. River Network, “The Carbon Footprint of Water,” May 2009, p. 1.

### MUNICIPAL OPERATIONS

Some cities separate out their “municipal operations” that involve portions of the four systems, but these typically are small contributors to a city’s carbon-emissions profile. Sectioning off municipal operations allows a city to (a) deeply analyze and strategize about its own role in emissions and (b) to develop strategies and actions that “model the behavior” of aggressively reducing carbon emissions.

### VARIATIONS

Within a city, the systems are quite different from each other. For instance: in the degree to which they employ a mix of market dynamics and government regulation; in who owns/controls their financial and physical assets; in their business models, physical infrastructure and technologies; and in their consumers’ behaviors and habits.

### DIFFERENCES

The same system may have quite different characteristics in different cities, and the degree of control or influence that a city has over a system may also vary substantially from city to city. For example, some cities own their electricity supplier, but most do not. Some cities control building codes, while other cities are subject to state/province or national building codes. Most cities’ control a part of their transportation and waste systems, but also share control with regional and national governance levels.

### OTHER GOALS

Each of the systems has performance goals other than carbon reduction. For example, an energy provider prioritizes reliability and revenue generation. These goals have to be taken into account on the front end, because failure to understand the drivers in a system can reduce the impact carbon reduction efforts.

## Setting a Path and Pace — Interim Targets

Setting carbon reduction targets for systems is an analytic process and a political process. It does not just mean applying the 80x50 goal to each emissions sector, in top-down manner. In examining changing infrastructure, technology, and behaviors, the analytic calculation that is made an-

swers a series of questions: How much reduction might it be possible to achieve? At what cost? In what time frame?

The political calculation that is made is two-fold:

- ▶ What is the likelihood that sufficient local “political will” can be assembled to support, push through, maintain, and sustain the potential changes?
- ▶ Since the city does not have direct control over everything that needs to change, what will motivate other levels of government, sectors, and the community to do their part?

In answering these questions, cities make decisions about which mix of transformative strategies to pursue, how aggressively to pursue them, and what their interim targets for reduction will be.

### VARIATION IN TARGETS

Given the complexities of the systems and the interplay of the many technical and political factors, it’s no surprise that interim targets of leading-edge cities vary quite a bit.

Berlin	40 percent by 2020
Boston	25 percent by 2020
Vancouver	33 percent by 2020
Portland	40 percent by 2030
San Francisco	40 percent by 2025
Sydney	70 percent by 2030
Washington, D.C.	50 percent by 2032
Yokohama	24 percent by 2030

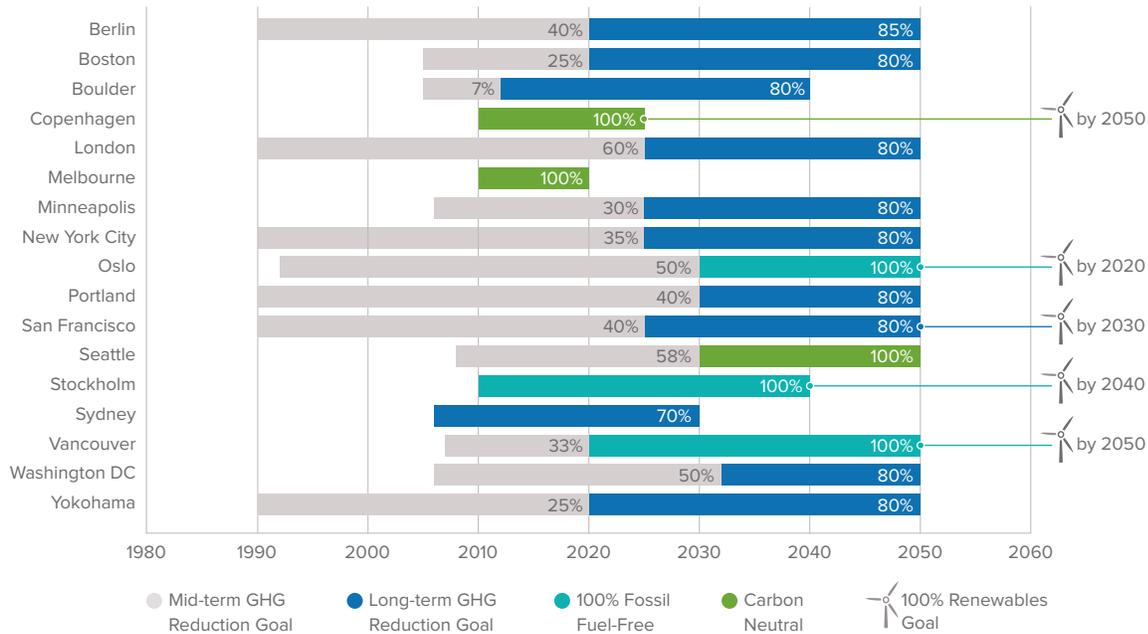
Within **VANCOUVER’S** interim target of a 33 percent reduction for 2020 are these system-by-system targets:

- ▶ **Building Energy Efficiency:** 20 percent reduction in emissions in existing buildings
- ▶ **Transportation:** More than 50 percent of trips will be by public transit, foot, or bicycle
- ▶ **Transportation:** 20 percent reduction in average distance driven per resident
- ▶ **Solid Waste:** 50 percent reduction in solid waste going to landfill or incinerator

It’s also not unusual for cities to adjust their interim targets along the way, typically because they decide to accelerate their carbon reduction efforts. This may be due to an increase in local political will to address climate change or because local leaders recognize that their interim targets, even if achieved, are not ambitious enough to put the city on a path to achieve its 80x50 goal.

- ▶ **STOCKHOLM** in 2015 changed its per-person emissions target for 2020 from 3.0 tonnes to 2.3 tonnes, a nearly 25 percent increase in ambition.
- ▶ **NEW YORK CITY** in 2015 changed its emissions reduction target for Buildings from 30 percent by 2030 to 30 percent by 2025, a 33 percent acceleration of the city’s timetable for achieving the goal.

## CNCA Cities' Long-Term and Interim GHG Reduction Targets



### TECHNICAL FACTORS IN SETTING TARGETS

A number of technical factors come into play when setting emissions-reduction targets:

- **Analysis and Detailed Mapping of the Systems.** Often a city does not have sufficient technical understanding of what the emissions system is and how it works, and must build this capacity and knowledge. This includes the physical infrastructure of the system, the technologies that are employed and the new technologies in the wings, the professional skills and expertise needed to operate the system, the life expectancy (and therefore decision timelines) for various types of equipment and facilities, and drivers of end-user demand, and more. As part of the response to this need, leading-edge cities have embarked on extensive spatial mapping projects to identify specific system assets and dynamics such as every physical aspects of the electricity grid, the energy intensity of every building (categorized into major types representative of the local range of use, scale, and vintage), traffic flows within and into/out of the city, and more.

- **Comparative Analysis of Carbon Reduction Technologies and Methods.** There is a growth industry in analytic tools/methods for comparing the costs and benefits of various emissions-reduction approaches, especially the use of technologies, including “smart” information technology used to manage systems. Cities want analysis of potential approaches at a general level; for example, how much rooftop solar energy could be produced in the city? They want to understand the availability and effectiveness of different versions of a solution, such as the multiple alternatives for street lighting. They want to know about new technologies that are emerging and might provide more cost-effective solutions. They use various tools, some of them proprietary, to assess the comparative potential for and cost of emissions reduction among scores of existing technologies. They want to know the “life cycle costs and benefits” of power plants, roads, waste treatment plants, dams, trains, buses, parking meters and more. They seek analysis of the drivers of markets for vehicles and housing, for instance, and how different strategies might affect market dynamics. The range of desired information and analysis is quite extraordinary and in most cases cities have neither the information nor the analytic tools on hand.

- ▶ **Economic Effects of Solutions.** Some emissions-reduction solutions, such as the conversion to LED lighting in buildings and streets, can result in substantial cost savings for cities and consumers after an initial investment in the solution. Over time the savings cover the cost of the investment, and the savings often continue to accrue long after. Other solutions generate business activity and job creation, such as the way increased design of net-zero new buildings and the retrofitting of buildings' energy systems expand a city's architecture, engineering, and construction sectors. Some solutions have impacts on city revenues, depending on local taxation and fee structures; for example, increases in public transit ridership or increased sales prices of green commercial buildings and homes can each drive revenue growth. And some have impacts on purchasing decisions by consumers; for instance, energy conservation can reduce an electricity utility's revenues and force consideration of ways to redesign the utility's business model.

Many of these potential impacts may affect a city's financial condition—its debt load and bond rating, for instance—and all are potential impacts that decision-makers will want to understand as they make decisions. City staff and, usually, consultants they hire apply analytic models to project these impacts.

### POLITICAL FACTORS IN SETTING TARGETS

Decision-makers in cities weigh many political factors in setting targets for emissions reduction, beyond the technical factors. They consider the policy context set at national, international, regional, and state/province levels, particularly which policies enable or impede city strategies and actions. **COPENHAGEN**, for instance, developed its goal of being carbon neutral by 2025 as a way of doing its share of achieving Denmark's national goal of 100 percent renewable energy by 2050. City leaders also must assess the potential emergence and staying power of certain policies, such as a national tax on carbon emissions, which are controversial and may be subject to change. Some cities in their planning assumptions have overestimated the national political will to establish ambitious carbon reduction policies.

Other political factors include:

- ▶ **City Control**—This involves the degree to which the city controls key decisions by each of the four main carbon-emissions systems, and its ability to influence the policies of other levels of government.
- ▶ **The Buy-in of System Leaders/Owners/and Other Stakeholders**—Each of the four systems has its own structure of authority over decisions that typically involves much more than a mayor or city council setting policy. They may have appointed or elected commissions with responsibility for the system, or may have much authority in the hands of private entities such as some utility companies. So the process of embedding carbon reduction targets into a system's goals involves getting the various "system owners" to embrace this new direction.
- ▶ **Community Understanding and Buy-In**—Engaging city residents in the planning process and gaining sufficient public support for carbon-emissions reduction efforts is a key concern and activity of city decision-makers. This includes, but goes beyond, engaging various stakeholder groups such as the business community or environmental advocates. Most residents do not belong to these organized groups, although their opinions may be influenced by what stakeholders say. In many cities, elected officials involve community members in climate action planning, communicate regularly with the public (directly and through the media) about plans, activities, and performance, and support educational efforts to help residents understand why the city is taking action and what the consequences of action will be. An important element of engaging and communicating with the public and stakeholders is being able to describe the potential of climate action plans to generate co-benefits for other city goals such as economic activity and public health. Not surprisingly, polling and focus groups are an important tool for ascertaining public opinion and readiness for policy change.
- ▶ **Policy Decision Horizons**—Local election cycles affect the judgments that city decision makers make about the content and timing of planning processes and implementation. At the same time, long-standing city planning and budget cycles, which run on annual or multi-year sequences, may also affect the timing of when climate action planning starts, how long it takes, and when carbon reduction plans can be embedded into other city plans.

# Resources

<p><b>Advancing Climate Ambition: Cities as partners in Global Climate Action</b></p>	<p>C40</p>	<p>Through these actions, cities’ GHG reductions in the year 2050 alone could equal more than half of the world’s annual use of coal today.</p>
<p><b>Climate Policy Implementation Tracking Framework</b></p>	<p>World Resource Institute</p>	<p>The Climate Policy Implementation Tracking Framework is a policy tool that allows users to track the adoption and implementation of climate mitigation policies across sectors.</p>
<p><b>Moving From Assessment to Action on Climate Change</b></p>	<p>ICLEI, Local Governments for Sustainability</p>	<p>The City of Toronto’s climate change adaptation strategy ‘Ahead of the Storm’ is a comprehensive plan to prepare the city for the adverse effects of climate change. As part of the plan, the city developed a new tool for assessing potential risks to its services and infrastructure. The Climate Change Risk Assessment Tool is an essential part of Toronto’s overall climate change adaptation strategy.</p>



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# **CITY TRANSFORMATIVE STRATEGY FRAMEWORK**

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The heart of any city's climate action plan is the explanation of how the city will achieve its carbon-emissions reduction goals. This spells out what city officials are committed to doing and why they think it will work. It also provides the information that stakeholders and city residents use to understand what the plan's potential impacts on them may be. Finally, it signals to city departments and agencies what they are expected to do as part of the plan. Although climate action plans are filled with numerous actions that cities intend to take—projects, programs, and other on-the-ground implementation mechanisms—the leading-edge cities tend to frame these actions within a set of broad strategies and assumptions about what it takes to make large-scale systemic change happen. The section that follows synthesizes these cities' approaches into an overarching strategy architecture. Subsequent sections apply this strategy architecture to the cities' four major carbon-emissions systems.

## System-Change Strategy Framework

Transformation of a system's carbon emissions profile depends on changing fundamental drivers of investment and behavior in the system. For each system, a city typically develops three components:

- ▶ An analysis of current system conditions
- ▶ A vision of what a transformed system could look like
- ▶ A portfolio of strategies for moving toward that vision, including ways of increasing the city's control over the system.

### MAJOR SYSTEM “AS IS” CONDITIONS

This involves in-depth analysis of the system's structures, sub-systems, performance, and key drivers, typically produced through a combination of city government staff with expertise, stakeholders from the specific system (e.g., utility managers, commercial building owners), and academic and private consulting experts.

### VISION FOR REDESIGNED SYSTEM

In addition to envisioning a future desired state for the system, this involves the decision makers in the system getting clear about the key barriers to realizing the vision and how they will be overcome. This includes carbon-emissions reduction goals/targets for the system.

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Transformative changes in energy supply, building energy efficiency, transportation and solid waste are essential to meeting the challenge of cutting greenhouse gas emissions by at least 80% by 2050.

LEVER	DEFINITION
Encouraging Voluntary Action	Providing information, challenges, learning opportunities, technical assistance, examples, and other support can motivate people to try new behaviors.
Sending Price Signals	Changing the economic impacts—the cost of consumption and other behaviors and the return on investments—through subsidies and incentives can motivate new behaviors and investment.
Making Public Investments	Investing government funds, short- and long-term, can create conditions that stimulate others to behave in new ways, and also significantly change the government’s own carbon footprint.
Mandating Change	Requiring behavior and enforcing the requirements can result in widespread compliance.

### SYSTEM-CHANGE ARCHITECTURE: LEVERS, STRATEGIES, AND ACTIONS

This architecture spells out how the city intends to change the system’s carbon-emissions performance. In most cities’ climate action plans, strategies and actions appear and the levers are left implicit, as unstated assumptions about what fundamentally motivates the desired change. It seemed helpful to describe these here, along with the rest of the architecture.

A **lever** is a general approach to changing underlying drivers in a system in ways that can dramatically shift the system’s performance. Cities typically work four levers to motivate individuals and organizations to change behavior and investment in the key carbon-emissions systems:

A **strategy** is the way the city applies a lever to the context of a specific system. Strategies are different across systems due to differing system conditions, visions for the redesigned system, and degrees of city control. In each system leading-edge cities eventually employ five or six major strategies for transformation.

► **STOCKHOLM** assessed and ranked 50 potential carbon reduction measures based on four criteria: cost efficiency, reduction potential, degree of city control, and speed at which impact could be achieved. (Stockholm action plan for climate and energy 2010-2020)

An **action** is the specific service, appropriation, tax, subsidy, regulation, or other mechanism that city government uses to implement a strategy. A single strategy may have many actions associated with it. Like strategies, actions are designed to work in the specific context of the city’s system and, as a result, actions are not always directly transferable to other cities’ contexts. Usually, though, they can be modified, adapted, to fit different contexts.

Below, for illustrative purposes, is an example of this System-Change Architecture, in this case for the Building Energy Efficiency and Renewable Energy System.

## System-Change Architecture

LEVERS	STRATEGIES	EXAMPLE ACTIONS
<b>Voluntary Action</b>	Encourage improved energy efficiency performance of existing buildings	<ul style="list-style-type: none"> <li>Promote competitive challenges among commercial buildings</li> <li>Use public facilities to promote “cool roofs” — coating of rooftops white to reduce building energy use</li> </ul>
<b>Price Signals</b>	Increase ROI for investment in building energy retrofiting	<ul style="list-style-type: none"> <li>Subsidized lending for energy deep retrofits by building owners</li> <li>Promote the development of supportive market mechanisms such as: building appraisal and mortgage underwriting that capture value of investments in energy efficiency</li> </ul>
<b>Public Investments</b>	Invest in decarbonizing building heating systems  Invest in workforce development, education & training	<ul style="list-style-type: none"> <li>Develop and expand low- to no-carbon district heating and cooling systems</li> <li>Develop city-sponsored/-endorsed workforce development, education &amp; training programs</li> </ul>
<b>Mandates</b>	Mandate performance disclosure and/or improvement of existing buildings	<ul style="list-style-type: none"> <li>Require targeted buildings to benchmark (measure and disclose) energy performance, and/or conduct energy audits</li> <li>Increase stringency of energy codes for new construction and alterations</li> </ul>

### A LEVERS-AND-STRATEGIES PROGRESSION

Some cities think of strategies as working in an explicit progression driven in part by the degree of difficulty involved in building political support.

The starting point is **voluntary action**, for which political support can usually be gained because no major economic or behavior changes are being required of community members or stakeholders. Promoting voluntary action is usually within a city’s power without having to negotiate with other levels of government. Voluntary action is a way of educating the community and stakeholder groups about climate change and the role the city may play in reducing carbon emissions. But voluntary action is unlikely to yield the desired substantial reductions in emissions; it may mobilize “early adopters,” but will not affect the mainstream of city residents and businesses.

Cities turn next to **price signals** and **public investments** for several reasons. Investments in public infrastructure, such as transportation equipment or solid waste processing facilities, are needed to achieve emissions reduction and these fall within the city’s normal responsibilities. The issue, of course, is how to prioritize and pay for them. Some of these investment decisions may be financially controversial because they increase the city’s debt or cut into budgets for other city functions or increase the cost of services. Price signals, such as subsidies to reduce the cost of producing renewable energy or improving a building’s energy efficiency, are also a typical way that local governments support desired behaviors. Although these draw from city funds, or sacrifice revenues, they don’t directly impose higher costs on anyone. However, the effectiveness of subsidies is uncertain, as other factors may strongly influence whether or not the desired behavior occurs. Related price signals include increasing the cost of consuming fossil-fuel energy in, for example, buildings

or vehicles, through taxes, fees, or carbon-pricing market mechanisms, and gathering political will to take such actions can be much more difficult. This may lead decision makers to adopt price increases that are relatively small (and less “painful”), but which may be insufficient to affect behavior. Municipal governments are unlikely to have complete freedom when it comes to price signals and may need approval by other levels of government.

For many cities, **mandates** are something of a last resort—the approach taken when it becomes clear, either through analysis, experience or both, that voluntary action, public investments, and price signals will not lead to sufficient carbon emissions reduction. Mandates tend to generate stronger political opposition, which can become widespread, because they may be viewed as authoritarian. They also may affect a particular sector, such as building owners, on behalf of the entire community, and trigger opposition from the sector, which is likely to have substantial political influence locally. When cities impose mandates, they usually phase them in to provide time for adoption and sometimes provide technical assistance and financial incentives to support the transition.

## Enhancing Cities’ Strategic Control

No leading-edge city has anything close to full control over the system-transforming strategies it might want to pursue; most must rely on other levels of government for decisions about many of the strategies. As C40 Cities reported in 2014, many cities working on the four key urban carbon-emissions systems do not have strong powers when it comes to setting the vision for the system, setting and enforcing policies of the system, controlling the system’s budget, or owning and operating the system.<sup>47</sup> In response to this challenge, cities employ three approaches to get what they want, tailored to specific systems. They seek to acquire more direct control, align stakeholders and other levels of government with their own point of view, and advocate for policy changes at other levels of government. These are discussed in detail in Chapter 13.

47 C40, “The Power to Act,” 2014, [http://c40-production-images.s3.amazonaws.com/researches/images/19\\_C40\\_Climate\\_Action\\_Report.original.pdf?1391555377](http://c40-production-images.s3.amazonaws.com/researches/images/19_C40_Climate_Action_Report.original.pdf?1391555377)

## Integrating Carbon Reduction and Climate Adaptation Planning

Increasingly, cities are making important linkages between their carbon emissions reduction approach and their efforts to increase climate resilience, especially in the planning and implementation of physical infrastructure. This integration is a relatively new development and is not yet prominent in many of the leading-edge cities’ climate action plans.

As Mia Goldwasser, now working on climate action for the City of Boston, reported in a 2015 masters thesis: “Some forward-thinking planners are trying to connect and integrate local mitigation and adaptation planning rather than pursuing them as independent planning processes. They are looking for compelling and practical strategies that broaden and sustain community engagement on climate change and can attract political support and funding by achieving multiple benefits. [They] hope to identify and maximize co-benefits that can result from initiatives that are consistent with both goals.”<sup>48</sup>

### BENEFITS OF LINKING ADAPTATION AND MITIGATION

- ▶ Planning for both can be done in a single process using the same staff and engaging the same stakeholders, increasing efficient use of resources and reducing timeframes.
- ▶ Working on both broadens the conversation, providing more “entry points” for community members, and engaging more stakeholders.
- ▶ Working on both broadens the set of co-benefits that plans can produce for the city, which can increase stakeholder and community support for funding and implementing the plans.
- ▶ Because the relevance of adaptation planning is more easily recognized by community members and stakeholders—in light of changing climate effects, such as extreme weather events—the linkage helps to show that mitigation, which many view as a remote and abstract exercise, serves a real and immediate preventive purpose.

48 Mia R. Goldwasser, “Linking Mitigation and Adaptation in Local Climate Change Planning: The Opportunity Facing Somerville, Massachusetts,” June 2015, p. 6.

- ▶ Planning for both can enable stakeholders to see strategies in common between both, and to advise or allocate resources more effectively where strategies differ.
- ▶ Linking adaptation with planning of transformative strategies for carbon emissions reduction helps push adaptation to look beyond a short-term emergency-preparedness or storm-management approach.

### INITIAL PLANNING LINKAGES

Goldwasser’s report identifies some of the mitigation/adaptation opportunities in major urban carbon-emissions systems.

- ▶ **Energy Supply.** “A focus on efficiency, alternative energy, and distributed generation can reduce energy use and carbon emissions, decrease demand on an overburdened electricity grid, and enhance grid resilience.” Vancouver awards a density bonus to developers who connect buildings to a district energy system, which can reduce energy use and emissions and build resilience to extreme heat or storm events. Washington D.C. is pursuing a citywide smart meter and smart grid infrastructure effort that boosts efficiency and resilience of its energy infrastructure.
- ▶ **Transportation.** Some cities are taking “an integrated approach to addressing flood vulnerability alongside emissions reduction.” Boulder, for example, built a bicycle path system that during a flood directs floodwaters safely through the city, which, under normal conditions, serves the city’s high percentage of bicycle commuters.
- ▶ **Land Use.** “Green stormwater infrastructure, such as green and cool roofs, tree planting, vegetation, bioswales, green walls, and pervious surfaces, are a particularly instructive example of the potential for climate co-benefits: these strategies have been demonstrated to decrease energy use and have carbon sequestration benefits (mitigation) while also retaining stormwater and reducing a building’s indoor air

temperature to combat the urban heat island effect.” Washington D.C. plans to use 75 percent of the city’s private and public landscape for stormwater management and retention—through green roofs, an expanded tree canopy, pervious surfaces, and an increase in wetland acreage along rivers.

