



CITIES 100

→ 100 solutions for
climate action in cities

2016



10

SECTORS

61

CITIES

100

SOLUTIONS

The paper and color
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A special thank you goes out to all the cities that submitted an application for the Cities100. You have all been a great source of inspiration.



→ 100
solutions
for climate
action in
cities

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Foreword

→ Think globally, act locally

How mayors will deliver the aims of the Paris Agreement

Mayors may not have coined the phrase “think globally, act locally” but they are definitely the biggest proponents of it. This is the mindset that local leaders around the world have not only adopted, but entrenched into their policies as they seek to combat global climate change. It is with this approach that I work to develop and implement policies that will clean Paris’ air, green its buildings, and give its streets back to the people – **local actions that, when added up, improve our entire planet**. This is also the framework that underpins every project featured in this year’s Cities100. These 100 city solutions bring to center stage the fact that local action is the foundation for mitigating and adapting to climate change globally.

Mayors were on the global stage last December, as I welcomed – with UN Secretary-General’s Special Envoy for Cities and Climate Change Michael Bloomberg – local leaders from around the world to attend an historic summit at Paris City Hall. I was inspired by their commitments. We discussed how cities could take coordinated and collective action to combat climate change. The result sent a clear message. In agreeing to deliver up to 3.7 gigatons of urban greenhouse gas emissions reductions annually by 2030 and supporting a long-term goal of reducing emissions by 80% by 2