**PORTLAND’S** climate action plan depicts the mitigation-adaptation/preparation relationship.<sup>49</sup>

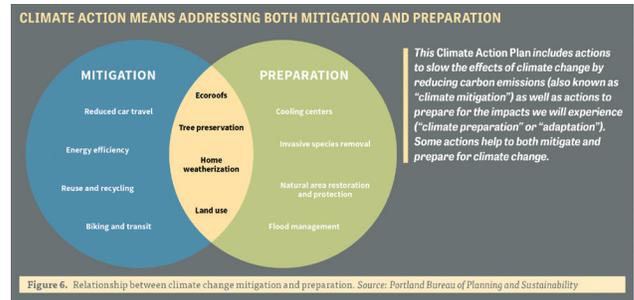
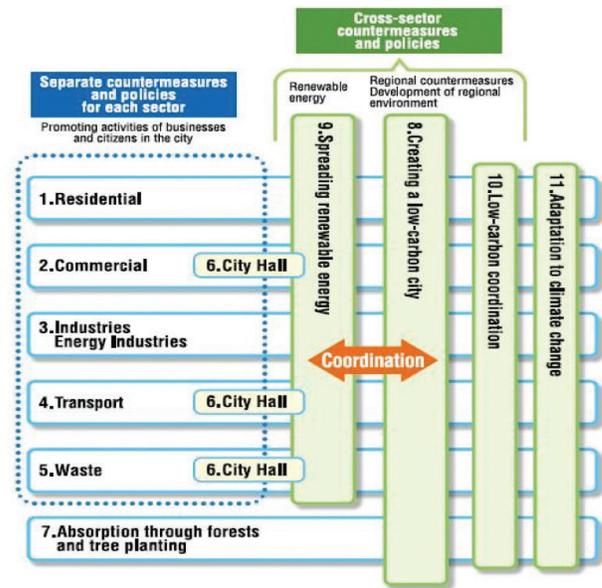


Figure 6. Relationship between climate change mitigation and preparation. Source: Portland Bureau of Planning and Sustainability

Source: City of Portland, “Climate Action Plan.”

### YOKOHAMA Framework for Countermeasures and Policies:



Source: City of Yokohama

49 City of Portland, “Climate Action Plan,” June 2015, p. 22.

## Place-Based, Cross-System Planning Approaches

Although the four key systems are typically treated as separate domains with their own carbon reduction targets, strategies, and actions, they come together to some extent in physical space—as a building, a street, a development project, a neighborhood, or district. These physical structures offer opportunities for integration and synergy across the systems. Increasingly, cities conduct planning with this in mind. Buildings are a physical nexus for energy, waste, and water systems, and are impacted by and have impact on transportation systems.

Neighborhoods or districts and single-owner campuses such as higher education or medical facilities can serve as a nexus of decentralized energy supply, such as district heating and owner-installed solar energy generation, of walkable and bikeable streets, tree canopies, energy efficient buildings and other emissions-reducing solutions. Public and private planners have begun to undertake integrated planning that considers many possible emissions-reduction strategies and actions for use in these places.

## Transforming Key Emissions Systems

As leading-edge cities work at the “edge of innovation” for deep carbon reduction, they have been identifying topics—problems to solve—embedded in transforming the performance of cities’ four main carbon emissions systems: energy supply, buildings, transportation, and solid waste. Chapters 9-12 examine how leading edge cities are tackling pressing challenges in each of these sectors.

## Resources

<b>Climate Grant Program</b>	Energy Foundation	The Climate Program seeks to build support for effective policies that would put a price on carbon and help us avoid the most serious impacts of climate change.
<b>Manual for Measuring Assessing and Analyzing Coast Blue Carbon</b>	Blue Carbon Initiative	Carbon Mitigation in coastal marshes, which also serve as an Adaptation mechanism to handle sea level rise. Manual to standardize protocols for blue carbon. A practical tool to produce robust blue carbon data.
<b>The City Resilience Framework (CRF)</b>	100 Resilient Cities	The CRF is built on 4 dimensions of urban resilience: Health & Wellbeing; Economy & Society; Infrastructure & Environment; and Leadership & Strategy. Each dimension contains three “drivers,” which reflect the actions cities can take to improve their resilience.
<b>Preparing Our Communities for Climate Impacts: Recommendations for Federal Action</b>	Georgetown Climate Center	The Georgetown Climate Center released 100 recommendations today to improve federal programs that could be used to prepare for climate change. The new report will inform the White House State, Local and Tribal Leaders Task Force on Climate Preparedness and Resilience.
<b>Transitioning of Urban Infrastructure Systems in the City of the Future</b>	University of South Florida, Dr. Kiran Patel College of Global Sustainability	Methods and techniques for the long term continuous phased change of existing urban infrastructure systems and their associated governance and financial models, to an optimized future system.
<b>City Powers</b>	C40	



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**TRANSFORMING  
ENERGY SUPPLY  
SYSTEMS**

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A city’s energy supply system contains two major sub-systems: electricity and thermal heating and cooling. (This Framework locates a third type of energy supply—fuels for vehicles and public transit—in the transportation system.) The energy-supply profiles and situations of cities vary considerably:

- ▶ Some cities, due to history and geography, derive much of their electricity from carbon neutral sources such as hydropower, while others rely heavily on dirty sources such as coal. This affects both their carbon reduction targets for the system and the sorts of strategies they use.
- ▶ Some cities own and operate their electricity-generating system, but most do not and are dependent on decisions by other levels of government and investor-owned utilities. Government regulatory contexts vary: some are heavily directed by government, others have been deregulated.
- ▶ Some cities have comparatively cheap electricity and this makes it difficult to spur investment in alternative, renewable sources.
- ▶ Some cities have easier opportunities to produce or access renewable energy; factors like wind and insolation levels, shade from buildings, and cost of building electricity transmission systems all make a difference.

Despite these differences, cities tend to share a set of general energy supply system conditions, a vision for what the redesigned system will look like, and common barriers to system change. They also share a strategic balancing act: how much to push for reduction of the carbon content of energy supply versus reduction in demand for energy, especially by increasing the energy efficiency of buildings. Finally, they tend to share a set of non-climate-oriented desired outcomes for the system:

### Desired Outcomes of the Energy Supply System

<b>Clean</b>	Reduce carbon emissions and toxic pollutants created by the system
<b>Reliable</b>	Minimize system downtime from outages and ensure high quality of power delivered
<b>Affordable</b>	Keep rates as low as possible and maintain competitiveness
<b>Predictable</b>	Minimize rate volatility
<b>Transparent</b>	Consumers can understand their power costs and what drives changes in costs
<b>Local Control</b>	Give residents greater control over their energy resources and energy choices
<b>Wealth Creating</b>	Keep more energy revenue in the local economy instead of exporting it to outside suppliers—to help drive local economic development, create new businesses and jobs
<b>Innovative</b>	The system spawns innovation, intellectual property creation, and entrepreneurship
<b>Just</b>	The system promotes “energy equity,” protecting vulnerable populations from undue hardship, and promotes energy literacy

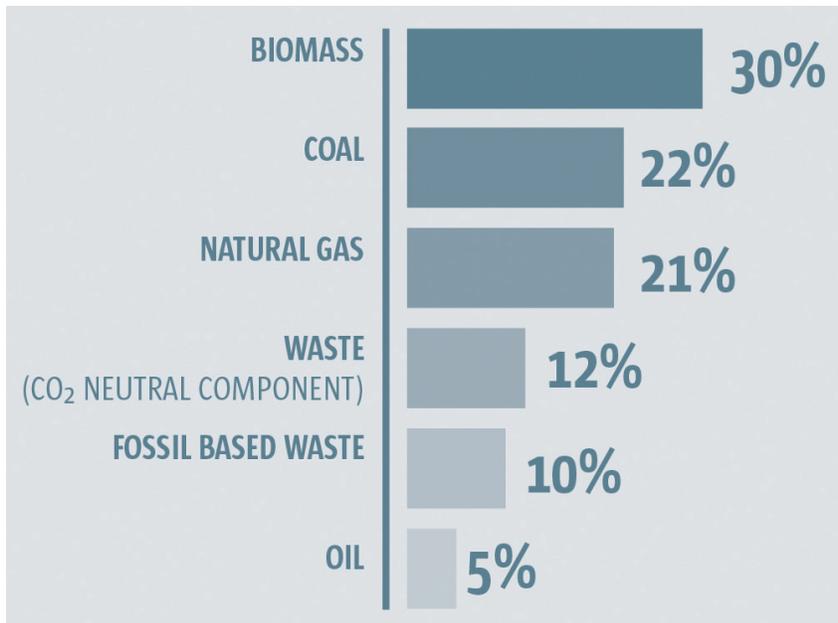
The energy-supply profiles of cities vary considerably; still, cities share common barriers and a similar vision for system transformation.

## Energy Supply System Conditions

- ▶ **Centralized and Integrated.** The electricity system integrates generation, transmission, and distribution of power, typically with centralized, large-scale energy production that requires many large, long-term, sunk investments in facilities and equipment. Centralization is a system feature that is undergoing change:
- ▶ **MINNEAPOLIS:** “The current electric grid—with its large centralized power plants and miles of transmission and distribution lines—relies on many technologies that originated more than a century ago with Edison and Westinghouse. The rapidly emerging modern grid looks much more distributed and decentralized, with many actors on the system sending electricity and data back and forth.”<sup>50</sup>
- ▶ **SYDNEY:** “Electricity used in the City of Sydney is currently provided by a remote, centralised, predominately coal-fired electricity grid. This is highly polluting and electricity used in the City of Sydney Local Government Area accounts for 80% of total greenhouse gas emissions.” In addition, much of the energy produced at remote power stations is lost in the form of evaporated waste heat.<sup>51</sup>
- ▶ **Renewables.** These typically are only a small percentage of the electricity generated. Hydropower is a large source of power in some leading-edge cities such as **OSLO**, **VANCOUVER** and **SEATTLE**. Solar and wind much less so up to now.
- ▶ **YOKOHAMA:** Yokohama has set goals for various types of renewable energy, such as waste energy, biomass power generation (sewage treatment), solar power generation and small hydroelectric generation.
- ▶ **SEATTLE:** Seattle’s electricity fuel mix includes around 89% hydropower and an additional 3.4% of wind generation. The remainder is comprised of landfill gas, nuclear, and fossil fuel purchases that the utility offsets through the purchase of renewable energy credits.
- ▶ **Private Investment.** A large portion of the capital used to build and operate energy-providing systems comes from private investors seeking returns on their investment.
- ▶ **Enormous Expenditures.** The electricity system has extensive, expensive infrastructure for transmission and distribution
- ▶ **Consumption-based Business Model.** The energy-supply business model has long been based on volume (consumption) pricing and a cost-plus rate setting model.
- ▶ **Cities Lack Control.** Except in a small number of cities that own their electricity generation and distribution utility, control of electricity system is typically at the state/province, regional, and/or national government levels.
- ▶ **Aggregated Buying Power.** Cities amount to large customers for power when you aggregate all of their individual customers.
- ▶ **Shifting Technologies.** Energy technologies are changing rapidly, and in ways that will increase the feasibility and importance of distributed, place-based design and management.
- ▶ **Emerging Capacity.** Most cities are in an early stage of developing the technical and human capacity to engage in energy systems management.
- ▶ **Heat Provided by Burning Fossil Fuels.** In many cities, heating oil is a fuel for buildings, and cities with district heating systems may incinerate fossil-fuel based plastic waste along with other waste.
  - In **COPENHAGEN**, for instance, which uses district heating to provide heat to nearly all buildings, a substantial amount of the fuel source is not renewable.

<sup>50</sup> City of Minneapolis, “e21 Initiative Phase 1 Report,” December 2014, p. 4.

<sup>51</sup> City of Sydney, “City of Sydney Decentralised Energy Master Plan Renewable Energy,” December 2013, p. 20.



Source: City of Copenhagen, “Copenhagen Solutions for Sustainable Cities,” January 2014, p. 30.

- **STOCKHOLM:** Waste is “currently being used as fuel for district heating and there are plans to increase [its] share of the total energy mix. However, this fuel contains significant amounts of fossil-based plastics. If the city is to become fossil fuel-free, these plastic fractions must be separated from the waste.”<sup>52</sup>

## Vision for Redesigned Energy Supply Systems

- ▶ **Decarbonized Imported Electricity.** Any large-scale, central supply will come from renewable sources.
- ▶ **Increased Locally Produced and Community-Owned Renewable Power.** Cities maximize the amount of energy generated by distributed, smaller-scale clean supply. **SYDNEY** noted in its vision for renewables that investment and ownership of distributed, small production systems is quite different from the current model: “Community owned renewable energy is owned or partly owned by the local community. Projects are financed by the community purchasing shares in the project as members of a cooperative for which they receive dividends for the shareholding investments. Members are normally required to be active members, which mean that they must also purchase and consume the renewable energy generated directly or indirectly by the cooperative to make the project financially viable to lenders.” The Sydney report noted that, “in Denmark, renewable energy developers must sell 50% of the shareholding in the project to residents

52 City of Stockholm, “Roadmap to a Fossil-Fuel Free Stockholm 2050,” March 2014, p. 6

### Vision for Redesigned Energy Supply Systems

- Decarbonized Imported Electricity
- Increased Local Production of Renewable Power
- Reduced Demand/Consumption of Electricity
- Elimination of Fossil-Fuel Heating Sources
- Utility of the Future Model
- Citywide Energy Management

living within 2km of the project by law.” In Germany, “hundreds of thousands of people have invested in citizen’s wind farms across the country representing 90% of wind farms in some states such as North Frisia.” In the United Kingdom, there were “43 community owned renewable energy schemes operating.” The first community owned solar farm “became operational in 2011 after raising £6 million from 1,650 members. The share issue was 50% over subscribed.” And in the U.S., community wind “is one of the fastest growing markets... with 27 states having legislation that allows community renewable energy schemes.”<sup>53</sup>

- ▶ **BERLIN:** “Solar energy offers the most promising potential of all the renewable portfolio, fitting well with the urban load curve and the urban distribution network. Berlin’s 320,000 residential houses — not only the roofs, but also the facades — offer a space-efficient basis for a massive rollout of photovoltaics as well as solar heating systems. Studies find that Berlin can generate 300 times the amount of solar energy it produced in 2010.”<sup>54</sup>
- ▶ **SYDNEY:** “Buildings, whether residential, industrial or commercial, can use onsite renewable energy technology to generate electricity and heating for the building. A small, local renewable power plant within the city could generate power for consumption within the local distribution network. Electricity produced at a great distance from cities requires major transmission and distribution infrastructure and its associated costs. These inefficiencies increase consumers’ electricity bills and the amount of greenhouse gas emissions. Therefore, there is greater value in generating renewable energy close to where it will be consumed. Generating renewable electricity and replacing natural gas with renewable gases to supply a decentralised trigeneration energy network would be a significant step for decarbonising Sydney.”<sup>55</sup>
- ▶ **PORTLAND** has piloted “community solar” to spread the use of on-site solar generation to residents who, because they are renters or own property that don’t receive sufficient sunlight, are unable to tap into solar

energy. “In its ideal form, community-shared solar is one larger-scale photovoltaic system that provides power or economic benefits to multiple customers.” The city launched a campaign to raise funds to develop solar on schools, libraries, community centers, and other spaces.<sup>56</sup>

- ▶ **Reduced Demand/Consumption of Electricity.** Reduced consumption will be mostly in the building sector. Other climate-action strategies, such promoting sale and use of electric vehicles, will increase demand on the electricity grid.
- ▶ **Elimination of Fossil-Fuel Heating Sources.** Leading-edge cities seek to eliminate the use of fossil fuel-based heat for buildings, including in district heating systems.
- ▶ **Utility of the Future Model.** The underlying model for an electricity utility will be modernized.

**Toward the “Electricity Utility of the Future”**

<b>Grid Modernization</b>	<ul style="list-style-type: none"> <li>• Smart Grids (Advanced Metering Infrastructure)</li> <li>• Improved grid performance (Volt/VAR Control)</li> <li>• Automated Demand Management</li> <li>• Improved Storage and Frequency Regulation</li> </ul>
<b>New Utility Revenue Models</b>	<ul style="list-style-type: none"> <li>• Revenue De-Coupling</li> <li>• Performance-Based Compensation</li> <li>• Fixed Cost Recovery</li> <li>• Minimize Stranded Assets</li> </ul>
<b>Other Aspects</b>	<ul style="list-style-type: none"> <li>• Reduce Peak Load Requirements</li> <li>• Improved Transmission Planning</li> <li>• Time-Variant Pricing</li> </ul>

53 City of Sydney, “City of Sydney Decentralised Energy Master Plan Renewable Energy,” December 2013, p. 28.

54 City of Berlin, “Climate-Neutrality Berlin 2050: Results of a Feasibility Study,” March 2014, p. 9.

55 City of Sydney, “City of Sydney Decentralised Energy Master Plan Renewable Energy,” December 2013, p. 20.

56 City of Portland, “Climate Action Plan,” June 2015, p. 69.

- ▶ **Smart Grids.** Smart grids are a critical component of the utility of the future.
- ▶ In **YOKOHAMA'S** Yokohama Smart City Project (YSCP), the city, in cooperation with Japan's 34 leading companies in the fields of energy, electronics and construction, introduced a system to optimize the energy supply-demand balance in mixed-use residential-commercial areas. The city set individual targets for the adoption of building energy management systems (BEMS), solar installations and uptake of electric vehicles, and achieved these targets by FY2013. YSCP is now moving from the demonstration stage to the implementation stage.<sup>57</sup>
- ▶ **SYDNEY** found that “the integrated smart grid system being developed by advanced economies in Europe shows how electricity, heat and gas can be integrated to provide a 100% non-intermittent renewable energy system. Renewable gas developed from waste converted into substitute natural gas and injected into the gas grid, the use of ‘power to gas’ technologies for surplus renewable electricity from intermittent renewable electricity generation technologies such as solar and wind converted into renewable hydrogen or renewable gas and injected into the gas grid and heat recovered from decentralised electricity generation for supplying heating and cooling are key features of such a system.”<sup>58</sup>
- ▶ **Citywide Energy Management.** This will be a new municipal function, with energy goals and targets; sophisticated analysis of energy systems serving the city; strategies and plans, including capital investment, to achieve goals for the system; and a capacity to manage implementation of new design and monitor progress.
- ▶ In addition, some cities — **BERLIN** and **COPENHAGEN**, for instance — project themselves as potential exporters of renewable energy.
- ▶ In **BERLIN'S** plans the city “will increase its total electricity production — and simultaneously decrease its import needs. This will change the image of the big city as an ‘energy sink’ significantly: in terms of energy accounting, Berlin can practically even out its electricity balance. If the new, system-relevant big consumers such as those from the power-to-gas/methanol technology sector were located outside Berlin, Berlin could even export an appreciable amount of electricity. However, the scenarios assume that it makes more economical and infrastructural sense to locate this production predominantly in Berlin. From a seasonal perspective, Berlin will export most of its electricity in the summer, when it produces large amounts of solar energy. In the winter, the city will need wind energy — from Brandenburg, for example — to complement its own CHP-generated power. Thus, the result pleads the case for a new division of tasks with Berlin's periphery: a high solar and cogeneration-based production of electricity will help reduce the area required for energy generation — in Berlin, but also in Brandenburg, where, at least from a Berlin perspective, lignite power plants might no longer be necessary.”<sup>59</sup>

57 City of Yokohama, “Midterm Plan 2010 — Chapter 4: Growth Strategy,” 2010, p. 127.

58 City of Sydney, “City of Sydney Decentralised Energy Master Plan Renewable Energy,” December 2013, p. 32.

59 City of Berlin, “Climate-Neutrality Berlin 2050: Results of a Feasibility Study,” March 2014, p. 18.

## Major Barriers to Energy Supply System Change

Among the many barriers cities encounter in seeking to transform their energy supply, these are some of the most prominent:

- ▶ **Reliability**—The electricity and heating systems’ reliability cannot be compromised; risks of incorporating intermittent renewable sources into the grid must be designed and managed.
- ▶ **Stranded Assets**—There is the potential for “stranded assets” in the system: devalued system components become liabilities, with financial losses and risks for private and public investors.

- ▶ **Financial Concerns**—Decision-makers may resist increased distributed production of energy and conservation because the current energy-supply business model depends on volume sales and loss of volume destabilizes financial performance.
- ▶ **Feasibility of Innovations**—The feasibility of microgrids and other distributed-generation models is not yet well established.
- ▶ **Renewable Supply Growth**—There is uncertainty about how rapidly a large-scale renewable supply can be developed and deployed.

## TIMELINE FOR BOULDER’S ENERGY SUPPLY TRANSFORMATION EFFORT



Source: City of Boulder

► **BOULDER** is in the middle of an unusual and complex process that indicates a city’s sustained desire to take control of its energy-supply future. When Boulder developed its climate action plans, the city realized that it would be almost impossible to achieve its deep decarbonization goal without an energy supplier willing to partner with the city to achieve those goals. Nearly 90 percent of electricity was generated from coal or natural gas. The City negotiated with the multi-state, investor-owned utility (Xcel) that supplied it over options for increasing renewable supplies, but was unable to reach agreement. In November 2011, Boulder voters passed a measure to fund an analysis of the

feasibility of establishing a municipal utility and two years later they authorized the city to issue bonds to finance purchase of the utility’s assets. A feasibility study found that a city-owned utility could immediately obtain 54 percent or more of its electricity from renewable resources. By 2015, the city was in the midst of legal maneuvering and had submitted a proposal to state regulators seeking permission to transfer the utility’s assets to the city. The next step would be to file condemnation proceedings to establish the value of the assets that the city would have to compensate the utility for. The timeline is for the City to “go live” with its new municipal utility in January 2018.

- Detailed analysis and modeling conducted to determine if a municipal utility could meet the Charter requirements.
- City projections are validated by a third party independent review.
- City Council authorizes the filing of condemnation to acquire Xcel assets if negotiations fail.
- The Boulder-Xcel Task Force is launched and issues its report.
- After extensive negotiations, Xcel and the city decide to terminate discussions because of a lack of agreement.
- Voters approve a ballot measure to

- City Council forms a utility in the charter.
- A detailed transition plan for establishment of the utility is developed and approved by City Council.
- Voters approve a ballot measure allowing the City Council to hold private executive sessions to discuss legal advice for creation of a local utility.
- City files a condemnation petition in Boulder District Court.
- Xcel files suit to block the City condemnation petition.
- FERC affirms Boulder’s right to move forward with condemnation without needing FERC approval.

## 2012

- White paper on potential Xcel partnership options is developed.

## 2013

- authorize city bonding to purchase Xcel assets.
- Voters defeat a ballot measure sponsored by Xcel that would prevent municipalization.
- The Colorado Public Utility Commission issues a ruling that requires CPUC approval before Boulder moves ahead on municipalization.

## 2014

- City petition for condemnation is dismissed, based on a decision that the city needs to get CPUC approval first.
- Boulder files a proposal for municipalization with the PUC.
- Staff begin work on a broader Energy System Transformation Blueprint.

## 2015

# Levers, Strategies and Actions for Transforming Energy Supply Systems

LEVER	STRATEGIES	ACTIONS			
Voluntary Action	Enable consumers to purchase and/or produce renewable energy	<ul style="list-style-type: none"> <li>• Provide clean power purchasing option (e.g., allow consumers to participate in wholesale market, Community Choice Aggregation)</li> <li>• Assist large enterprises in implementing clean energy purchasing through PPAs and other arrangements</li> <li>• Ease permitting/land use regulation for on-site renewables (e.g., rooftop solar)</li> </ul>			
	<table border="1"> <tr> <td rowspan="2">Price Signals</td> <td>Reduce cost of renewables</td> <td> <ul style="list-style-type: none"> <li>• Provide financial incentives for on-site and off-site renewable generation (e.g., property tax breaks)</li> <li>• Provide feed-in tariffs and/or net metering incentives for excess distributed renewable generation</li> </ul> </td> </tr> <tr> <td>Ease regulatory compliance</td> <td> <ul style="list-style-type: none"> <li>• Reduce regulatory barriers to Combined heat and power (CHP), microgrids, district energy, tri-generation</li> </ul> </td> </tr> </table>	Price Signals	Reduce cost of renewables	<ul style="list-style-type: none"> <li>• Provide financial incentives for on-site and off-site renewable generation (e.g., property tax breaks)</li> <li>• Provide feed-in tariffs and/or net metering incentives for excess distributed renewable generation</li> </ul>	Ease regulatory compliance
Price Signals	Reduce cost of renewables		<ul style="list-style-type: none"> <li>• Provide financial incentives for on-site and off-site renewable generation (e.g., property tax breaks)</li> <li>• Provide feed-in tariffs and/or net metering incentives for excess distributed renewable generation</li> </ul>		
	Ease regulatory compliance	<ul style="list-style-type: none"> <li>• Reduce regulatory barriers to Combined heat and power (CHP), microgrids, district energy, tri-generation</li> </ul>			
Public Investments	Invest in renewable supply	<ul style="list-style-type: none"> <li>• Invest in large- and medium-scale distributed generation (district energy for heating and cooling, micro-grids, CHP, tri-generation districts), or in public-private partnerships</li> <li>• Invest in converting city-owned fossil-fuel power generating facilities</li> <li>• Invest in large-scale renewable production (wind, solar) facilities</li> <li>• Invest in “community solar” projects</li> </ul>			
	Model the behavior —Purchase and produce renewable energy	<ul style="list-style-type: none"> <li>• Install distributed renewable energy generation on city facilities</li> <li>• Purchase clean energy</li> </ul>			
Mandates	Mandate decarbonization of central supply	<ul style="list-style-type: none"> <li>• Increase renewable portfolio standards (RPS) for utilities (at state/ province, regional, national scale)</li> <li>• Force the retirement or conversion of fossil-fuel plants (perhaps with financial support)</li> <li>• Implement an emissions “cap and trade” market (at state/province, regional, national scale)</li> <li>• Require the phasing out/conversion of buildings’ fossil-fuel heating systems (and provide technical and financial assistance for owners/managers) toward waste heat, biomass or geothermal energy systems</li> </ul>			
	Mandate increased energy efficiency and conservation	<ul style="list-style-type: none"> <li>• Increase efficiency and emissions requirements for fossil-fuel plants</li> <li>• Implement mandates to reduce energy consumption in buildings and transportation systems</li> </ul>			

## Resources

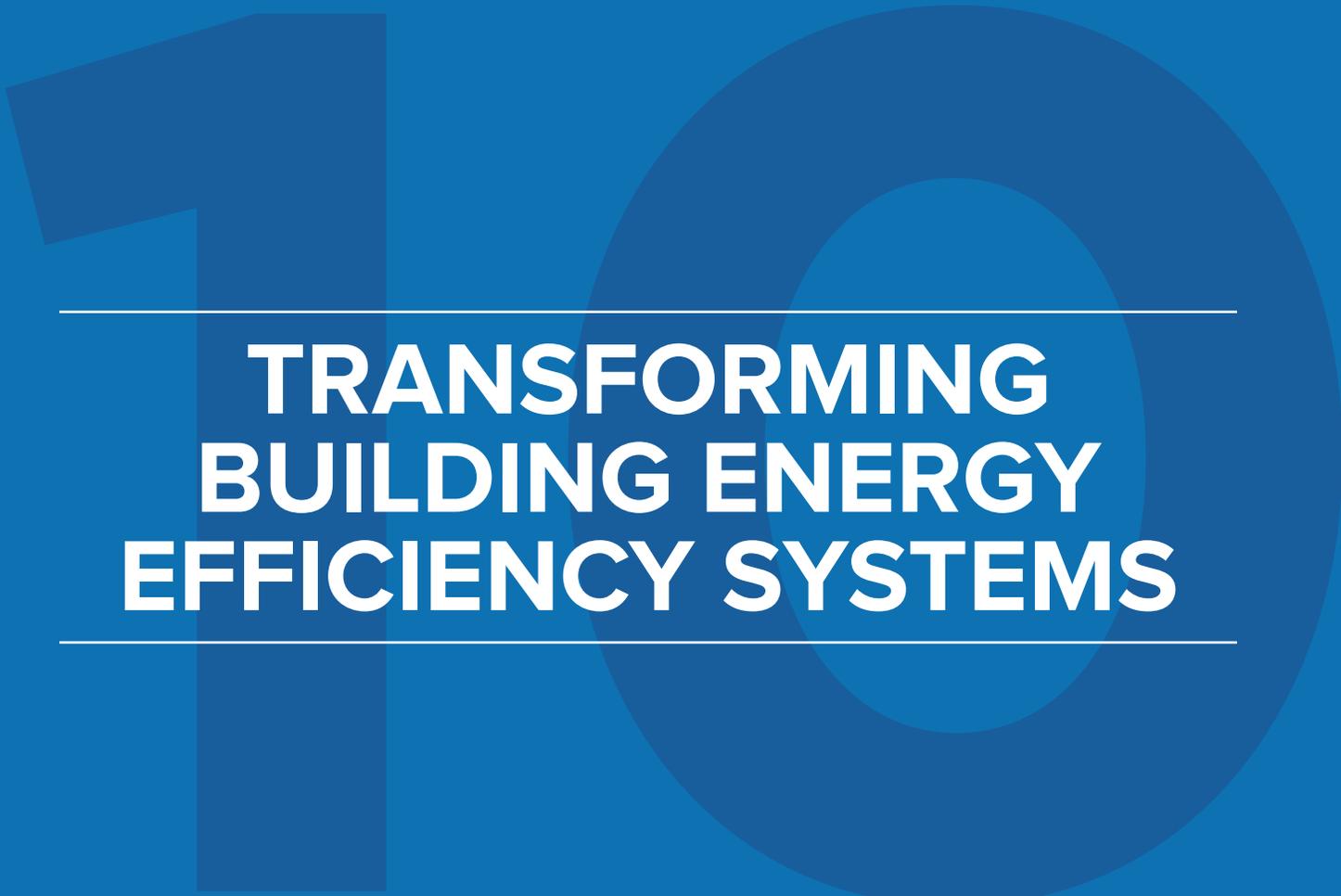
<b>Berlin Energy Concept 2020</b>	Berlin	Develops a future strategy for Berlin's energy supply.
<b>Delivering London's Energy Future (2011)</b>	London	A strategic framework that aims to protect the environment through reducing energy usage and carbon emissions in various sectors.
<b>Minneapolis Energy Pathways: A Framework for Local Energy Action (2014)</b>	Minneapolis	Describes the current energy system in Minneapolis, the plan to develop Minneapolis' energy vision, local utility franchise agreements and the pathway to achieve Minneapolis' energy vision.
<b>e21 Initiative Phase 1 Report (2014)</b>	Minneapolis	The e21 Initiative produced this report to provide Minnesota with options to decide their energy infrastructure, the production of their energy and how they want to utilize their energy.
<b>Geothermal Systems and their Application in New York City (2015)</b>	New York City	Explains that the use of geothermal energy can improve the efficiency of New York City's energy systems
<b>San Francisco Mayor's Renewable Energy Task Force Recommendations Report 2012</b>	San Francisco	Recommends specific steps to take in order to achieve San Francisco's goal to get 100% of its electricity demand with renewable power.
<b>Stockholm Action Plan for Climate and Energy 2012-2015</b>	Stockholm	Includes Stockholm's strategies to reduce greenhouse gas emissions and long term goals and visions to make Stockholm more sustainable.
<b>Yokohama FutureCity Initiative (2012) and Yokohama Action Plan 2013-2017</b>	Yokohama	Yokohama's energy strategy and strategies to tackling climate change.
<b>Seattle Climate Action Plan (2013)</b>	Seattle	Outlines near-term and long-term actions to achieve a carbon neutral city, including a Building Energy strategy to achieve deep energy savings in new and existing buildings and reduce the carbon content of Seattle's energy supply.

<p><b>A Guide to Electricity Markets, Systems, and Policy in Massachusetts</b></p>	<p>Conservation Law Foundation</p>	<p>Helps stakeholders in Boston understand how regional electricity markets function in New England and Massachusetts, and to introduce some of the important choices about the design of those markets currently being discussed in the region.</p>
<p><b>Better Growth Better Climate</b></p> <p>Charting a new path for low-carbon growth and a safer climate.</p>	<p>The Global Commission on the Economy and Climate — The New Climate Economy</p>	<p>Commissioned in 2013 by the governments of seven countries: Colombia, Ethiopia, Indonesia, Norway, South Korea, Sweden and the United Kingdom. In chapter 4, this report examines energy trends and makes recommendations to reduce GHG emissions through changes in energy systems away from fossil fuels to renewable energy sources and minigrids.</p>
<p><b>District Energy in Cities: Unlocking the Potential of Energy Efficiency and Renewable Energy</b></p>	<p>United Nations Environment Programme</p>	<p>A new report from UNEP has surveyed low-carbon cities worldwide to identify the key factors underlying their success in scaling up energy efficiency and renewable energy, as well as in attaining targets for zero or low greenhouse gas emissions.</p>
<p><b>PEER: New Rating System for Sustainable Power Systems</b></p>		<p>Modeled after the U.S. Green Building Council's (USGBC) LEED green building rating system, PEER, or Performance Excellence in Electricity Renewal, evaluates power generation, transmission and distribution systems through the lens of the customer, focusing on efficiency, quality, reliability, resiliency and the environment. GBCI will serve as the independent, third party, global certification and credentialing body for PEER.</p>
<p><b>Advancing Toward a more Sustainable Urban Energy System</b></p>	<p>World Resources Institute by Rodrigo Villarroel Walker; Daniele Poponi; Benoit Lefevre</p>	<p>Analyses the drivers and barriers to sustainable urban energy systems.</p>

<p><b>Energy Efficiency as a Low-Cost Resource for Achieving Carbon Emissions Reductions</b></p>	<p>U.S. Environmental Protection Agency</p>	<p>Examines the role of energy efficiency in addressing global climate change. It summarizes research on the size, economic value, and carbon dioxide (CO2) emissions reduction impacts of efficiency resources, reviews available information on the benefits and costs of energy efficiency, discusses the factors that limit efficiency investment in today's markets, and outlines energy efficiency policy and programs in use today that can be further expanded.</p>
<p><b>Energy Efficiency in Local Government Operations</b></p>	<p>U.S. Environmental Protection Agency</p>	<p>Describes how local governments can lead by example and achieve multiple benefits by improving the energy efficiency of their new, existing, and renovated facilities and their day-to-day operations. It is designed to be used by facility managers, energy and environment staff, other local government agencies, and mayors and city councils.</p>
<p><b>Renewable Energy Policy in Cities: Selected Case Studies</b></p>	<p>International Renewable Energy Agency (IRENA) and International Council for Local Environmental Initiatives (ICLEI)</p>	<p>IRENA, in collaboration with the International Council for Local Environmental Initiatives (ICLEI), has produced a series of case studies on cities where local governments have successfully adopted measures to promote renewable energy and sustainability.</p>
<p><b>Sustainable Urban Energy Planning: A Handbook for Cities and Towns in Developing Countries</b></p>	<p>UN-Habitat, UNEP and ICLEI-Local Governments for Sustainability</p>	<p>The main purpose of this handbook is to assist people who are working in or with local government to develop sustainable energy and climate action plans and implementation programmes. This handbook deals with the role of urban centres and local governments in defining a sustainable development path and a new energy future in their countries.</p>
<p><b>Built-Environment Wind Turbine Roadmap</b></p>	<p>National Renewable Energy Laboratory (NREL)</p>	<p>The authors summarize the expertise and resources needed in understanding the built-environment wind resource and developing testing and design standards. This roadmap identifies key barriers to the development and deployment of BWTs.</p>

<b>Case Study, Vancouver:</b>		
<b>Reducing Carbon Emissions through District Energy</b>	C40 Cities	District energy is a major part of Vancouver's effort to reduce its carbon emissions 33% by 2020 from a 2007 baseline, as outlined in its Greenest City Action Plan.
<b>Cities, Towns and Renewable Energy: Yes in my front yard</b>	International Energy Agency (IEA)	The goals of this report are to inspire city stakeholders by showing how renewable energy systems can benefit citizens and businesses, assist national governments to better appreciate the role that local municipalities might play in meeting national and international objectives, and help accelerate the necessary transition to a sustainable future.
<b>Developing Geothermal Heat Pumps in Smart Cities and Communities</b>	ReGeoCities: Intelligent Energy Program of European Union	Increasing the use of geothermal energy, and strengthening the geothermal industrial sector, will allow a substantial reduction of CO2 emissions, the saving of primary energy, and the creation and sustainment of a work force with many skill levels.
<b>Grid Integration and the Carrying Capacity of the U.S. Grid to Incorporate Variable Renewable Energy</b>	National Renewable Energy Laboratory (NREL)	Summarizes the challenges to integrating increasing amounts of variable renewable energy (RE), identifies emerging practices in power system planning and operation that can facilitate grid integration, and proposes a unifying concept-economic carrying capacity-that can provide a framework for evaluating actions to accommodate higher penetration.
<b>Integrating Variable Renewable Energy in Electric Power Markets: Best Practices from International Experience</b>	National Renewable Energy Laboratory (NREL)	Documents the diverse approaches to effective integration of variable renewable energy among six countries—Australia (South Australia), Denmark, Germany, Ireland, Spain, and the United States (western region-Colorado and Texas)—and summarize policy best practices to ensure that electricity markets and power systems can effectively co-evolve with variable renewable energy.

<p><b>Microgrids—Benefits, Models, Barriers and Suggested Policy Initiatives for the Commonwealth of Massachusetts</b></p>	<p>Massachusetts Clean Energy Center</p>	<p>Focuses on the benefits of microgrids and articulates the value of microgrids, as opposed to stand-alone distributed energy resources, whose operations are not necessarily coordinated. Microgrids represent coordinated control of DERs to maximize economics, reliability and clean energy (if feasible), and to stabilize electric loads and generation while operating independently of the macrogrid.</p>
<p><b>Smart Thermal Grids</b></p>	<p>Smart Cities and Communities (EU Commission)</p>	<p>The scale of smart thermal grids can range from neighborhood-level systems to city-wide applications, depending on heating and cooling demand and urban context</p>
<p><b>Energy Policy Simulator</b></p>	<p>Energy Innovation</p>	<p>A tool that helps cities see the impacts of their energy policy decisions in relation to various outputs, including greenhouse gas emissions.</p>



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**TRANSFORMING  
BUILDING ENERGY  
EFFICIENCY SYSTEMS**

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A city's building energy efficiency system — energy consumption by residential, commercial, industrial, and public facilities, including streetscapes (outdoor lighting, for example) — produces an enormous portion of most cities' carbon emissions, especially in larger and densely developed cities. Most broadly, this system divides into two categories: new buildings for which increased energy efficiency standards can be put in place from the beginning, and existing buildings whose energy systems must be retrofitted.

Different cities' buildings profiles and situations may vary considerably:

- ▶ Type, age, uses, construction methods and materials, height, size (square meters/feet), age, energy-use intensity and type of energy use (electricity/thermal loads, hours of operation, plug loads) of building stock vary. Although cities haven't standardized a typology for building stock, a fairly typical version of building types includes:
  - Small Scale Residential
  - High Rise Residential
  - Residential/Commercial Mixed Use
  - Small to Mid-Scale Commercial
  - High-Rise Commercial
  - Industrial
  - School/Daycare/Church
  - Medical/Laboratory
  - Government
- ▶ In **BERLIN**, almost 90 percent of dwellings are in multifamily houses, while single- or two-family houses account for only 10 percent and 9.6 percent of the buildings are protected as listed monuments.<sup>60</sup> Low household density can drive up the amount of energy needed for building heating citywide.
- ▶ The dynamics of the real estate market vary — both in terms of the amount of demand and supply (“strong” versus “weak” markets), as well as demand for “green performance” building space, and these drive both the pace of new development and the rate of demolition, ownership transfer, and renovations of existing buildings.
- ▶ City and other applicable building codes and real-estate development requirements (zoning requirements, development project requirements) vary in how stringent they are when it comes to efficiency and conservation.
- ▶ The presence of district-scale heating and cooling systems and building-by-building fossil-fuel heating systems varies — and this affects strategy choices.
- ▶ The concentration of building ownership is different, although there is not substantial cross-city data about this.

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Cities' building energy efficiency profiles vary, as do their regulatory jurisdiction. However, the basic methods for building-level energy efficiency are broadly applicable.

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<sup>60</sup> City of Berlin, “Climate-Neutrality Berlin 2050: Results of a Feasibility Study,” March 2014, p. 10.

- ▶ In **BOSTON**, for instance, commercial and industrial buildings produce about 50 percent of Greenhouse Gas emissions. In those sectors, the 50 biggest property owners control buildings that generate 30 percent of the city’s building emissions.
- ▶ In **NEW YORK CITY**, the largest buildings (over 50,000 square feet or multiple buildings on a lot that total 100,000 square feet) make up just 2 percent of building stock, but account for almost half of built floor area and 45 percent of citywide energy use.
- ▶ In **WASHINGTON D.C.**, the capital of the U.S., a substantial portion of the buildings are owned by the federal government.

In spite of these differences, cities tend to share a set of general building energy efficiency conditions, a vision for what the redesigned system will look like, and common barriers to system change. They also share a strategic balancing act: how much to push for efficiency and resulting reductions in demand for energy, versus how much to push for reduction of the carbon content of energy supply to buildings. In addition, the basic methods for building-level energy conservation methods tend to be broadly applicable to power sources, heating and cooling, windows and lights, and the building envelope. Some examples include:

### Typical Building-level Energy Conservation Methods

<b>Building Power Sources</b>	<ul style="list-style-type: none"> <li>• On-site and remote renewables, including Power Purchasing Agreements</li> <li>• Combined heat and power</li> <li>• Clean energy grid procurement</li> </ul>
<b>Heating and Cooling</b>	<ul style="list-style-type: none"> <li>• High efficiency HVAC systems, including boilers and chillers</li> <li>• Demand controlled ventilation; displacement ventilation</li> <li>• Separation of thermal conditioning from ventilation</li> <li>• High efficiency fan and pump motors</li> <li>• Tighter and better insulated building envelopes</li> </ul>
<b>Building Management</b>	<ul style="list-style-type: none"> <li>• Development of standardized building operating manuals</li> <li>• Retro-commissioning of existing buildings on a regular basis</li> <li>• Annual building maintenance upgrades</li> <li>• Building energy management systems</li> <li>• Certification programs for facilities and building management</li> </ul>
<b>Lighting and Windows</b>	<ul style="list-style-type: none"> <li>• Reduced lighting power densities; LEDs</li> <li>• Day-lighting</li> <li>• Occupancy sensors</li> <li>• High performance windows and glazing</li> </ul>
<b>Other</b>	<ul style="list-style-type: none"> <li>• Occupant behavior change initiatives</li> <li>• Plug-load management</li> <li>• Data center management</li> <li>• Thermal energy storage</li> <li>• Demand response</li> <li>• Load shifting</li> <li>• Other</li> </ul>

## Building Energy Efficiency System Conditions

- ▶ **Blend of Markets and Regulations**—The system is made up of a complex blend of markets, private and public finance, professions (architects, engineers, building operators), and government regulations with highly distributed ownership/control of buildings
- ▶ **Economic Value**—The system contains an enormous amount of underlying private economic value, (property assets and income), and both new construction and existing buildings generate substantial business activity and job creation in cities. Even in cities with fast-growing populations, existing buildings make up the bulk of the economic value in real estate—and this puts a priority on retrofitting their energy efficiency.
- ▶ **LONDON:** “It is anticipated that 80 percent of London’s buildings will still be standing in 2050. Retrofitting existing homes with energy efficiency and energy supply measures is therefore essential to reducing Londoners’ energy bills and the associated CO2 emissions.”<sup>61</sup>
- ▶ **Building Variation**—Variations in building stock mean that energy conservation methods have to be customized to a building’s specific characteristics.
- ▶ **Building Ownership**—Across most cities there are single-owner “campuses” (e.g., universities, hospitals) as well as large commercial properties.
- ▶ **Real Estate Market Dynamics**—The “metabolics” of the real estate sector—including rate of new building development, transfer of ownership, remodeling, deconstruction, etc.—are complex and not well documented or analyzed. This makes planning for retrofitting particularly difficult since extensive “deep” retrofits typically disrupt a building’s inhabitability, often for extended periods of time.
- ▶ **SEATTLE:** With a mild climate and inexpensive electricity, returns on investment for energy efficiency upgrades are often longer in Seattle than in other U.S. cities. In large commercial buildings, the challenge is magnified by the frequency in which buildings change hands. For companies that often hold properties for only three years, paybacks on energy efficiency investments are even more challenging to absorb.

- ▶ **Energy Efficiency Market Capacity**—The building energy retrofitting services sector usually operates at very small scales, with a large number of small enterprises, so capacity to expand to greater scales is uncertain.
- ▶ In addition to managing system reliability and demand response, **YOKOHAMA’S** Integrated Building Energy Management System (BEMS) controls 29 separate BEMS’s at city-owned facilities, commercial buildings and large-scale office complexes with multiple energy generation, storage, water purification and wastewater treatment functions. The system has been able to demonstrate a 22.8% peak demand reduction.<sup>62</sup>
- ▶ **“Green Buildings” Economic Sector**—The emergence of new “green building” and “energy performance” skills, products, and services is helping to increase “green jobs” in cities.
- ▶ **Climate Change Effects**—In most cities, the buildings sector has already experienced some of the damage caused by effects of climate change—and long-term resilience has become a concern.
- ▶ **Demand for Green Buildings**—Some cities have strong demand for “green” commercial space, which provides market incentives for building owners/managers to invest in reduction of carbon-emissions/energy consumption.
- ▶ **Variation in City Control**—Cities’ control over building systems varies considerably. Most importantly, some cities control local building and energy codes, but for others these are set at the state/province or national level.

## Vision for Redesigned Building Energy Efficiency Systems

The vision for redesigned building energy efficiency systems typically has five elements:

**High-Efficiency Existing Buildings**—Older buildings will have been transformed into highly energy efficient structures, powered by renewable sources of energy, and using energy recovery systems. An important element of reducing consumption is demand management by building residents.

61 Greater London Authority, “The Mayor’s Climate Change Mitigation and Energy Annual Report, 2013-2014,” June 2015, p. 19.

62 City of Yokohama.

## Vision for Redesigned Building Energy Efficiency Systems:

- High-Efficiency Existing Buildings
- Net Zero or Positive Renewable Energy New Buildings
- Building Energy Performance Information for the Market
- Performance-Driven Management of Building Energy
- Growing “Green Buildings” Economic Sector

- ▶ In the summer of 2013, for instance, **YOKOHAMA** tested home energy management systems in about 3,500 homes, the largest test of its kind in Japan, and found that peak demand for power dropped up to 15.2 percent.<sup>63</sup>
- ▶ **Net Zero or Renewable Energy Positive New Buildings**—All new buildings will meet the highest possible energy performance standards
- ▶ **Building Energy Performance Information for the Market**—The market for real estate will provide and be driven in part by energy-performance information.
- ▶ **SEATTLE** has envisioned several aspects of this development: “Individuals making decisions about whether to buy, lease, or finance a building expect to receive information about a building’s energy performance. Building energy use information is just as available and understandable as a “miles per gallon” rating on a vehicle is today, and energy efficiency has a clear market value. Building owners, operators, and occupants have access to real-time feedback about the energy use in their building and options to improve energy performance.”<sup>64</sup>
- ▶ **Performance-Driven Management of Building Energy**—Larger buildings in particular will be run by building operators trained in green, energy-performance management and systems.
- ▶ **Growing “Green Buildings” Economic Sector**—The growing market for technologies and services for green, energy-efficient buildings will spur business and job creation and expansion in the green buildings sector.

**PORTLAND’S** climate action plan noted that “several initiatives in the building industry support low- to no-energy use by maximizing energy-efficient construction techniques, incorporating on-site renewables and reducing occupants’ energy use.” These include:

- ▶ **Passive Buildings**—A design and construction approach used to attain super-insulated, virtually air tight buildings primarily heated by solar gain and minimal equipment.
- ▶ **Net-Zero/Zero-Energy and Energy Positive Buildings**—A net-zero or zero-energy building produces as much energy as it consumes, calculated on a net basis for one year. An energy positive building produces more energy than it consumes, sending excess back into the electricity grid.
- ▶ **Living Buildings**—To achieve Living Building status, buildings are required to meet a series of performance requirements, including net-zero energy, waste and water, over a minimum of 12 months of continuous occupancy.<sup>65</sup>

63 City of Yokohama, “Community Development of FutureCity Yokohama,” October 2015, p. 10.

64 City of Seattle, “Seattle Climate Action Plan,” June 2013, p. 38.

65 City of Portland, “Climate Action Plan,” June 2015, p. 67.

## Major Barriers to Building Energy Efficiency System Change

The primary barriers to building energy efficiency system transformation include:

- ▶ **Cost-Benefit Analysis**—Return on investment in building energy efficiency, generated by savings in future costs, takes a number of years to achieve, and some technologies, such as certain heat pumps, biogas, and biomass fuels, are not yet cost-effective.
- ▶ **The “Split Incentive” Problem**—This occurs when a rental-building owner pays for energy efficiency retrofits to the building but cannot recover the savings from reduced energy use that tenants receive.
- ▶ **MELBOURNE** detailed some of the complications around the split incentive problem: “High-rise apartments have been shown to be the most energy intensive dwelling type, due in large part to the energy consumption of shared services and common property such as hallway and car park lighting, ventilation and pool and heating pumps. A key challenge is to achieve the largest reduction in emissions for the least cost by encouraging energy efficient retrofits in apartment building common areas as well as within the apartments themselves. Making change within an apartment building’s owners corporation can be complex and each building is unique in its physical and human elements. Apartment residents, managers and owners need tailored assistance and long lead times to create change. High upfront costs and limited access to finance for retrofits can impede change, as well as overcoming a split incentive between property owners and tenants.”<sup>66</sup>
- ▶ **BOULDER** is one of the few cities that has mandated residential rental property energy standards. In 2011 the city launched the nation’s first residential rental property energy efficiency requirement in the U.S. Rental units represent approximately 50 percent of Boulder’s housing stock. This city required that every licensed rental property meet basic efficiency standards by 2018.
- ▶ **Housing Affordability**—Even as they tackle energy performance of buildings, many cities find they also need to address concerns about affordability, equity, and gentrification of neighborhoods.
- ▶ **SEATTLE’S** plan includes actions to support growth near high capacity transit without displacement, allow a greater diversity of housing types, and provide for the retention and creation of affordable family-sized housing and commercial space in transit communities through strategies such as expanded density and height bonuses, tax exemptions, joint development projects, and inclusionary zoning.
- ▶ **Enforcement Capacity**—As standards for buildings increase, cities need to increase investment in monitoring and enforcement.
- ▶ **The Need for—and Resistance to—Mandates**—Leading-edge cities anticipate that residential and commercial real estate markets probably will not choose or be incentivized to invest in energy efficiency at sufficient scale to meet the cities’ decarbonization goals. Thus, they expect that sooner or later more stringent policy mandates will be needed, but the local real estate/development sector naturally resists government mandates that will force investment and new behaviors.
- ▶ **Managing the Market’s “Metabolics”**—Cities have recognized that as they substantially increase energy efficiency requirements for existing buildings they need to align the mandates with the natural times when it is least disruptive to implement deep retrofitting: when a building is being sold or undergoing significant renovation, for instance.
- ▶ An analysis of **NEW YORK CITY’S** metabolics estimated that the volume of annual sales and renovations of the city’s residential and commercial buildings between 2015 and 2050, based on historic patterns, would be enough to ensure that “nearly all buildings” could be retrofitted under updated city energy conservation codes that would require high standards of energy performance.<sup>67</sup>

66 City of Melbourne, “Zero Net Emissions by 2020: 2014 Update,” 2014, p. 21.

67 Ed Mazria, “Achieving 80x50: Reducing Energy Use, Creating Jobs, and Phasing Out Carbon Emissions in New York City’s Buildings,” July 2015.

## Levers, Strategies and Actions for Transforming Energy Supply Systems

LEVERS	STRATEGIES	ACTIONS
Voluntary Action	Encourage Improved Energy Efficiency Performance of Existing Buildings	<ul style="list-style-type: none"> <li>• Conduct building energy performance challenges</li> <li>• Promote building energy rating systems (commercial and residential)</li> <li>• Promote voluntary energy use benchmarking programs</li> <li>• Promote voluntary “stretch” building energy conservation codes and green-building principles by providing information, technical assistance</li> <li>• Promote “cool roofs” — coating of rooftops white to reduce building energy use — and other low-cost approaches</li> <li>• Support best practice information sharing among building owners</li> </ul>
	Promote Energy Conservation Behaviors by Building Occupants/Tenants	<ul style="list-style-type: none"> <li>• Work with utilities to improve customer access to energy-use data</li> <li>• Conduct public education programs and campaigns that promote energy-saving measures</li> <li>• Promote green leasing for commercial buildings, which enable a fair proportion of costs/benefits to be allocated to both tenants and landlords</li> </ul>
Price Signals	Increase Access to Financing	<ul style="list-style-type: none"> <li>• Improve access to specialized financing to pay for efficiency improvements</li> </ul>
	Support/Provide Rewards for Performance	<ul style="list-style-type: none"> <li>• Provide regulatory and zoning relief for projects meeting certifiable high standards (e.g., LEED)</li> <li>• Promote supportive market mechanisms such as building appraisal and mortgage underwriting that capture the value of investments in energy efficiency</li> </ul>
	Subsidize Capacity Improvements for Building Management	<ul style="list-style-type: none"> <li>• Support efforts to train building operators in energy efficiency best practices</li> </ul>

	Expand capacity of efficient heating and cooling	<ul style="list-style-type: none"> <li>• Develop and expand low- to no-carbon district heating and cooling systems</li> <li>• City piloting of new building technologies</li> </ul>
	Invest in Technology Development and Deployment	<ul style="list-style-type: none"> <li>• Support Municipal Strategic Energy Management programs</li> </ul>
<b>Public Investment</b>	Model the Behavior- Invest in Energy Retrofitting of Government Buildings	<ul style="list-style-type: none"> <li>• Conduct deep retrofitting combined with installation of on-site renewable energy supply</li> <li>• Improve building operations and preventative maintenance</li> <li>• Improve energy efficiency of public/government-owned housing</li> <li>• Require all rehabilitation projects financed by city to include “green” capital needs assessment</li> </ul>
<b>Mandates</b>	Mandate Reporting	<ul style="list-style-type: none"> <li>• Adopt Building Energy and Reporting Disclosure ordinances</li> <li>• Require energy audits and disclosure</li> <li>• Require sub-metering</li> <li>• Require building rating system</li> </ul>
	Mandate No- to Low-Carbon Standards for New Construction	<ul style="list-style-type: none"> <li>• Adopt/phase-in building and energy conservation codes based on carbon neutral, zero net energy, Passive House, Living Buildings, and other cost-effective high-efficiency approaches</li> </ul>
	Mandate Performance Improvement of Existing Buildings	<ul style="list-style-type: none"> <li>• Require targeted buildings (e.g., commercial above certain amount of floor area) to benchmark (measure and disclose) energy performance, and/or conduct energy audits, and/or install energy sub-meters for large tenants</li> <li>• Require “deep” retrofitting of buildings at designated intervention points: time of sale/purchase, financing, major renovation of building or space, and rebuilding</li> <li>• Require upgrades to commercial/industrial buildings’ lighting systems</li> <li>• Require higher standards for energy efficiency of appliances</li> <li>• Require certification of building operators</li> </ul>

## Resources

<b>Climate Action Plan Building Energy TAG Preliminary Recommendations 2012</b>	Seattle	Includes recommendations to reduce greenhouse gas emissions in the building sector.
<b>A common definition of Net Zero Buildings</b>	U.S. Department of Energy	Generally speaking, a zero energy building produces enough renewable energy to meet its own annual energy consumption requirements, thereby reducing the use of non-renewable energy in the building sector. This definition also applies to campuses, portfolios, and communities. In addition to providing clarity across the industry, this publication provides guidelines for measurement and implementation, specifically explaining how to utilize this definition for building projects.
<b>Analysis of the Chinese Market for Building Energy Efficiency</b>	Pacific Northwest National Laboratory (PNNL)	Assesses the impact of China's policies on building energy efficiency and on the market for energy efficiency in the future. By examining the existing literature and interviewing stakeholders from the public, academic, and private sectors, the report seeks to offer an in-depth insights of the opportunities and barriers for major market segments related to building energy efficiency.
<b>Green Building City Market Brief</b>	C40	Addresses a critical issue facing mayors in cities around the world: building energy use is a leading contributor to urban and global greenhouse gas (GHG) emissions.
<b>State and Local Energy Policy</b>	American Council for an Energy Efficient Economy (ACEEE)	ACEEE's State and Local Policy Database includes comprehensive information on energy efficiency policies currently implemented at the state and local level. The database tracks policy activity across multiple sectors, including government, utilities, transportation, buildings, combined heat and power, and appliance standards.
<b>Urban Energy Efficiency Key to Mexico's Ambitious Goals for Energy and Low Carbon Growth</b>	World Bank	SENER, Mexico's Ministry of Energy, is rolling out a national municipal energy efficiency program with the help of the World Bank. The program will work with city institutions to systematically integrate energy efficiency into policymaking, investment decisions, and procurement at the local level.

<p><b>Applying Sustainable Building Strategies</b></p>	<p>National Resource Defense Council</p>	<p>Brief descriptions of a wide range of building strategies, grouped according to the five areas of sustainability: site, water, energy and atmosphere, materials and resources, and indoor environmental quality.</p>
<p><b>ACHIEVING 80x50, Reducing Energy Use, Creating Jobs, 50 and Phasing Out Carbon Emissions in New York City's Buildings</b></p>	<p>By Edward Mazria for Architecture 2030</p>	<p>Renovating New York City's buildings to high-performance standards when they change hands is crucial to the City reaching its ambitious goal of an 80% reduction in greenhouse gas emissions by 2050.</p> <p>New York City contains about one million buildings comprising 5.75 billion square feet of building stock. Its buildings are responsible for 71% of the city's greenhouse gas emissions (GHG) and 94% of its electricity consumption.</p> <p>While requiring new buildings to become more efficient and renovating city-owned buildings are both important, in order to meet the city's greenhouse gas emissions reduction target by the year 2050, most of the city's existing building stock must also be renovated to high-performance standards over the next 35 years.</p>
<p><b>Building With Nature</b></p>	<p>EcoShape</p>	<p>Where possible, strive to make use of natural processes, creating integrated building solutions that are flexible, safeguard our economy, boost our ecology, and are cost effective and sustainable.</p>
<p><b>Local Energy Efficiency Policy</b></p>	<p>American Council for an Energy Efficient Economy (ACEEE)</p>	<p>The responsibilities of local governments give them large influence over energy use in their communities through land use and zoning, building requirements, property taxes and transfers, transportation investment decisions, economic and workforce development, and, in many cases, the provision of services such as water and electricity</p>
<p><b>Transforming Cities: IMT Resources for Local Governments and Allies</b></p>	<p>Institute for Market Transformation (IMT)</p>	<p>Buildings account for more than 40% of the total energy consumption in the U.S., and addressing their energy use is key to reaching a city's carbon reduction targets. IMT helps cities engage their building owners, managers, tenants and finance stakeholders in all areas of building efficiency to reduce carbon emissions and bolster local development.</p>
<p><b>Achieving 50% Energy Savings in Office Buildings</b></p>	<p>U.S. Department of Energy: Energy Efficiency &amp; Renewable Energy</p>	<p>Summarizes recommendations for designing new office buildings that result in 50% less energy use than conventional designs meeting minimum code requirements. This fact sheet provides key principles and a set of prescriptive design recommendations appropriate for smaller office buildings with insufficient budgets to fully implement best practices for integrated design and optimized performance.</p>

<p><b>ACUPCC Energy Performance Contracting (EPC) Best Practices Toolkit</b></p>	<p>American College &amp; University Presidents' Climate Commitment (ACUPCC)</p>	<p>A best practices toolkit as a resource for signatories interested in learning about and conducting an EPC. This toolkit is intended to support a school's internal project team throughout the EPC process, from early stage opportunity assessment to contract negotiation, implementation, and beyond.</p>
<p>Deep Energy Retrofits: An Emerging Opportunity</p>	<p>American Institute of Architects and The Rocky Mountain Institute</p>	<p>Besides introducing architects to the retrofit market, the guide explains how energy efficiency–related skills such as energy modeling are integrated into the project delivery process of a deep energy retrofit, providing architects with the resources they will need to begin acquiring these specialized skills. Additionally, the guide acquaints architects with basic financial knowledge, including available incentives and financing methods that they can use to help clients access capital for retrofits.</p>
<p><b>United States Building Energy Efficiency Retrofits</b></p>	<p>The Rockefeller Foundation</p>	<p>Upgrading and replacing energy-consuming equipment in buildings offers an important capital investment opportunity, with the potential for significant economic, climate, and employment impacts. The potential employment and climate benefits presented by energy efficiency retrofits have led to the production of this research report.</p>



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**TRANSFORMING  
TRANSPORTATION  
SYSTEMS**

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Transportation is usually one of the city's top two carbon-emitting systems.

A city's transportation system moves people and goods throughout the city, and into and out of a city from nearby and distant places. In almost every city the dominant mode of mobility is fossil-fuel vehicles, and transportation usually is one of the city's top two carbon-emitting systems. In most major cities, the streetscapes, networks of roads, and parking and fueling infrastructures—the overall urban form—have been designed to promote and respond to the needs of cars and trucks at a massive scale. Public transit also contributes to carbon emissions, because fossil fuels are often the energy source for buses and trains or because electricity used to power transit systems is produced from fossil fuels. Finally, city government vehicle fleets and private taxi fleets licensed by cities, while usually just a small portion of a city's total mobility, are another important source of carbon emissions.

Transportation systems include many mobility modes:

### MODES OF MOBILITY

TRANSIT SERVICE	WALKING AND BIKING	DRIVING AND PARKING
<ul style="list-style-type: none"> <li>• Bus</li> <li>• Subway</li> <li>• Trolley bus</li> <li>• Light rail</li> <li>• Para-transit (non-fixed route)</li> <li>• Heavy rail</li> <li>• Regional bus</li> <li>• Ferry</li> <li>• Streetcar</li> <li>• Cable car</li> </ul>	<ul style="list-style-type: none"> <li>• Private bicycles</li> <li>• Bike sharing</li> <li>• Pedestrian access</li> </ul>	<ul style="list-style-type: none"> <li>• Commercial:</li> <li>• Taxi</li> <li>• Car sharing</li> <li>• Ride sharing</li> <li>• Private automobiles</li> <li>• Commercial/freight fleets</li> <li>• Emergency responders</li> <li>• Public &amp; private parking</li> </ul>

Cities may have extensive roles to play in the transportation system, including:

- ▶ Operating transit services
- ▶ Designing and planning transportation modal networks, providing long-range forecast analysis of fleets, facilities, and right of way infrastructure
- ▶ Regulating commercial vehicles and parking
- ▶ Partnering with regional transit operators & agencies
- ▶ Building and maintaining city-owned public rights-of-way and infrastructure, including streets, sidewalks, and public spaces
- ▶ Guiding development on private property through land use and urban design policies and guidelines

- ▶ Managing how streets are used through rules, regulations, and pricing
- ▶ Educating and empowering citizens to make sustainable transportation choices

Importantly, a city’s transportation system is closely linked to city land use decisions; the two interact with and impact each other. The linkage occurs in five categories:

### The “5 D’s of Transportation and Land Use”<sup>68</sup>

<b>Destinations</b>	Locating major destinations and centers at rapid transit stations or along corridors makes them easy to serve efficiently by frequent transit
<b>Distance</b>	A well-connected, fine-grained pedestrian network enables shorter, more direct walking and biking connections and is easier to serve cost-effectively with transit
<b>Density</b>	Higher levels of residential and employment density support more local amenities within walking and cycling distance, and justify high levels of transit service
<b>Diversity</b>	A diverse mix of land uses and housing types makes it easier to live, work, shop, and play without having to travel far
<b>Design</b>	Well-designed buildings and public realms create places that feel interesting and safe to walk or cycle

When transportation systems pursue carbon emission reductions, they see potential co-benefits from various strategies, including encouraging healthy lifestyles; supporting vibrant public spaces that encourage a culture of walking, cycling, and social interaction; and increased economic development and services located around public transit stations.

68 Robert, Cervero, “5 Ds of Urban Development & Rapid Transit Performance.”

- ▶ **SEATTLE’S** plan calls for residents to “meet many of their daily needs by walking, bicycling, or riding transit also benefit from lower overall household costs, improved health, thriving local business districts, and increased opportunities for housing and jobs.”<sup>69</sup>

The International Energy Agency described the characteristic of four types of urban transportation systems, which may reflect differences between cities.

### Different Types of Urban Transportation Systems

<b>Developing</b>	Developing cities are experiencing increased demand for transport services and rapid growth in private motorization. They frequently have relatively low densities, inadequate travel infrastructure and are often characterized by weak public transit services (e.g. unregulated, poor quality bus operators).
<b>Sprawling</b>	Sprawling cities tend to have low densities and high urban and suburban sprawl. They often have weakly-defined urban cores with commercial and business hubs spread intermittently throughout the urban and metropolitan areas.
<b>Congested</b>	Congested cities often experience heavy roadway traffic, especially during peak travel hours. They generally have medium to high densities and strong urban cores, although urban sprawl may exist in surrounding metropolitan areas.
<b>Multi-Modal</b>	Multi-modal cities have high densities, strong urban cores, and high public transit and non-modal transport shares. Multi-modal cities generally have strongly interconnected, well-developed travel networks, which facilitate and encourage more efficient travel.

69 Seattle CAP p16

Although the specifics of control of transportation systems vary among cities, it is not unusual for control to be distributed among multiple city government agencies, state/province and national government agencies, as well as private companies and nonprofit organizations. For instance, a 2013 analysis of transportation in **BOSTON** found control spread among four city agencies, five state agencies, and about a dozen private or nonprofit entities — each with different responsibilities. Cities especially lack much control over the marketplace for cars and trucks and the degree to which energy efficiency and renewable energy fuels are used. These markets are controlled mainly at the national level, although cities may play important roles in supporting market change, for instance by building local infrastructure for electric vehicles.

- ▶ **VANCOUVER** described its sphere of control over transportation: “The City has a number of ways in which we can influence travel behaviour and effect change in transportation. Transportation is complex, as issues often extend beyond municipal or even regional boundaries, and many players are involved through overlapping jurisdictions. Some things are largely within the City’s control, like our public rights-of-way, street infrastructure, land use, and much of the built environment. Other things fall under regional, provincial, or federal jurisdiction — like transit, ports, and regional infrastructure planning. In this latter case, the City is a partner, stakeholder, and advocate for local transportation issues.”
- ▶ **YOKOHAMA** formulated its “eco-mobility” program with an eye toward creating a low-carbon city, prioritizing the use of public transportation, making walking and bicycling accessible and enjoyable, advancing the commercialization of low-carbon, “next-generation” transportation, providing information about alternatives at transport nodes, providing attractive transport modes for tourists (such as LRT and articulated buses), and introducing emerging mobility technologies amphibious bus and water transportation.

## Prevailing Transportation System Conditions

- ▶ **Vehicles Rule** — The system’s most notable relevant feature is the dominance of private vehicles (car/trucks) as the preferred mobility mode over public transit and other modes.
- ▶ **Congestion** — Many cities’ streets and roads are chronically congested, creating other problems for the cities.
  - **SYDNEY:** “Major public transport routes are at capacity and it can be difficult to move efficiently around the City. Congestion inhibits economic development and private vehicle use is a major source of green house emissions. Buses and taxis are impacted by congestion and make pedestrian movement and cycling unpleasant and sometimes dangerous.”<sup>70</sup>
- ▶ **System Drivers.** There are a number of hard-to-manage drivers for the design and operation of urban transportation systems:

<b>Population &amp; Economic Activity</b>	Increases/decreases in population and jobs drive increases/decreases in transportation use.
<b>Demographics</b>	Age of population drives needs/preferences for transportation and accessibility, security, comfort issues. E.g., a growing percentage of the urban population is elderly; the percentage of 16-24 year olds who have driver’s licenses has been declining.
<b>Smart Technology</b>	Various technology applications — to integrate mobility choices, control efficiency of vehicle travel, etc. — are maturing for widespread use.

<sup>70</sup> City of Sydney, “Sustainable Sydney 2030: The Vision,” p. 44.

<p><b>Inter-government Funding Levels</b></p>	<p>A pattern of decline in national and state/province government funding increases the importance of regional and local funding, new funding sources and funding partnerships. This is particularly important when it comes to funding expansion of transit options.</p>
<p><b>System “Legacies”</b></p>	<p>The design and condition of system assets drives the need for major overhaul and investment. E.g., making existing fleets more family-friendly; inefficient parking systems create congestion and slower transit speeds.</p>

- ▶ **Misaligned Policies** — There tends to be a lack of policy alignment at the municipal, metropolitan, state/province, regional, and national government levels about goals for the transportation system, with cities exercising a fairly small amount of independent control over assets and operations.
- ▶ **The Potential in Freight** — In many cities the degree to which freight—the movement of goods—contributes to carbon emissions is not well understood, nor is the degree to which cities can change patterns of freight movement.
- ▶ **STOCKHOLM’S** analysis concluded that transportation of goods “accounts for approximately 35 percent of greenhouse gas emissions from road traffic in Stockholm. A rise in population will lead to greater needs, not only for goods to be brought into the city, but for the proportionately larger amounts of waste they generate to subsequently be driven away. Emissions resulting from the distribution of goods can be reduced by 20-25 percent. There is great potential to make goods distribution more efficient, first and foremost by increasing the coordination of deliveries and optimising delivery routes and times.”<sup>71</sup>

71 City of Stockholm, “Roadmap to a Fossil-Fuel Free Stockholm 2050,” March 2014, p. 9.

- ▶ **Broad Set of Goals/Priorities** — Most transportation systems embrace a set of goals beyond carbon-emissions reduction, including:
  - Increasing the use of public transit
  - Improving the performance of public transit (affordability, service delivery efficiency, customer satisfaction)
  - Increasing the efficiency of service delivery
  - Increasing the satisfaction of transit customers
  - Increasing safety
  - Reducing noise and waste
  - Improving the use of parking
  - Improving the system’s financial sustainability
- ▶ **Chronic Financial Deficits** — Public transit systems historically operate with deficits, deferred maintenance, and insufficient capital investment. As a result, they may not offer an attractive and competitive mobility choice and are subject to political and budgetary ups and downs.
- ▶ **Unconnected, Underserved Neighborhoods** — **PORTLAND** has done extensive analysis of the “completeness” of its neighborhoods when it comes to various factors including transportation. “Portland’s land use plan calls for growth to be concentrated in a network of centers and corridors of different sizes, serving multiple neighborhoods. These ‘healthy connected neighborhoods’ are places that support the health and well-being of residents. In these neighborhoods, people of all ages and abilities have safe and convenient access to more of the goods and services needed in daily life—grocery stores, schools, libraries, parks and gathering places—reachable on foot or by bike.... They are well-connected to jobs and the rest of the city by transit. They have a variety of housing types and prices so households of different sizes and incomes have more options.” The city’s analysis found that “40 percent of Portlanders do not have safe and convenient access to transit, commercial services, jobs, or in many areas, even sidewalks. This is especially critical in East Portland, which is home to many low-income households and a large youth population.”<sup>72</sup>

72 City of Portland, “Climate Action Plan,” June 2015, p. 72.

## Vision for Redesigned Transportation Systems

- Radically Different Mode Share
- An Array of Affordable, Accessible Mobility Choices
- Market Dominance of Clean Technologies and Fuels
- Complete, Connected, Regionalized Mobility System
- Alternative Urban Form

### Some Portland neighborhoods are more complete than others

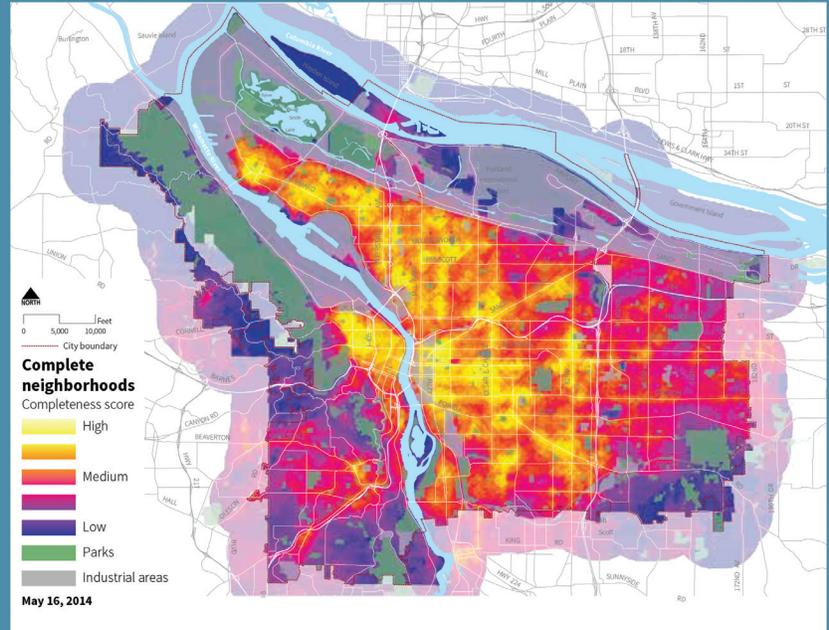


Figure 29. Complete neighborhoods. Source: Portland Bureau of Planning and Sustainability

The City developed the 20-minute neighborhood index to measure access to community amenities, products and services. The areas shown in yellow have the highest levels of access to services and amenities. The areas shown in purple have the lowest levels of access.

Source: City of Portland, "Climate Action Plan," June 2015, p. 20.

## Vision for Redesigned Transportation Systems

- ▶ **Radically Different Mode Share**—Up to 66-75 percent of all trips in the city will be by walking, bicycling, or public transit. Leading-edge cities set ambitious targets for mode shift:
  - ▶ **COPENHAGEN:** By 2025, 75 percent of all journeys in city will be on foot, by bicycle, or public transit.
    - **VANCOUVER:** By 2040, two-thirds of all trips on foot, bicycle, or public transit.
    - **BOSTON:** By 2030, increase walking, bike and transit trip share to 66 percent.
- ▶ **An Array of Affordable, Accessible Mobility Choices**
  - **SAN FRANCISCO:** "Expanding transit, walking, and bicycling infrastructure and services to provide effective choices for getting around."

- **SYDNEY:** “A sustainable and integrated transport network requires planning for the right mode of transport in the right place with easy transfer and suitable, accessible pricing.”<sup>73</sup>
  - **BOSTON:** “Provides users with real transportation choices that are affordable, connected, safe and convenient.”
  - **COPENHAGEN** emphasized time-saving and convenience.<sup>74</sup>
  - **OSLO** makes it much more convenient to drive, park and fuel an electric vehicle than a conventional one. The city’s policies complement policies at the national level that exempt e-cars from vehicle taxes that average more than \$12,000 per car.
- **Market Dominance of Clean Technologies and Fuels**
- **COPENHAGEN:** 20-30% of all light vehicles and 30-40% of all heavy vehicles will use “new fuels” (electricity, hydrogen, biogas, bioethanol)
  - **SAN FRANCISCO:** “Green, Clean, and Quiet Mobility—Use the greenest, most efficient, and quietest technologies available.”
- **Complete, Connected, Regionalized Mobility System**
- **VANCOUVER:** “Linking key destinations throughout the region, with convenient and attractive connections between lines.”
  - **BOSTON:** “Allows everyone to have equitable access to a region’s important goods, services and destinations.”
  - **COPENHAGEN**, which set a goal of 50 percent of trips made by bicycle: “Cycling infrastructure is central to urban planning and design.” This requires “investments in dedicated, uninterrupted cycle lanes” and “easy transfer to public transport services.”
- **Alternative Urban Form**—Cities will have transitioned to a prevailing “urban form”—walkable, transit-connected, and affordable neighborhoods—that leverages density and livability.
- **SAN FRANCISCO:** “Complete and Green Streets—Streets are designed and managed to be attractive, inviting public spaces for people.”
- **SEATTLE:** “Meeting the growing demand for conveniently located homes and businesses in walkable neighborhoods with a variety of recreation and service opportunities.”
  - **BERLIN:** “A significant amount of traffic can be successfully avoided if future urban development is consequently oriented towards the Leitbild of a ‘city of short distances’. Berlin’s polycentric city structure is a very good starting point for this. Furthermore, newly developed urban logistics concepts offer ways of avoiding the transportation of goods.”<sup>75</sup>

## Barriers to Transportation System Change

Obstacles to transforming transportation systems include:

- **Lack of Jurisdictional Authority**—Most cities do not have jurisdictional control over transit systems and funding sources; these are most often controlled at the regional and/or national level.
- **Slowness of Change in Vehicles Market**—In many cities there are persistent cultural norms about the importance and value of car ownership and driving. At the same time, fossil-fuel vehicles continue to enjoy a sales price advantage over alternative-fuel vehicles, which have limited driving range, and the infrastructure of alternative-fuel vehicles is only just beginning to be built within some cities.
  - **STOCKHOLM:** “Despite a large proportion of ‘clean’ vehicles, more than 90 percent of vehicles on the road today run on fossil fuels. It is, however, technically possible to replace these fuels with biofuels.”
- **“Stranded” Transit Assets**—Public transit equipment and infrastructure are huge investments, both in terms of equipment, such as buses, streetcars and subway trains, and infrastructure, such as train/subway stations, overhead or underground power lines, etc. Once a city makes such purchases, it is difficult to suggest strategies that do not take advantage of such sunk costs.
- **Deferred Maintenance Costs**—Similarly, the planning process for addressing deferred maintenance on

73 City of Sydney, “Sustainable Sydney 2030: The Vision,” p. 44.

74 City of Copenhagen, “Copenhagen: Solutions for Sustainable Cities,” p. 11.

75 City of Berlin, “Climate-Neutrality Berlin 2050: Results of a Feasibility Study,” March 2014, p. 13.

broken transit equipment and infrastructure is often backlogged for several years.

- ▶ **Political Influence** — The automobile/fossil fuel/road building industries have substantial political influence.
- ▶ **Traditional Government Funding Formulas** — In much of the world, government funding formulas typically favor roads over public transit, while fuel subsidies mask the true costs of travel choices.
- ▶ **Analytic Gaps** — The lack of life-cycle cost analysis for transportation system investments tends to favor road-related investments.
- ▶ **Automobile-Driven City Form** — City land use plans and regulations historically have been skewed toward accommodating vehicle/truck movement and parking.
- ▶ **Weak Government Standards** — There is a lack of transportation system-level commitments and binding government standards to reduction of GHG emissions — partly because of the newness of the carbon reduction imperative, competing goals and priorities of the system, and political resistance within the system.

▶ **Concerns About Alternative Mobility Modes** — A barrier to increasing the use of bicycles, for instance, can be concerns about safety when riding in the city’s streets.

- **COPENHAGEN:** “The goal is to create a network of bicycle lanes throughout Copenhagen. This will reduce traveling time and increase safety for their cyclists. Safety, convenience, comfort, timesaving and livability are the keywords in designing a city where cycling is the norm. More and broader bicycle lanes, improved design of intersections and behavioral campaigns are the means of achieving a safer city for the cyclists. With those types of initiatives, Copenhagen wishes to achieve a rise in the proportion of inhabitants feeling safe while biking (from 67% in 2010 to 80% in 2015 and further to 90% in 2025).”<sup>76</sup>

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<sup>76</sup> City of Copenhagen, “Copenhagen: Solutions for Sustainable Cities,” p. 8.

## Levers, Strategies and Actions for Transforming Transportation Systems

LEVER	STRATEGIES	ACTIONS
Voluntary Action	Promote Non-Vehicle Modes of Transportation	<ul style="list-style-type: none"> <li>• Promote the recreational and health benefits of bicycling and walking</li> <li>• Promote household financial benefits (disposable income) of reduced reliance on automobile</li> <li>• Promote tele-working as an alternative to commuting</li> <li>• Promote car pooling and High Occupancy Vehicle lanes</li> <li>• Partner with employers to encourage employee commuting using public transit, biking, or walking</li> </ul>
	Promote New Mobility Technologies and Business Models	<ul style="list-style-type: none"> <li>• Support pilots and address regulatory barriers for on-demand busing, shared use mobility, driverless vehicles, etc.</li> <li>• Support on-demand parking software</li> <li>• Implement smart-transit systems to provide up to the minute transit/parking/travel information to residents</li> <li>• Encourage private investment in street cars, highways, shared use systems</li> </ul>
Price Signals	Increase the Cost of Using Fossil-Fuel Vehicles  Reduce the Cost of Carbon-Free Vehicles	<ul style="list-style-type: none"> <li>• Establish congestion/climate taxes on fossil-fuel vehicles in designated areas</li> <li>• Establish taxes/fees on fossil-fuel vehicles (at purchase and/or registration)</li> <li>• Set taxes on gasoline/petroleum purchase (can be done on VMT basis)</li> </ul>
	Increase the Cost of Driving in Certain Places	<ul style="list-style-type: none"> <li>• Institute new parking pricing models (performance-based parking, off-street parking tax, dynamic pricing, etc.)</li> <li>• Establish regional road pricing (toll roads, dynamic pricing)</li> <li>• Promote automobile insurance options that reward drivers for driving less</li> <li>• Tax off-street parking</li> </ul>

<b>Public Investments</b>	Invest in Decarbonizing Public Transit	<ul style="list-style-type: none"> <li>• Convert public transit, government fleets, and taxi fleets to no-to low-carbon energy (electric, hybrid, natural gas, hydrogen)</li> </ul>
	Invest in Increasing Non-Vehicle Share of Mobility	<ul style="list-style-type: none"> <li>• Invest in public transit capacity (modernization, expansion), choices (e.g., streetcars, light rail lines), reliability, speed, accessibility, convenience, way-finding, and reduced waiting times</li> <li>• Convert bus lines into high-capacity transit lines</li> <li>• Expand rapid transit for job centers</li> <li>• Invest in bicycle sharing programs and public bicycle parking (coupled with requirements for buildings to provide bicycle space)</li> <li>• Invest in infrastructure for low- to no-carbon mobility: electric vehicle charging, hydrogen, fuel cell infrastructure (including incentives for real estate owners to install charging stations)</li> <li>• Support shift of freight transportation from road to rail and ship</li> </ul>
	Invest in Redesigned Urban Form/Density to Promote Less Use of Vehicles	<ul style="list-style-type: none"> <li>• Develop bicycle/walking infrastructure (citywide network)</li> <li>• Develop “complete”/green streets, walkable neighborhoods, and complete/green public spaces</li> <li>• Use transit-oriented development (TOD) planning and investments to increase neighborhood density and use of public transit</li> <li>• Develop an integrated, multi-modal mobility system at regional scale</li> <li>• Redesign parking system regulations and infrastructure (e.g., eliminate/reduce parking spaces in high density/traffic areas)</li> <li>• Redesign goods movement in city</li> </ul>
<b>Mandates</b>	Mandate Vehicle Fuel Efficiency	<ul style="list-style-type: none"> <li>• Establish reduced idling ordinances</li> <li>• Increase fuel efficiency targets for vehicle producers</li> </ul>

## Resources

<b>Good, Better, Best 2011-2025</b>	Copenhagen	Copenhagen's Bicycle Strategy, which promotes a better cycling city and further helps Copenhagen achieve their carbon dioxide neutral goal by 2025
<b>Action Plan for Green Mobility</b>	Copenhagen	Includes 25 initiatives that encourage extending public transportation, becoming the world's best cycling city, reducing traffic and providing more urban development areas in Copenhagen.
<b>SFMTA Strategic Plan 2013-2018</b>	San Francisco	The SFMTA Strategic Plan includes future goals to create safer transportation, make walking, bicycling, taxi ridesharing and carsharing the preferred means of transportation and improve the environment and quality of life in San Francisco.
<b>Seattle Transit Master Plan</b>	Seattle	
<b>Energy and Transportation in the U.S</b>	Marc Ross	This is a concise overview of transportation energy use in the U.S. The paper includes an analysis of the historical changes in energy intensity by transportation mode.
<b>Millennials in Motion</b>	U.S. PIRG Education Fund	Now is the time for the nation's transportation policies to acknowledge, accommodate and support Millennials' demands for a greater array of transportation choices.
<b>Pew Says Us Can Reduce Transportation GHGs By 65% By 2050</b>	International Society of Sustainability Professionals	The report by the Pew Center on Global Climate Change lays out three plausible scenarios of actions that could significantly reduce the carbon footprint of the transportation sector, which is responsible for more than a quarter of U.S. GHG emissions."
<b>Quality of Life, Equality of Place</b>	CNT and Open Communities	Rail transit anchors downtowns and neighborhoods in communities throughout Chicago's northern suburbs and across the region, but many of these communities are falling behind in creating mixed-income transit-oriented development. This guidebook offers case studies, policy recommendations, and public participation tools to help suburbs build affordable, accessible housing around transit.

<b>Transportation and Global Climate Change</b>	Edited by Danilo Santini and David Greene, Argonne & Oak Ridge National Laboratories	The book attempts to put the problem of the U.S. transportation system into perspective among worldwide systems. In addition, the effects of engine technology improvements, fuel choice and production, vehicle design, commercial transportation requirements, transportation choices by consumers, and government policies are examined.
<b>What Cities Can Do to Increase the Use of Alternative Transportation</b>	Maxwell Young	100 Resilient Cities received ~ 125 responses from 26 countries, offering ideas (10 themes) on how cities can better encourage alternate transportation.
<b>Interactive Transit Tools</b>	Center for Neighborhood Technologies (CNT)	CNT Tools: research tools to help planners, developers, and community leaders make smart, data-driven decisions.
<b>Planning and Design for Sustainable Urban Mobility: Global Report on Human Settlements 2013</b>	UN-Habitat	This new report of the United Nations Human Settlements Programme (UN-Habitat), the world's leading authority on urban issues, provides some thought-provoking insights and policy recommendations on how to plan and design sustainable urban mobility systems.
<b>Strategising sustainable urban mobility in EU Neighbour Countries</b>	ICLEI – Local Government for Sustainability	This report intends to be an initial exposure for local governments (LGs) to the subject of sustainable mobility: an introductory urban sustainable mobility guide for LGs.
<b>Changing Habits for Urban Mobility Solutions (CHUMS)</b>	European mission – Intelligent Energy Europe	The aim of the project is to apply a composite CHUMS behavioral change campaigns in 5 'champion' cities that represent the scale of carpooling and the diversity of mobility mind-sets in Europe: Craiova (RO), Edinburgh (UK), Leuven (B), Toulouse (F) and Perugia (IT).
<b>Impact of Carpooling on Fuel Saving in Urban Transportation: Case Study of Tehran</b>	Seyedehsan Seyedabrishamia, Amirreza Mamdoohia, Ali Barzegarb, Sajjad Hasanpourb (Procedia-Social and Behavioral Science)	In this paper, the factors which persuade travellers to choose carpooling are investigated for Tehran city, capital of Iran. Considering the data, carpooling impacts are analyzed in different situations. The results show that if appropriate strategies like carpooling websites are designed to help travellers for identifying appropriate rideshares, carpooling would increase by 30 percent and this increase will reduce annual fuel consumption about 240 million litres. Results also show that high occupancy vehicle lanes (HOV) that reduce travel time for ridesharing may not highly influence on carpooling tendency of travellers.

<p><b>Innovative Transportation Index</b></p>	<p>U.S. PIRG Education Fund</p>	<p>This report reviews the availability of 11 technology-enabled transportation services—including online ridesourcing, carsharing, ridesharing, taxi hailing, static and real-time transit information, multi-modal apps, and virtual transit ticketing—in 70 U.S. cities. It finds that residents of 19 cities, with a combined population of nearly 28 million people, have access to eight or more of these services.</p>
<p><b>Parking Management for Smart Growth</b></p>	<p>Richard W. Wilson</p>	<p>This book offers a set of tools and a method for strategic parking management, so that communities can better use parking resources and avoid overbuilding parking.</p>
<p><b>Parking Solutions</b></p>	<p>American Planning Association</p>	<p>This PAS Essential Info Packet provides articles and reports on the background, importance, and range of parking strategies available to planners.</p>
<p><b>Peer to Peer Car Sharing Study</b></p>	<p>Ingrid Ballús-Armet, Susan A. Shaheen, Kelly Clonts, and David Weinzimmer</p>	<p>Exploring Public Perception and Market Characteristics in the San Francisco Bay area, California</p>
<p><b>Public Bike Sharing in North America</b></p>	<p>Mineta Transportation Institute</p>	<p>Evaluates public bikesharing in North America, reviewing the change in travel behavior exhibited by members of different programs in the context of their business models and operational environment.</p>
<p><b>Sustainable Railway Futures: Issues and Challenges</b></p>	<p>Becky P.Y. Loo, Claude Comtois</p>	<p>This in-depth overview places the importance of railways in the wider context of comprehensive sustainability, which encompasses sustainable development, social and economic equity and community livability. This book offers the latest research insights on the renewed interest about railway expansions and their wide-ranging environmental, socio-economic and even political implications.</p>



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**TRANSFORMING  
SOLID WASTE  
SYSTEMS**

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A city's solid waste system directly produces carbon emissions in several ways. When compostable materials like food scraps and yard trimming that are sent to landfills produce methane, a greenhouse gas that has a much greater global warming effect than carbon dioxide. Fossil fuel vehicles hauling waste produce carbon emissions. Waste-to-energy facilities also produce these emissions. In some cities, large-scale wastewater treatment facilities and processes also produce large amounts of carbon emissions. In addition, there is the "opportunity cost" of materials that, instead of being reused or recycled, are sent to the landfill for disposal. Reuse and recycling reduces the amount of new material needed to make new products and the resulting emissions from new products production processes. An analysis by **NEW YORK CITY** found that landfill methane was responsible for 89 percent of the city's solid waste emissions, with emissions from waste-to-energy processing accounting for 6 percent, and the remainder from transporting waste.

Solid waste systems typically make up a small fraction of a city's carbon emissions profile. **NEW YORK CITY** estimated that methane emissions released from its landfilled waste added up to 4 percent of the city's total. But waste systems shouldn't be ignored because, given the difficulties of carbon reduction, "every bit counts" and because a great deal is understood about how to reduce emissions from solid waste systems. In **BERLIN**, for instance, planned reduction of solid waste system emissions amounted to about 25 percent of all reductions targeted for the decade from 2010 to 2020.<sup>77</sup>

In many leading edge cities the approach to solid waste system transformation starts with the goal of getting to "zero waste." Zero waste means that no material goes to landfill or high-temperature destruction. Instead, cities design their solid waste systems to prevent waste, reduce and reuse materials, recycle and compost, and recover energy in ways that do not release carbon emissions. In many ways, zero waste is part of a broader "sustainable consumption" approach. It is not just a matter of what is done with materials, but also of the design and packaging of products to minimize waste. It also involves affecting "upstream" purchasing decisions — consuming less, consuming smartly and influencing producers to produce less non-recyclable, non-compostable goods and packaging — because this can make a difference to downstream emissions. As **PORTLAND** reported from its analysis of how consumption generates carbon emissions: "The things we buy matter. Over one-third of local consumption-based carbon emissions come from the food and goods that we purchase."

In general, a city's solid waste system collects waste and then sends it to one of four types of destinations to be processed: recycling facility, organic waste processing facility, waste-to-energy facility, or landfill. **OSLO'S** Waste to Energy Agency describes its system as a cycle-based waste management cycle: "This first entails minimizing the amount of waste, then maximizing the amount of re-used waste, and at last recycle waste types such as food, plastic packaging,

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"Zero waste" systems prevent waste, reduce consumption, reuse materials, recycle and compost, and recover energy in non-GHG emitting ways.

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77 Berlin Senate Department for Urban Development and the Environment, "Municipal waste management in Berlin," 2013, p. 22.

and paper. The combustible residual waste is recycled to energy in form of district heating and electricity. The ash from this process is transported for metal recycling before what is left is used for landfill cover.”

Progressing toward and achieving zero waste has additional benefits for cities. For example, composting food waste creates natural fertilizer to help grow fruits and vegetables at local farms. Biogas, an alternative fuel, is also produced from waste (and in OSLO is used as fuel for buses). Recycling saves city residents and businesses money and creates local green jobs.

### Variations that Affect Cities’ Solid Waste Transformation

<p><b>Levels of Consumption and Waste Production</b></p>	<ul style="list-style-type: none"> <li>• Existence of a culture of “re-use/recycle” versus a culture of “throw it away”</li> <li>• In its “Pathways to Deep Carbon Reductions” document New York City noted “The wealthier a city, the more its residents tend to consume, and the less they tend to reuse.”</li> </ul>
<p><b>Waste Disposal Legacies</b></p>	<ul style="list-style-type: none"> <li>• Degree of landfilling, incineration, and other disposal</li> <li>• Exporting and importing of solid waste</li> </ul>
<p><b>Recycling Markets</b></p>	<ul style="list-style-type: none"> <li>• Existence of strong markets for recyclables</li> <li>• Degree to which market process cover cost of collecting and transporting recyclables</li> </ul>
<p><b>Regulatory Framework</b></p>	<ul style="list-style-type: none"> <li>• Mandates by other levels of government for waste prevention and recovery</li> </ul>

## Solid Waste System Conditions

- ▶ **A Blend of Regulation and Technologies**— Waste management is a blend of public regulation, mix of technologies, assets, services, and fees along with commercial, market-driven services. This “infrastructure” has many elements: local transport—from trucks to transfer stations and disposal sites for different waste streams (e.g., commodities, C&D, organics).
- ▶ **Prevailing Solid Waste Management Model**— As landfilling starts to become an unacceptable option, cities are turning to a management hierarchy that starts with waste reduction, emphasizing recycling and energy recovery. Recycling typically costs less than landfilling, and, as in the case of paper and other waste streams in many markets, may generate revenue.
- ▶ **Enormous Waste Management Operations**— Waste management in **NEW YORK CITY** costs about \$1 billion annually—\$700 million to collect waste and \$300 million to export it to landfills.
- ▶ **BERLIN’S** management operation, Berliner Stadtreinigungsbetriebe (BSR), “is one of the largest waste management companies in Europe. It has around 5,300 employees and a fleet of some 1,600 vehicles... In 2012, BSR collected and disposed of more than 1 million tonnes of waste... The waste collection and disposal in Berlin is organised from four BSR depots. Operating some 194 trips every day for residual waste collection and 42 ‘BIOGUT’ trips (collection of organic waste), BSR collects some 820,000 tonnes of residual waste annually and more than 62,000 tonnes of biodegradable waste from households and businesses... In addition, BSR operates 15 recycling yards in the city with 6 collection points for harmful substances, collecting 20 recyclable substances and 30 harmful substances. Here members of the public can hand in domestic recyclable substances, e.g. bulky waste items, wood, scrap paper, electric and electronic waste, as well as problem waste. The recycling yards are visited by about 2.2 million customers annually. Every year, the recycling yards collect some 140,000 tonnes of recyclable materials and 3,000 tonnes of harmful waste.”<sup>78</sup> In Berlin there are some 20,000 public litter bins.

<sup>78</sup> Berlin Senate Department for Urban Development and the Environment, “Municipal waste management in Berlin,” 2013, p. 26-27.



Source: Berlin Senate Department for Urban Development and the Environment, “Municipal waste management in Berlin,” 2013, p. 26

- ▶ **Organic Waste.** In many cities, organic waste — food scraps and yard trimmings, mainly — is one of the least managed sources of waste. Even in cities with high rates of waste recovery through recycling, composting, or anaerobic digestion, there is likely to be a much lower rate of recovery of food waste.
- ▶ **PORTLAND** diverts 70 percent of waste from landfill, among the highest in U.S. cities, but “food scraps now make up the biggest slice of landfill-bound waste.”
- ▶ A study in **BERLIN** found that “the district parks and gardens departments alone collected some 41,000 tonnes of grass clippings and dead leaves every year, and that this could be treated in ways which promised to offer higher quality than simple composting. The implementation of these measures can reduce annual greenhouse gas emissions in Berlin by some 12,000 tonnes CO<sub>2</sub> equivalent. The further refinement of the separate collection of green waste — in particular dead leaves — could further increase this reduction to 20,000 tonnes CO<sub>2</sub> equivalent. Large quantities of dead leaves and grass cuttings are also collected by the BSR utility and private companies. In total, some 150,000 tonnes of green waste are generated every year in Berlin which could in future be available for

high-quality handling with corresponding reductions in climate impacts.”<sup>79</sup>

- ▶ **Major Producers of Waste.** Although solid waste is generated by everyone, there are general categories of large producers of waste. In some cities the majority of waste is generated in the commercial sector, including rental residential buildings.
- ▶ In **PORTLAND**, for instance, the commercial sector generates 80 percent of the city’s waste.
- ▶ Some 80 percent of municipal waste in **BERLIN** is domestic waste, and the remaining 20 percent is trade or industrial waste.<sup>80</sup>
- ▶ **Waste to Energy.** In some cities, waste-to-energy is strongly tied into building heating systems as a primary supplier of energy needed by the city’s district system.
- ▶ In **OSLO**, the waste-to-energy agency provides 50 percent of the district heating energy.

## Vision for Redesigned Solid Waste Systems

Solid waste system transformation is guided by a vision with three main elements:

- ▶ Zero Waste
- ▶ Sustainable Consumption
- ▶ Producer Responsibility
  - **Zero Waste** — This describes the goal of a system that instead of just managing “downstream” waste conducts “materials management” for the full-life cycle of all materials, from extraction to the design and production of materials, their use, and “end of life” management. In effect, the system is a “closed loop” that maximizes the efficient use of all resources. In this system, among other radical changes, products are designed and packaged for durability, reuse, and recyclability, and producers take responsibility for the costs of resource recovery and disposal.

<sup>79</sup> Berlin Senate Department for Urban Development and the Environment, “Municipal waste management in Berlin,” 2013, p. 45.

<sup>80</sup> Berlin Senate Department for Urban Development and the Environment, “Municipal waste management in Berlin,” 2013, p. 7.

## Vision for Redesigned Solid Waste Systems

- Zero Waste
- Sustainable Consumption
- Producer Responsibility

- ▶ **SAN FRANCISCO** has a goal of sending zero waste to landfill by 2020, and with a 80 percent diversion rate at present, is well on the way to meeting it.
- ▶ **SEATTLE** has adopted a zero waste goal and since 1990 waste emissions declined 22% total and 37% per person due to progressive and highly effective waste reduction, recycling and composting programs. In addition to providing curbside recycling, Seattle has implemented bans on recyclable and compostable materials in garbage, including a ban on food waste.
  - **Sustainable Consumption**—The vision is for a comprehensive shift in consumption to a widespread and sustained culture of sustainable purchasing, reuse, recovery, etc. The public approaches consumption quite differently—“Buy less, buy better, keep longer,” said Oslo’s communications on this. What residents buy and use, and how they use it, is radically different.
- ▶ **PORTLAND**: “Recycling and composting are helpful steps in reducing carbon emissions associated with the things we buy... but the majority of carbon emissions are generated before we even purchase the products. Close to 70 percent of the carbon emissions from the food and goods that we buy are associated with producing, transporting and selling those products.”
  - **Producer Responsibility**. In the redesigned system, products are designed and packaged for durability, reuse and recyclability, and producers take responsibility for the costs of resource recovery and disposal.
- ▶ **BERLIN**: “Waste prevention is the first priority of waste management. Key instruments are the principle of producer responsibility and waste prevention programmes.”

## Barriers to Solid Waste System Change

- ▶ **Behavior Change**—Reuse, recycling and composting depend on decisions of hundreds of thousands and millions of city residents, workers, and visitors— influencing these choices is possible, but is not easy. For residents whose waste is collected and processed as a part of their tax bill, there is little visible financial incentive to modify behaviors.
- ▶ A report for **NEW YORK CITY** described the challenge of unlocking the potential to reduce waste emissions: “New Yorkers would need to improve recycling habits, which will be aided by the recent simplification of rules and improved messaging. Waste processing infrastructure improved significantly this fall with the opening of the new Sims recycling facility in South Brooklyn—but the infrastructure to process organic waste would need to be expanded. Plants in New Jersey convert some of the waste-to-energy—but newer, cleaner, and more efficient plants are yet to be built.”<sup>81</sup>

81 GreeNYC, [http://s-media.nyc.gov/agencies/planyc2030/pdf/nyc\\_pathways.pdf](http://s-media.nyc.gov/agencies/planyc2030/pdf/nyc_pathways.pdf).

► **New Infrastructure**—Progressing toward zero waste requires local facilities for processing, not just landfilling, waste in different ways, but few cities have sufficient processing capacity on hand. This means new capital investment will be required, decisions about which processing technologies to use will have to be made,

and siting of facilities throughout the city will have to be determined. At the same time, to make the investments worthwhile, the city has to ensure sufficient waste stream will be delivered—and often this requires mandates, rather than promotion or incentives.

## Levers, Strategies and Actions for Transforming Solid Waste Systems

LEVERS	STRATEGIES	ACTIONS
Voluntary Action	Encourage Reductions in Waste-Making Behaviors	<ul style="list-style-type: none"> <li>• Promote waste reduction awareness (e.g., use of paper, plastics)</li> <li>• Support food waste reduction programs: e.g., gleaning and donation of unused and excess food; waste reduction challenges for restaurants, large hotels, banquet halls, cafeterias, food wholesalers</li> <li>• Encourage reduction of plastic food-service packaging</li> <li>• Promote consumption-reduction approaches such as renting, sharing, fixing and reusing goods, as well as choosing products with lower emissions across the entire lifecycle</li> <li>• Support “product stewardship” programs (e.g., product and packaging design, reuse of recovered materials) by leveraging city and/or corporate purchasing to encourage suppliers to reduce packaging waste and end-of-life disposal costs</li> <li>• Promote alternatives to traditional building demolition such as relocation, deconstruction and salvage</li> <li>• Educate households and businesses about why and how to separate materials for recycling</li> <li>• Small financial incentives for resident and business recycling: providing discounts/gift certificates at retailers</li> <li>• Provide technical assistance to multi-family rental property owners and managers to increase onsite recycling collection</li> </ul>
Price Signals	Increase Cost of Waste Disposal to Encourage Waste Prevention	<ul style="list-style-type: none"> <li>• Impose “Pay As You Throw” fees charged for non-recyclable waste</li> <li>• Increase the cost of using landfills</li> <li>• Impose fees on disposable plastic and paper bags (if not banned)</li> <li>• Increase penalties for failing to recycle</li> </ul>

<b>Public Investments</b>	Expand and Improve Existing Waste Processing Infrastructure and Services	<ul style="list-style-type: none"> <li>Invest in infrastructure, collection services, and public awareness (including children) for recycling and composting, including neighborhood-based composting and recycling in public spaces (e.g., recycling compactors)</li> <li>Expand waste-to-energy capacity</li> <li>Expand separation and processing of organic waste (includes waste-to-energy) and make storage and pickup available to all sectors</li> <li>Increase methane capture in existing landfills and reuse (flare, feed back into natural gas grid, convert to electricity onsite)</li> </ul>
	Pilot New Technologies (Proof of Concept)	<ul style="list-style-type: none"> <li>Test small-scale anaerobic digestion facilities for organic waste</li> <li>For waste-to-energy, pilot small-scale plasma gasification with district heating</li> <li>Pilot on-site processing of food waste</li> </ul>
<b>Mandates</b>	Mandate Waste Prevention	<ul style="list-style-type: none"> <li>Ban disposable plastic and paper bags</li> <li>Mandate that waste that can be incinerated cannot be sent to landfill</li> <li>Redesign city purchasing rules to favor sustainable consumption and support improved materials management by city agencies</li> <li>Require use of recycled asphalt in new streets</li> <li>Require recycling of construction and demolition waste</li> <li>Require a minimum percentage of recycled concrete in certain building materials</li> <li>Require new and fully renovated buildings of certain size to include a designated waste and recycling room</li> </ul>
	Redesign Waste Hauling	<ul style="list-style-type: none"> <li>Re-route haulers to increase energy efficiency and convert haulers to no- to low-carbon fuels (e.g., use of biodiesel)</li> <li>Shift hauling from truck to rail and barge</li> <li>Require fuel efficiency/clean fuel from commercial haulers operating in city</li> </ul>

## Resources

<b>Municipal Waste Management in Berlin 2013</b>	Berlin	Discusses how municipal waste is managed in Berlin, relevant legislation, various model projects that have led to the reduction of waste in Berlin and potential plans to reduce waste in the future.
<b>Resource and Waste Management Plan 2018</b>	Copenhagen	In order to become a zero waste city by 2050, the Resource and Waste Management Plan provides specific initiatives and measures to take in order to help achieve Copenhagen's sustainability goals.
<b>City of Seattle Climate Action Plan Waste GHG Emissions Reduction Strategies</b>	Seattle	A compilation of various recommendations and strategies to reduce emissions from the waste sector for the 2013 Seattle Climate Action Plan
<b>"Picking up the Pace to Zero Waste"</b>	Seattle	Seattle's Solid Waste Management Plan
<b>City of Sydney Advanced Waste Treatment Master Plan 2013-2030 (2014)</b>	Sydney	Discusses Sydney's waste treatment strategies and targets to help reach the Sustainable Sydney 2030 targets.
<b>San Francisco Climate Action Strategy (2013)</b>	San Francisco	San Francisco's climate and zero waste action plan.
<b>Commercial Waste Scan</b>	USDN	A scan and roadmap to reduce commercial waste. (Innovation Fund, 2013).
<b>Materials Management Approaches for State and Local Climate Protection</b>	Linked from the International Sustainability Professional site	This toolkit is a product of the West Coast Climate and Materials Management Forum. The Forum was convened in 2008 by U.S. Environmental Protection Agency Regions 9 and 10, and is a partnership of federal, state and local government stakeholders from the western states committed to advancing materials management strategies to reduce GHG emissions.
<b>Recycling and Waste Resources</b>	National League of Cities Sustainable Communities Institute	A public space recycling program serves high traffic areas that fall outside the coverage of other diversion programs. These places include: parks, stadiums, transit hubs, shopping centers, along streets and at special event sites. Usually these programs can be integrated into existing public space waste services and/or residential recycling programs. Coordination among multiple city or county departments and agencies is often required.

<p><b>Solid Waste Management in the World's Cities: Water and Sanitation in the World's Cities 2010</b></p>	<p>UN-Habitat</p>	<p>In our rapidly urbanizing global society, solid waste management will be a key challenge facing all the world's cities. Solid Waste Management in the World's Cities provides a fresh perspective and new data on one of the biggest issues in urban development. Using the framework of Integrated Sustainable Waste Management (ISWM), the report brings together unprecedented research from 22 cities across six continents. It uncovers the rich diversity of waste management systems that are in place throughout the world, and draws out the practical lessons for policymakers.</p>
<p><b>Waste Management</b></p>	<p>Smart Cities Council</p>	<p>With the total volume of waste generated globally expected to increase by nearly 50% over the next decade, the adoption of innovative technologies will result in more integrated waste management solutions that move beyond the traditional use of labor, diesel trucks and conventional landfills. In this section you'll read about the technologies driving the emerging smart waste market and how they will lead to more sustainable cities.</p>
<p><b>Integrated sustainable waste management in developing countries</b></p>	<p>Wilson, David C.; Velis, Costas A.; Rodic, Ljiljana (Institution of Civil Engineers Journal Article)</p>	<p>This paper uses the lens of 'integrated sustainable waste management' to examine how cities in developing countries have been tackling their solid waste problems. The evidence suggests that efficient, effective and affordable systems are tailored to local needs and conditions, developed with direct involvement of service beneficiaries. Despite the remaining challenges, evidence of recent improvements suggests that sustainable solid waste and resources management is feasible for developing countries.</p>
<p><b>New Waste Technologies Scan</b></p>	<p>USDN</p>	<p>A study of innovative waste diversion systems to redefine municipal solid waste from a liability to a valuable asset. (Innovation Fund, 2014).</p>
<p><b>Solid waste management and sustainable cities in India: the case of Chandigarh</b></p>	<p>Gupta, Namita (Environment &amp; Urbanization Journal Article)</p>	<p>This paper presents research on solid waste management in the city of Chandigarh, well known in India for its achievements in this regard. It provides an overview of the situation, discussing the strategies adopted and the continued and emerging challenges in waste management, as well as suggesting measures for possible solutions.</p>

<p><b>Solid Waste Management Initiative:</b></p> <p><b>Sustainable Solid Waste Systems</b></p>	<p>C40 Cities</p>	<p>The Sustainable Solid Waste Systems Network aims to transform C40 cities’ holistic approach to waste management through source reduction, improved collection and transportation, resource and energy recovery, recycling, organics utilization, landfill diversion and alternative disposal.</p> <p>By understanding the benefits and disadvantages of various management technologies, local decision makers can best allocate resources, select processes and vendors, and develop policies and procedures to meet the community’s needs.</p>
<p><b>Compostable Plastics Toolkit</b></p>	<p>USDN</p>	<p>A toolkit for how cities can manage compostable plastics in local solid waste programs. (Innovation Fund, 2014).</p>
<p><b>Developing Solid Waste Management Plans</b></p>	<p>U.S. EPA</p>	<p>Planning is the first step in designing or improving a solid waste management system. A SWMP assists in taking institutional, social, financial, economic, technical, and environmental factors into consideration when managing solid waste systems. A SWMP is a practical document that can help guide solid waste management effort.</p>
<p><b>Seattle Solid Waste Recycling, Waste Reduction, and Facilities Opportunities</b></p>	<p>City of Seattle, Washington</p>	<p>This study, completed in 2007, evaluated both new strategies and existing programs adopted previously under the guiding principle of “zero waste” as originally laid out in the 1998 Seattle Solid Waste Comprehensive Plan, “On the Path to Sustainability.” Zero Waste and collection strategies with the potential to divert significant tonnage away from landfill disposal were identified in this five month comprehensive study.</p>
<p><b>Library of Resources</b></p>	<p>Zero Waste Alliance</p>	<p>The Zero Waste Alliance is a bridge between an organization’s needs and the capabilities available through universities, national labs, state, federal and local government resources and private consulting firms. ZWA promotes and supports the concept of Zero Waste through education and supporting services.</p>



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**INSTITUTIONALIZING  
DEEP DECARBONIZATION  
PLANNING &  
IMPLEMENTATION**

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## Six Major Planning Challenges

Most leading-edge cities' climate action plans don't address the many challenges of implementing the plans. This is done through operational plans and budgets, typically developed on an annual basis, which work through the details of taking action. Nonetheless, cities' action plans speak in various ways to six major concerns that affect implementation:

- ▶ **Organizing Oversight and Accountability in City Government.** — Given the complexity of climate action planning and the traditional division of local governments into separate departments and agencies, cities must clearly locate the authority of climate planning in a way that commands the attention of the departments and is also in close touch with the elected leadership.
- ▶ **Building Technical Capacity and Stimulating Innovation** — Cities must develop the technical capacity for analyzing, modeling, designing, and planning climate action planning and implementation.
- ▶ **Engaging Stakeholders and the Community** — To strengthen and sustain local political will for long-term systems transformation, city governments must build effective relationships with the many stakeholder groups and must communicate effectively with community members at large, the public.
- ▶ **Influencing Other Levels of Government** — Since cities typically don't have full control over the major carbon-emissions systems that must be transformed, they must develop ways of influencing other levels of government that control important decisions and assets.
- ▶ **Funding Climate Action Plans** — Any ambitious carbon reduction strategy requires funding — whether it is money to support city operations or money to incentivize consumer or business behaviors and investments. Cities must apply traditional methods of funding public programs to their climate action plans and also invent new funding mechanisms.
- ▶ **Stimulating Innovation in City Government** — In addressing climate change, leading-edge cities must develop and test new ideas for city policies and programs. They have to innovate, because few proven solutions exist and because most solutions have to be adapted to the city's specific context.
- ▶ **Sustaining Long Term Endeavors.** Climate action is not a brief process; a portion of strategies and critical outcomes necessarily span multiple political lifetimes. Buy-in from subsequent leaders depends in part upon medium and long-term measured results, and in part upon the ability to adjust or enhance prior efforts — to have 'ownership'.

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Long-term systems transformation requires political leadership and “out of the box” thinking about providing services, investing in infrastructure, and engaging stakeholders.

## Organizing Oversight and Accountability in City Government

Cities must clearly locate the authority of climate planning in a way that commands the attention of the departments and is also in close touch with the elected leadership. This involves doing three things well: clarifying who is responsible for what, conducting high-level coordination across the government silos, and ensuring that decision makers are well informed.

### CLARIFYING WHO IS RESPONSIBLE FOR WHAT

Given that climate planning must be a concern of every city department or agency, not just a concern for environment entities, where within the city government's structure should responsibility for planning be located?

A number of cities have found they needed to centralize authority for climate planning; otherwise they ran several risks by leaving authority diffused among departments. One risk was a diminished commitment to the effort as departments weighed climate action against their other goals and priorities. **BOULDER** reported that “an important lesson learned during Boulder’s first ten years of climate action efforts was the propensity for climate action work to become ‘siloed’ in ways that diminished overall organizational investment and participation in the initiative.”<sup>82</sup> Some cities, **STOCKHOLM**, for instance, have centralized responsibility for climate action planning in a strategy office located within the city chief executive’s office, because the alternative—diffusing responsibility among many departments—didn’t work as well as desired. In a few cities—**PORTLAND**, for example—climate planning has been embedded in the city’s planning department, which strongly integrates climate issues into land-use and other planning processes. Seattle created an implementation strategy which identifies the lead department, other departments involved, implementation tasks, needed policy decisions, existing resources, needed resources, and public engagement for each by 2015 action in its 2013 Climate Action Plan.<sup>83</sup>

82 City of Boulder, “Baseline Assessment Report,” April 2014, p. 8.

83 <http://www.seattle.gov/Documents/Departments/OSE/FinalCAPIImplementationStrategy.pdf>

Another risk some cities have noted is a lack of innovativeness in designing and implementing climate policies, programs, and other solutions; some departments have capacity and an organizational culture for innovation, others do not. To manage the risk, some cities have created innovation and incubation units, also within the chief executive’s office, to develop and test solutions.

### CONDUCTING HIGH-LEVEL COORDINATION ACROSS GOVERNMENT SILOS

Even with clarity within city government about where responsibility lies for climate action planning, coordinating across government’s many silos can be a difficult task. Ultimately, cities seek to embed climate action goals—for both GHG emission mitigation and adaptation—into each key department’s own short- and long-term plans, which makes department management accountable and drives into departments the fact that their success depends in part on other departments’ strategies and actions. Cities also are building internal decision-making structures that force departments to coordinate, especially when it comes to long-term infrastructure.

- In 2014 **LONDON’S** mayor created the London Infrastructure Delivery Board to develop “more efficient, integrated, and innovative infrastructure solutions.” The Board includes chief executives of the water, parks, rail, transport, gas, environmental, solid waste, business development, and electricity systems in the city. Among the Board’s first actions: to develop case studies to test the potential for “more joined-up infrastructure delivery” in three places in London and to develop a better understanding of the phasing of projects, the synergies and tensions that arise when looking at the cumulative impact of investments. This should inform investment decisions and help incentivise greater cooperation among providers.”<sup>84</sup>

### ENSURING THAT DECISION MAKERS ARE WELL INFORMED

Cities’ deep decarbonization action plans routinely contain hundreds of actions to be taken, some small, many of them large and requiring many years to implement. Many are a big departure from business as usual for city government and require new management structures within the gov-

84 City of London, “London Infrastructure Delivery Board.”

ernment. It's imperative, then, to set up decision-making processes for the elected officials and top city managers that routinely keep them well informed about processes that lead to decisions and the progress that's being made on decisions already taken. Different cities do this differently, but it typically involves periodic briefings that go beyond the annual indicators-of-progress reports that are a part of a city's typical climate action planning.

Some cities, for instance, conduct a briefing every few months for the mayor and other elected officials as a way of helping them keep up to speed on developments, and to anticipate decisions they will have to make in the near future. For instance, **COPENHAGEN'S** climate action staff meets three times a year with the mayor to discuss climate strategy and requirements, roadblocks, and pending decisions. Cities may also call elected officials' attention to various benchmarking or rating studies about multiple cities' climate action and progress, as a way of highlighting where their city stands among the "competition," what their city is and is not doing compared with other cities.

## Building Technical Capacity and Stimulating Innovation

Cities must develop the technical capacity for high levels of analysis, modeling potential impacts, designing, and planning climate action planning and implementation. Often, they are tackling topics/systems that have not received much scrutiny from them in the past. The energy supply system is an example of this; since other levels of government have substantial control over the system, cities have traditionally been more like bystanders. Essentially, cities must assemble sufficient expertise and use and/or develop new analytic tools to conduct tasks they may not have had to do before.

### ASSEMBLING EXPERTISE

It is not unusual for cities to find they have difficulty organizing the in-house expertise to do all of the analytic work required in climate action planning. Expertise on the different emissions systems may reside in different departments and agencies, which then have to be recruited and coordinated. It's possible that the necessary expertise is insufficient or doesn't exist at all, because responding to

climate change is driving the emergence of new professional practices, such as the development of citywide and regional infrastructure networks for bicycles.

One option is to hire more staff, but cities also have other ways to assemble the expertise they need. In some cities, such as **BOSTON**, the city has partnered with local philanthropic organizations that provide the funding for fellowships of a year's length, which allows the city to bring on board technical experts at little cost. Typically, though, cities will identify expertise in consulting businesses, non-profit organizations, and universities and either contract for services or ask for free help. They may also identify retired experts who may be willing to provide unpaid support. **VANCOUVER** has a City Studio partnership with local universities in which the city provides graduate students with office space and engages them on city projects.

Most cities assemble working groups, task forces or study groups, drawn from a specific system/sector, such as building owners or private transportation providers and alternative mobility advocates, and works with them to develop analyses of the system as well as recommendations for climate strategies and actions. These groups may also include officials from other levels of government, especially regulators who know the ins and outs of government policies. Working group processes have to be facilitated so their work will lead to results. Sometimes the group's knowledge is enhanced by hired consultants. As cities rely more and more on consultants they find they need to build some expertise inside government to be able to engage with and double check the consultants' expertise; they cannot just outsource their thinking.

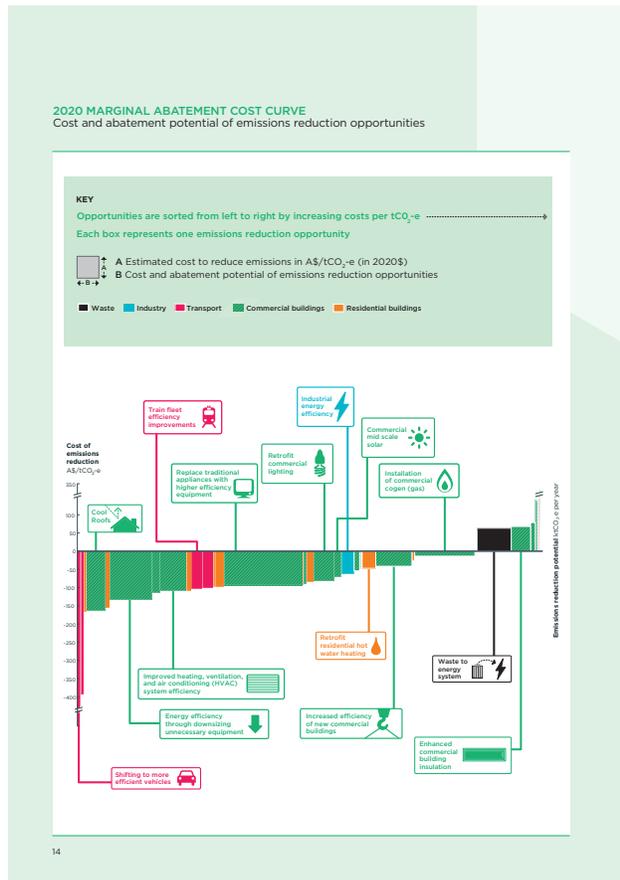
### TOOLS

Although this Framework doesn't examine tools for climate action planning in any detail, it is evident from the leading-edge cities' plans that an array of tools, some proprietary and used by private consultants, some not, are being used and others are under development. An initial inventory is below.

## Tools for Climate Action Planning

<b>Data Gathering</b>	<ul style="list-style-type: none"> <li>• Cities work with other levels of government to tap their databases. Of particular importance is national data about climate, which informs local adaptation planning</li> <li>• Cities work with local energy and water providers to obtain consumption data tagged to each metered location. (Often this data gathering runs into the barrier of privacy protections for the consumers.)</li> </ul>
<b>Spatial Mapping of City Systems</b>	<ul style="list-style-type: none"> <li>• Sydney produced a 3-dimensional map of buildings in the city, with energy intensity data for 20 different types of buildings; every five years university students visit every building in the city and check/verify the data/plans the city has for the building</li> <li>• London is producing a “heat map” of buildings citywide</li> <li>• Many cities map vehicle flows within cities, between cities and within the region</li> <li>• Boulder, Boston and other cities are mapping their cities’ electricity systems at a high level of detail</li> </ul>
<b>Analysis of Sector Potentials</b>	<ul style="list-style-type: none"> <li>• Cities typically analyze the renewable energy — solar and wind — potential within their boundaries and nearby</li> <li>• San Francisco developed a “solar map” which applies remote mapping and shading algorithms to estimate the solar potential of every building in the city<sup>2</sup></li> </ul>
<b>Analysis of Carbon Reduction Methods</b>	<ul style="list-style-type: none"> <li>• A Marginal Abatement Cost Curve estimates potential for reduction in buildings, transportation, and solid waste by evaluating scores of abatement measures, focusing on existing technologies and making conservative assumptions (See graphic below from Melbourne)</li> </ul>
<b>Technology/ Equipment</b>	<ul style="list-style-type: none"> <li>• Analysis of emerging technologies’ likely availability, cost and “learning curve,” which is the pace at which technologies are improving or their cost is being reduced</li> <li>• Expected “useful life” of technology and equipment</li> </ul>
<b>Economic Modeling</b>	<ul style="list-style-type: none"> <li>• Cities model the potential return on financial investment for carbon reduction actions, for public and private investment</li> <li>• Potential business activity and job creation due to carbon reduction actions</li> <li>• Potential tax revenue impacts due to climate action plans</li> <li>• Potential pricing impacts on consumer purchasing decisions and other behaviors (e.g., electricity prices)</li> </ul>
<b>Measuring Public Opinion</b>	<ul style="list-style-type: none"> <li>• Most cities conduct polling, surveys, and focus groups to determine public understanding of and opinions about climate action</li> </ul>

MELBOURNE'S report on abatement cost curve analysis.<sup>85</sup>



Source: City of Melbourne, “Zero Net Emissions by 2020: 2014 Update.”

## Engaging Stakeholders and the Community

Long-term systems transformation requires leadership by the city’s top elected and management officials, especially in using scientific and technical information and public input to set deep decarbonization goals/targets and strategies. To strengthen and sustain local political will, city governments must build effective relationships with many stakeholder groups and must communicate effectively with community members at large. Successful engagement helps to develop strategies and actions that will work locally and benefit all populations. It also ensures that when plans are completed there is a strong group of supportive stakeholders to help ensure successful implementation.

85 City of Melbourne, “Zero Net Emissions by 2020: 2014 Update,” 2014, p. 14.

In general, engagement involves two-way communication with the public and outreach and consultation with stakeholders. These are not the same thing, although engaging with the public can affect engagement with stakeholders and vice versa.

- **The Public**—The public means the residents living in and businesses and other organizations operating in the city, as well as workers commuting into the city. Many residents are voters and most residents and businesses are local taxpayers.
- **Stakeholders**—Stakeholders are individuals or groups of people whose interests are directly affected by specific actions proposed or taken. Cities have numerous types of stakeholders when it comes to climate action. All residents and businesses have a stake in deep decarbonization, but not all are active as stakeholders in advocating for their interests. Various disadvantaged populations or neighborhoods in the city are stakeholders, although the city may not have a strong history of considering their interests. Not all stakeholders are residents or enterprises in the city; other government jurisdictions in the metropolitan region may also be stakeholders in a city’s climate action planning.

Different cities have different contexts that affect how they engage the community and stakeholders.

### Factors Affecting Engagement of Public and Stakeholders

<p><b>Political Cohesion</b></p>	<ul style="list-style-type: none"> <li>• Distribution of local political power</li> <li>• Barriers to reaching local political consensus</li> <li>• Influence of industries that benefit financially from status quo (e.g., fossil-fuel sector)</li> </ul>
<p><b>City Government Relationships</b></p>	<ul style="list-style-type: none"> <li>• Trust in city’s elected leaders and top management</li> <li>• Perceptions of city competence</li> <li>• History of city engagement with different populations</li> </ul>

<b>Stakeholder Cohesion</b>	<ul style="list-style-type: none"> <li>• Degree to which stakeholder segments contain civic-minded leaders willing to co-develop solutions with the city</li> <li>• Degree to which stakeholders are organized and effective in articulating interests</li> </ul>
<b>Market Conditions</b>	<ul style="list-style-type: none"> <li>• Degree to which real estate, energy, and mobility markets are growing, stagnating, shrinking</li> <li>• City resources for operating engagement processes</li> </ul>

## ENGAGING THE PUBLIC

- ▶ Some of the keys to effective engagement of the public include:
  - ▶ **Input, Input, Input**—Invite input over and over (summits, meetings, hearings, online feedback, etc.) and provide evidence that the city is responsive to what the public says.
  - ▶ **VANCOUVER'S** “Talk Green to Us” campaign, which asks residents to submit suggestions for how Vancouver can meet its goal of being the ‘Greenest City In The World’ by 2020.<sup>86</sup>
  - ▶ **SAN FRANCISCO** invited people to create short films showing how they are taking climate action, with the winning entries being screened at its annual SF Green Film Festival.<sup>87</sup>
  - ▶ **Community Knowledge**—Increase public, thought-leader, and stakeholder awareness and understanding of systems change in a variety of ways, including offering a “sustainability curriculum” for the public and using climate action planning as educational tools not just plans.

- ▶ **YOKOHAMA'S** Eco School (YES) is a participatory education program that provides various learning opportunities to citizens, non-profit organizations, business operators, universities, and government agencies under the unified brand “YES,” and with the slogan “Learn about Earth in Yokohama.” The program, which began in 2009, provides deeper understanding of environmental issues and global warming, educates people about energy conservation and environmentally friendly actions, and promotes ecological life choices.
- ▶ **Transparency**—Make planning and decision-making processes and plans visible and accessible. Cities are using advanced websites to provide extensive access to information and share progress toward goals. Particularly important is to make the fairly complicated planning process steps visible. (See **BERLIN** graphic on page 115).
- ▶ **Constant Communication**—In addition to a city’s direct communication with the public, generate media coverage of climate action processes and results.
- ▶ **Behavior Change Campaigns/Branding**—Campaigns to engage residents in voluntary actions (e.g., to walk/bike more, conserve energy) can reach large numbers of people, building their awareness and making them feel a part of the effort.
- ▶ **Celebration**—Part of developing a culture of climate action is to celebrate successes small and large. The European Commission’s “European Green Capital Award” program recognizes one European city per year demonstrating exemplary efforts to improve the urban environment and move towards healthier and sustainable living areas as the “European Green Capital.”<sup>88</sup>
- ▶ **Highlight Stakeholder Actions and Endorsements**—What stakeholders think and do can have a powerful effect on public opinion.

<sup>86</sup> <http://greenbriefs.ca/2010/09/can-vancouvers-talk-green-to-us-campaign-answer-with-real-green-jobs/>

<sup>87</sup> <http://www.greenfilmfest.org/contest>

<sup>88</sup> [http://ec.europa.eu/environment/europeangreencapital/index\\_en.htm](http://ec.europa.eu/environment/europeangreencapital/index_en.htm)

## MAKING THE CASE FOR DEEP DECARBONIZATION

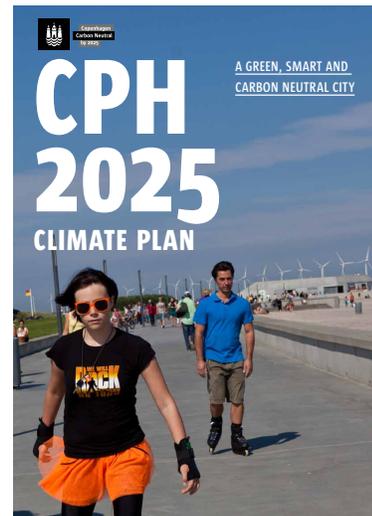
When making the case, elected officials and top city managers usually lead with a broad, inspiring vision for the city's future and the “co-benefits” of climate action—rather than just stressing the problems posed by climate change. Messaging approaches that resonate with people include:

- ▶ **Highlight the scientific consensus about climate change**—Although the public may not understand the science involved, it is responsive to the fact of scientific agreement that climate is changing and what the implications will be for the city.
- ▶ **Stress that climate effects are already happening and the city is vulnerable**—Extreme weather affecting the city or other places underscores the immediate reality of climate change and the damage it can cause.
- ▶ **Present an optimistic vision for city**—Articulate a broader goal for the city than just achieving carbon reduction. Describe a long-term vision that depicts a city people that want to live in (city will be “livable,” “resilient,” “thriving,” “vibrant,” “smart,” etc.)
- ▶ **Articulate co-benefits of climate action**—Sustainable economic growth, improved public health and more livable neighborhoods are some of the potential co-benefits of climate action that resonate with the public.
- ▶ **Integrate adaptation and mitigation into one story**—Making the case for adaptation/climate resilience can strengthen the case for mitigation, which aims to prevent/reduce the very effects to which adaptation responds.
- ▶ **Address concerns about equity**—Deep decarbonization must be extensive and long-term and resilience depends on social cohesion as well as physical infrastructure changes. Cities will increasingly find that “fairness” matters not just in building broad, sustainable political will but also in planning and implementing in ways that consider the available resources of affected groups. There is a growing realization that a thriving economy and resilient city relies on the active pursuit of a “just transition,” cities are starting to examine new models for transformation centered on intensive collaboration with members of the community.

## COMMUNICATING WITH THE PUBLIC

Effective communication with the public tends to include ways to simply explain the content of climate action plans. For example, **SAN FRANCISCO** turned its basic climate action strategy into an easy to talk about and remember catchphrase: “0-50-100” which refers to the city’s formula for reaching 2025 GHG reduction goals: 0 waste to land-fill, 50 percent of all trips to non- automobile modes of transportation, and sourcing 100 percent of energy from renewable sources.<sup>89</sup>

Cities also communicate through stories and images that resonate with the public. For instance, the cover of **COPENHAGEN’S** climate action plan features people in the foreground and wind turbines, barely visible in the background, an important item in the city’s “new normal” condition.<sup>90</sup>



Source: City of Copenhagen, “CPH 2025 Climate Plan.”

Some cities build a marketing brand for sustainability and climate action through which they communicate. The brand provides cohesion in communication efforts, both organizing and coordinating city efforts and delivering focused information and messages to the public.

89 City of San Francisco, “Climate Action Strategy, 2013 Update,” October 2013, p. iii.

90 City of Copenhagen, “CPH 2025 Climate Plan,” 2012, cover.

► “GreenNYC” is **NEW YORK CITY’S** public education program dedicated to “educating, engaging, and mobilizing New Yorkers to take simple, but meaningful, steps to reduce their energy use, generate less waste, and live more sustainable lifestyles. These steps are critical to achieving the city’s goal of sending zero waste to landfills by 2030, reducing NYC’s greenhouse gas emissions by 80 percent by 2050 and improving the quality of the city’s environment.” The city created the “Birdie” brand with its own bumper stickers, Facebook page, twitter handle and mascot suit that Birdie wears to public events.



Source: <http://www.nyc.gov/html/greenyc/html/home/home.shtml>

► **BOSTON’S** Greenovate Boston,” launched in 2013, is an initiative to get all Boston residents involved in reducing the city’s GHG emissions and making the city greener, healthier, and more prosperous. Greenovate uses citizen outreach, education, and engagement to help advance the city’s sustainability goals. Thus, the city’s 2014 update on climate action was issued through the Greenovate brand and included an overall scorecard.<sup>91</sup>

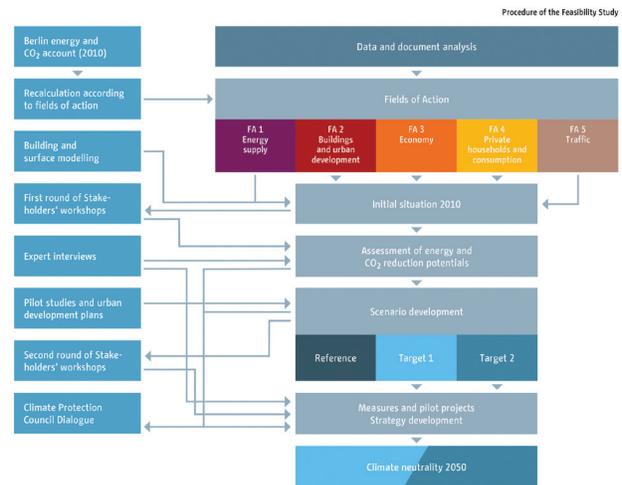
FIGURE 2: Boston’s GHG Goals and Targets by Sector



Source: City of Boston, “Greenovate Boston, 2014 Climate Action Plan Update, Summary Report.”

91 City of Boston, “Greenovate Boston, 2014 Climate Action Plan Update, Summary Report,” February 2015, p. 6.

In public communications, it is essential to make the complexities of climate action planning processes, and the plan itself, as easily understandable as possible. Cities resort to a variety of communications tools to accomplish this, particularly the use of explanatory graphics in their action plans. For instance, **BERLIN’S** plans include this depiction of the steps in the feasibility phase of the planning process.<sup>92</sup>



Source: City of Berlin, “Climate-Neutrality Berlin 2050: Results of a Feasibility Study.”

Another and crucial aspect of communicating with the public is reporting on the progress of climate action plans. Many cities mix climate action indicator measurements in with their broader reports on city sustainability.

- **MINNEAPOLIS** has a long history of reporting progress on environmental, social, and public health goals and the Minneapolis Sustainability Indicators, first adopted in 2005, tracks progress on 52 specific goals on an annual basis.
- **SEATTLE’S** Indicators for transportation demonstrate the use of a detailed set of indicators and specific targets to track and report progress.<sup>93</sup>

92 City of Berlin, “Climate-Neutrality Berlin 2050: Results of a Feasibility Study,” March 2014, p. 7.

93 City of Seattle, “Seattle Climate Action Plan,” June 2013, p. 7.

Table: Climate Action Outcome Indicators

SECTOR	INDICATOR	TARGET	
TRANSPORTATION	Passenger	Passenger Vehicle Emissions (Million Tonnes CO <sub>2</sub> e)	82% Reduction
		Vehicle Miles Travelled (VMTs)	20% Reduction by 2030*
		GHG Emissions Intensity of Travel (GHG Emissions per mile of Seattle Vehicles)	75% Reduction by 2030*
	Mode Share	Center City Commute Trip	Trend away from single occupant vehicles
		All Trips in Seattle	Trend away from single occupant vehicles
	Transit	Ridership	Increase in transit mode share and ridership
		Service	Increase in transit service hours and service levels on Seattle's Frequent Transit Service network
	Bicycling	Ridership	Triple the amount of bicycling from 2007 levels by 2017
	Safety	Crash Data	Eliminate serious injuries and fatalities on Seattle streets by 2030

Source: City of Seattle, "Seattle Climate Action Plan."

- **OSLO'S** broad set of indicators includes the use of smiley faces to graphically represent the trend in change for each indicator.<sup>94</sup>

STATUS – IMPORTANT ENVIRONMENTAL TARGETS				
INDICATOR	2012	2013	CHANGES FROM 2012 TO 2013	TREND
Number of buildings heated by oil, owned and leased	34 pcs	26 pcs	- 24 %	😊
Litres of fossil heating oil used in buildings occupied by the agencies	1,397,875	1,127,649	- 19 %	😊
Number of environmentally certified service locations	341 pcs	411 pcs	+ 20 %	😊
Number of service locations separating waste at source		83%		Data from 2012 unavailable
Total CO <sub>2</sub> emissions from the delivery of municipal services	89,565 tonnes	66,954 tonnes	- 25 %	😊
Changes, share of zero-emission vehicles in the municipal car fleet	2 % (24 av 1175)	9 % (97 av 1236)	+ 7 %	😊
Total energy use	805,862 MWh	742,689 MWh	- 8 %	😊
Increase, share of renewable energy used by the municipality (green electricity, district heating, bioenergy)	23 %	38 %	+ 15 %	😊
Municipal unit with the highest share of zero-emission cars in their fleet	Østensjø District – 32 % (22 pcs of a total of 66 vehicles)			

The City of Oslo Environment and Climate Report 2013 39

Source: City of Oslo, "Environment and Climate Report 2013."

94 City of Oslo, "Environment and Climate Report 2013," 2013, p. 33.

## ENGAGING STAKEHOLDERS

Effective deep decarbonization plans are not possible without the active support of key stakeholders. Stakeholders can strengthen or weaken the political will to take bold actions. And because municipalities directly control only a small portion of the assets that drive deep emissions reductions, many of the actions and investments that will be needed must come from stakeholders. This is why it is essential to connect the challenge of climate change to stakeholders' interests and concerns and to communicate in terms that make sense to them.

### Cities Have Many, Many Stakeholders

Community Groups	<ul style="list-style-type: none"> <li>• Community-Based Organizations</li> <li>• Environmental Organizations</li> <li>• Faith-Based Organizations</li> <li>• Neighborhoods</li> <li>• Schools</li> </ul>
Business and Civic Leadership	<ul style="list-style-type: none"> <li>• Private Industry</li> <li>• Commercial Real Estate</li> <li>• Health Care &amp; Higher Education</li> <li>• Hospitality</li> <li>• Finance &amp; Insurance</li> <li>• Investor Owned Utilities</li> <li>• Cultural Institutions</li> <li>• Infrastructure Managers</li> <li>• National and International NGOs</li> </ul>
Energy Supply	<ul style="list-style-type: none"> <li>• Utilities</li> <li>• Renewable Energy Providers</li> <li>• Oil Industry</li> </ul>
Buildings	<ul style="list-style-type: none"> <li>• Energy Equipment Manufacturers</li> <li>• Building Owners</li> <li>• Renters</li> </ul>

Transportation	<ul style="list-style-type: none"> <li>• Automobile industry</li> <li>• Taxi operators</li> <li>• Road construction sector</li> </ul>
Solid Waste	<ul style="list-style-type: none"> <li>• Waste haulers</li> <li>• Landfill operators</li> </ul>

Some of the keys to working effectively with stakeholders include:

- ▶ **Segment, Segment, Segment**—Organize outreach by stakeholder groupings so that specific interests can be identified and detailed analysis undertaken.
- ▶ **Co-Develop**—Articulate and make the case for the city’s climate goals and direction, but invite stakeholders to co-develop strategies and actions with the city.
- ▶ **Engage Stakeholders’ Expertise**—Using taskforces/working groups, supported by consultants and city staff specialists, capture the deep knowledge that stakeholders have and identify gaps in their knowledge. This can be an important learning experience for stakeholders and the city, as well as a relationship-building opportunity for both.
- ▶ **Strategy Progressions.** Leading-edge cities explain to stakeholder groups that in addition to strategies for voluntary action and public investment, it may be necessary to use more controversial pricing signals/incentives and mandates to achieve climate action goals.

Many cities also find that it’s important to go beyond the stakeholders with whom they are familiar, beyond the “usual suspects.” They seek out other voices — small businesses, especially green businesses, for example, which may in the past have let larger corporate interests set the business community agenda; health advocacy organizations that in the past may not have been involved in climate planning processes; and, especially, members and representatives of long-isolated stakeholders such as low-income populations and minority and ethnic groups.

### FOCUSING ON THE BUSINESS COMMUNITY

In many cities, the organized business community is an especially important stakeholder, both because city strategies will heavily effect and depend on businesses, and because the voice of business may strongly influence

political leaders and the public. Among the approaches that cities have taken to engage their local business communities are:

- ▶ **Economic Opportunity**—Civic-minded businesses can be persuaded that decarbonization will generate economic opportunities and strengthen a city’s comparative advantages in the future.
- ▶ **Leading By Example**—Businesses run key parts of a city’s emissions-producing infrastructure systems (energy, buildings, transportation, and waste). They are producers of emissions, not just stakeholders, and can be enlisted to take action to reduce their emissions, particularly if cost savings can be achieved.
- ▶ **Influence through Co-Development**—When a city’s business community embraces the deep decarbonization vision, it can support city strategies for voluntary action and public investment, while co-developing with the city the types of economic incentives and mandates that may be put into place.
- ▶ **Institutionalizing Business Commitment**—Establishing a business-driven entity with sufficient financial and staffing resources enables a sustained and visible presence by business in the city’s decarbonization strategies, a presence that can shape the decision of future city leaders.
- ▶ **YOKOHAMA** created a “Global Warming Countermeasure Business Council” in collaboration with business operators to promote effective countermeasures in the business sector and scale up some of the technologies and know-how developed through public-private partnerships in the city’s smart city program.
- ▶ In 2010, **BOSTON** created a Green Ribbon Commission to advise the city on implementation of its climate action plan, advocate within key sectors to align strategies within the sector the climate plan goals, and highlight best practices within and across sectors. The Commission has 34 members, drawn from the key sectors in the city that are affected by mitigation and adaptation goals and actions, and is funded by a coalition of six foundations that make multi-year grants. Sectors represented on the Commission include higher education, health care, commercial real estate, hospitality, finance, insurance, construction, utilities, clean energy, philanthropy, state government, faith-based entities, and local and international NGOs.

The Commission meets twice a year and operates through a working group structure that undertakes a number of different types of activities:

- ▶ **Sector research**—Understanding where the largest enterprises (the sector’s share of the top 50) are relative to the city’s climate targets, what it takes to hit these targets, what the barriers are, how they can be overcome
- ▶ **Sector data**—Organizing systems for sector-level data sharing on energy use and GHG emissions
- ▶ **Access to Incentives.** Facilitating sector participation in utility energy efficiency programs
- ▶ **Best Practices**—Sharing best practices across institutions and developing common tools that help sector players achieve their emissions reductions goals (e.g. common approaches to Strategic Energy Master Planning; ROI and financial investment decision-making; large scale behavior change).
- ▶ **Sector Initiatives**—Developing and implementing collaborative initiatives within the sector.

The Commission has also played a role in elections, providing briefing materials to candidates in the 2013 mayoral election and the state’s 2014 gubernatorial election. Members met with candidates during and after the elections to assure continuity of political support for aggressive climate action at the city and state levels.

## ENGAGING NEIGHBORHOODS

In many cities, neighborhoods are organized, formally or informally, into cohesive stakeholder groups that are effective in advocating for city policies/programs and in mobilizing residents and businesses to take action. Cities recognize that neighborhoods, as geographic places and as social units, may play an important role in deep decarbonization action, depending on the city’s strategies.

- ▶ **Decentralized Climate Solutions**—In many cities, mitigation and adaptation strategies and actions involve neighborhood-level changes with disruptions and benefits (e.g., district heating/cooling systems, green infrastructure, distributed solar and wind energy production). It’s essential to involve neighborhoods in the planning process and secure the buy-in of the residents and businesses.
- ▶ **“Climate Equity”**—Many city leaders are working to integrate issues of equity into climate strategies, considering who is most impacted by climate change and how the benefits of climate actions are distributed equitably across the city’s population. One aspect of climate equity is the potential inequitable treatment of different neighborhoods. **PORTLAND** in its 2015 climate action plan stated that its “vision for a climate-positive future cannot be achieved without advancing equitable outcomes and addressing existing disparities,” and included an extensive analysis of city inequity, focused

### Benefits of Boston Green Ribbon Commission

<p><b>GRC members are motivated to participate by a number of factors</b></p>	<ul style="list-style-type: none"> <li>• Personal passion</li> <li>• Engagement with the Mayor and other city leaders</li> <li>• Alignment with their enterprise’s mission and strategy</li> <li>• Peer networking and learning</li> </ul>
<p><b>The Commission brings a range of value to the city climate action strategy</b></p>	<ul style="list-style-type: none"> <li>• A highly informed cohort of business and civic leaders</li> <li>• A forum to test out controversial ideas</li> <li>• A structure to align private and institutional behavior to city climate targets and goals</li> <li>• A source of political continuity</li> </ul>

on one large neighborhood. “East Portland, home to 25 percent of Portland’s population, reflects both the demographic change and missed opportunities to reduce carbon emissions in under-served communities. Thirty-eight percent of East Portland residents are people of color, notably more diverse than the city as a whole. That percentage has grown substantially since 2000 as many people of color have been pushed to East Portland due to a combination of factors. In particular, the lack of affordable housing in many close-in neighborhoods which has been exacerbated by housing discrimination. Housing preference also played a role in this demographic shift, although to a lesser degree.”<sup>95</sup>

In addition to using typical stakeholder-engagement methods to involve neighborhoods in deep decarbonization planning and action, cities find they may not have strong connections at the neighborhood level and they turn to community-based organizations that work with people and entities in the neighborhood. **SEATTLE’S** action plan listed more than 35 community-based organizations involved in climate planning, identifying what each organization does and providing links to their websites. It noted that community groups generally use three strategies to engage residents and businesses when it comes to climate action.

- ▶ **Education/Outreach**—Community organizations provide important information about climate change and solutions to their members, neighbors, constituents, and general public. Increasing awareness of what actions will make a difference, how to take the first step, and the numerous other benefits of climate action—including benefits to the economy, social justice, and public health—is an important first step in getting people to take and support climate action.
- ▶ **YOKOHAMA** worked with its local Resources Recycling Cooperative Business Association to engage children in thinking about what they’d like their “FutureCity” to look like by creating a “Picture Diary of the Environment.” In 2014 the city joined other cities in Japan to exhibit 600 winning entries from 20,000 applicants across the country.

- ▶ **Advocacy**—Community organizations are the voice of their members and constituents when policymakers are considering implementing policies. This collective voice is powerful in demonstrating the level of community support for action to policymakers. Strong support for a goal of carbon neutrality from community organizations has played a significant role in the adoption of cities’ deep decarbonization goals.
- ▶ **Direct Action**—Community organizations provide opportunities for people to take direct action; they turn individual action into collective impact and inspire new patterns of behavior over the long term.<sup>96</sup>
- ▶ To help community groups play these roles, **SEATTLE** provides information, tools, and some staff support to community organizations that are implementing climate action projects. It also supports them through grants and contracts and creates forums that bring like-minded or complementary organizations together to work towards mutually agreed upon goals.

## Influencing Other Levels of Government

Cities’ climate action plans routinely note that cities don’t have full control over the major carbon-emissions systems that must be transformed. For instance, **SEATTLE**, in its “2030 Vision,” stated that the city “has adequate funding to fully implement the Transit, Bicycle, Pedestrian and Freight Master Plans, and meet maintenance needs,” but went on to identify various gaps in city government’s control over other elements of its transportation strategy: It had to secure local or transit agency authority to levy a motor vehicle excise tax (MVET) at the City or County level. It had to work with regional and state partners to adopt a funding strategy to meet current and future transportation needs including mechanisms in which state legislative action is required, such as a city development authority that serves as an independent entity of Seattle government, or similar mechanism, forming public private partnerships in order to use district-based funding mechanisms; and a tax on unpaid off-street parking in commercial areas, to supplement the current commercial parking tax authority.

95 City of Portland, “Climate Action Plan,” June 2015, p. 43.

96 City of Seattle, “Seattle Climate Action Plan,” June 2013, p. 90.

To overcome lack of control, cities develop ways of influencing other levels of government that control important decisions and assets. Some of these are fairly traditional, but are applied to the challenges of climate action. They involve assembling political influence—aligning municipalities and stakeholders—and then engaging decision makers in other levels of government, lobbying for policy changes, intervening in regulatory matters, seeking appropriations. Often this requires the city to develop new expertise. **MINNEAPOLIS**, for instance, began to intervene in energy-supply planning cases at the state government’s regulatory body—tackling a set of complex issues for the first time.

Some cities explore the possibility of developing new decision-making structures, particularly at the regional level. **VANCOUVER** is one of more than 20 municipalities that shares infrastructure in its metropolitan region. A lot of the future growth will occur there but there is no regional structure for alignment and collaboration on GHG emissions reductions. Cities are constantly struggling with the challenge of translating success in the core city into a region-wide strategy that more thoroughly embeds the climate mitigation (and adaptation) goals into the planning and operations of regional infrastructure. **LONDON’S** Infrastructure Delivery Board (described earlier) offers an example of a new structure with intergovernmental, as well as private sector, representation. A variation of this approach is to obtain a “city seat” in existing structures for decision-making.

- ▶ Some cities have decided to purchase or otherwise acquire essential assets that they were having difficulty influencing. **BOULDER**, for instance, is in the process of legally forcing the electricity utility that serves the city to sell its assets to the city. This was necessary, concluded city officials, so they could rapidly convert the system to renewable energy and meet their carbon-emissions reduction targets. (For more details see the Energy Supply System chapter.)
- ▶ **COPENHAGEN** purchased a power plant and co-invested in a wind energy enterprise, and then sold a portion of its share of the company to citizens.

## Funding Climate Action Plans

Some, but not many, leading-edge cities’ climate action plans indicate what the potential cost of some strategies and actions are expected to be and what the potential sources of revenue might be.

- ▶ **COPENHAGEN** estimated that to achieve carbon neutrality by 2025 would require municipal investments of about DKK 2.7 billion (about US \$400 million), which was on par with municipal investments allocated in recent years. About half of that amount is for retrofitting municipal properties and replacing streetlights. The savings in energy consumption will have repaid a major part of the investment by 2025. When it came to private costs, the plan estimated it “will only have limited impact on the private economy of Copenhageners.” A couple with one child living in a flat and owning one car will save about 6,500 DKK (about US \$1,000) a year if they invest in energy measures and use their bikes more. The city estimated that requiring new buildings to meet highest building requirements would add about 5 percent to costs.

Any city’s ambitious decarbonization strategy requires funding—whether it is money to support city operations or money to incentivize consumer or business behaviors and investments. In general cities seek to address five types of funding challenges:

- ▶ How to obtain short-term operational funds to pay for programs to stimulate voluntary action (e.g., marketing campaigns)
- ▶ How to secure long-term capital to pay for public investments in infrastructure.
- ▶ How to design pricing signals that stimulate desired behaviors/investment by residents and businesses.
- ▶ How to design and fund programs to provide financial incentives/subsidies that stimulate desired behaviors/investments (e.g., energy retrofitting loans) by residents and businesses
- ▶ How to obtain operational funds to support increased enforcement costs due to new mandates

## APPLYING TRADITIONAL METHODS OF FUNDING

Cities can apply some traditional methods of funding public programs to their climate action plans:

### Applying Traditional City Funding Methods to Decarbonization Strategies

Climate Action Strategies	<ul style="list-style-type: none"> <li>• City budget</li> <li>• Philanthropy grants</li> <li>• In-kind services from local contractors</li> </ul>
Paying for Voluntary Action Programs	<ul style="list-style-type: none"> <li>• City budget</li> <li>• Sponsors/partners</li> <li>• Philanthropy grants</li> </ul>
Paying for Long-Term Public Investments	<ul style="list-style-type: none"> <li>• Capital borrowing/bonding</li> <li>• Earmarked fees/surcharges</li> <li>• City budget</li> </ul>
Sending Price Signals	<ul style="list-style-type: none"> <li>• Taxes, fees, surcharges</li> <li>• Differential pricing (e.g., monthly transit passes)</li> </ul>
Funding Incentives and Subsidies	<ul style="list-style-type: none"> <li>• Sharing private investor/lender risk</li> <li>• Reducing cost of financing to borrower</li> <li>• Co-investing with private sector</li> <li>• Tax credits</li> <li>• Cost-reducing or revenue-increasing waivers of regulations</li> </ul>
Paying for Increased Enforcement	<ul style="list-style-type: none"> <li>• City budget</li> <li>• Earmarked fees</li> </ul>

Given the political difficulties that may be involved in securing policies that increase taxes and other costs for city residents and businesses, it's not unusual for cities to initiate funding efforts in two ways:

► **“Low Hanging” City Funds**— Cities seek cost savings, such as those achieved by implementing energy efficiency measures in city facilities, or reprogram existing funds in budgets. For example, **SYDNEY** was the first Australian city to install LED street lights. With a third of the area’s more than 6,000 street and park lights replaced, the city achieved a 27 percent reduction in carbon emissions. “Once complete, the initiative will save the City up to \$800,000 per year in electricity bills.”<sup>97</sup> Sydney also undertook a \$6.9 million building energy and water efficiency retrofit of 45 city properties. “Annually, we estimate that the retrofit will reduce carbon emissions from our properties by 23 percent... and utility bills by more than \$1 million.”<sup>98</sup> Cities typically use the saved or repurposed funds to stimulate voluntary action, such as “green behavior” campaigns or to provide incentives for city residents and businesses to undertake, for example, energy-efficiency improvements, or in some cases to make public climate-action investments in public facilities as part of a “lead by example” strategy.

► **Willing Partner and Sponsor Funds**— Cities turn to willing stakeholders, typically in philanthropy or the corporate sector, to provide funds that support decarbonization planning processes, including access to technical capacities, or the design and testing of solutions. These allies’ funds mostly come in the form of one-time grants. However, some allies, such as the local business community, may be interested in taking responsibility for certain elements of a climate plan, such as development of green businesses or promoting the city’s post-carbon brand.

## INNOVATIONS IN FUNDING DECARBONIZATION

Leading-edge cities and other advocates are inventing a number of additional funding mechanisms to support deep decarbonization, including:

► **Carbon Taxes and Cap-and-Trade Markets for Carbon Emissions**— Only a handful of cities have put in place either a tax or market for carbon emissions. Tokyo established a local cap-and-trade emissions market for larger commercial buildings. Seven cities in China

<sup>97</sup> City of Sydney, “Sustainable Sydney 2030 Snapshot: Key Achievements 2012/13,” p. 1.

<sup>98</sup> City of Sydney, “Sustainable Sydney 2030 Snapshot: Key Achievements 2012/13,” p. 2.

have established local markets for emissions as pilots for a national trading scheme.<sup>99</sup>

- ▶ **BOULDER** levies a surcharge on electricity consumption (not strictly a carbon tax) that produces revenues used to fund energy-efficiency programs.
- ▶ Other cities — **LONDON** and **STOCKHOLM**, for instance — have established “congestion taxes” that increase the price of driving in certain places such as downtown districts. **LONDON** has set up an Ultra Low Emission Zone that will become effective in 2020; all cars, motorcycles, vans, minibuses and heavy goods vehicles will need to meet exhaust emission standards or pay an additional daily charge to travel within the zone.
- ▶ **Insurance and Financing Pricing** — Some cities (as well as advocacy groups) have explored the use of assessments of climate risks for public and private physical infrastructure (e.g., buildings, transport systems) to either increase or decrease the cost of insurance for and cost of financing infrastructure projects. Recognition of climate risks would increase the cost of insurance and financing, a price signal that would provide an economic incentive to change the design of projects or in other ways manage the climate risks.
- ▶ **Citizen Equity** — **COPENHAGEN** made it possible for residents to buy shares in the wind power enterprise it partly owns. The first wind farm created a Wind Turbine Cooperative that owned 10 out of the 20 wind turbines. The shares were sold to 8,650 members of the local community. Each share represents production of 1000 kWh/year and was sold for € 570.100
- ▶ **100-Year “Green” Municipal Bonds** — In 2014 the water and sewer utility for **WASHINGTON, D.C.** issued a \$350-million infrastructure bond with a 100-year maturity, part of the funding for its clean rivers project. Proceeds will be used to build a tunnel to transport stormwater and sewage to a wastewater treatment plant and reduce sewage overflows.

## STIMULATING INNOVATION IN CITY GOVERNMENT

In addressing climate change, leading-edge cities must develop and test new ideas for city policies and programs. They have to innovate, because few proven solutions exist and because any solution has to be adapted to the city’s specific context. Some cities establish internal “innovation units,” often within the top executive’s office. Other cities use their engagements with consultants and stakeholders to generate new thinking that can be used. A number of cities have established innovation funds to encourage and support innovation.

- ▶ **OSLO** dedicated EUR 8.125 million annually to the city’s Climate and Energy Fund to encourage research and development, as well as innovations in renewable energy and energy saving technologies.
- ▶ **STOCKHOLM** created a competition among city departments to fund the best ideas for addressing climate change between 2015-2018. (This is 1 billion krona, about US \$120 million, out of an annual city budget of about 40 billion krona.)
- ▶ **WASHINGTON, D.C.** has a Green Building Fund that provides grants to fund innovation and research that will support its green buildings strategies. Funds have been used to study mortality and the urban heat island effect, develop a Green Building Program manual, train bankers and appraisers about the value of green buildings, and to create a way to add green building attributes and analysis to real estate listings.
- ▶ **VANCOUVER** has a Greenest City Fund of \$2 million (funded in partnership with the Vancouver Foundation) that provides grants to citizens that help implement the Greenest City action items.

99 Innovation Network for Communities, “Cities and Carbon-Emissions Pricing, July 2015, <http://www.in4c.net/files/Cities-and-Carbon-Emissions-Pricing-Final-Report-7.2.15.pdf>

100 City of Copenhagen, “Copenhagen: Solutions for Sustainable Cities,” p. 23.

# Resources

<p><b>Cities and Carbon-Emissions Pricing</b></p>	<p>Innovation Network for Communities</p>	<p>An examination of the potential use by cities in the United States of mechanisms for pricing carbon emissions.</p>
<p><b>New Climate Economy Report</b></p>	<p>New Climate Economy</p>	<p>Annual report (since 2014) quantifying how countries at all levels of income can achieve economic growth while combating climate change.</p>
<p><b>Risky Business: The Economic Risks of Climate Change to the United States</b></p>	<p>Risky Business</p>	<p>This study, completed in 2007, evaluated both uses a standard risk-assessment approach to determine the range of potential consequences for each region of the U.S.—as well as for selected sectors of the economy—if we continue on our current path.</p>
<p><b>Yokohama FutureCity and energy action plans (March 2015, in Japanese)</b></p>	<p>Yokohama</p>	<p>Yokohama’s “FutureCity” and energy action plans.</p>





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It is possible to achieve many of the interim carbon reduction targets through continuous improvement in existing systems.

But achieving “80x50” reductions will require transformative and systemic changes in many core city systems.

*Carbon Neutral Cities Alliance  
Copenhagen Meeting, June 2014*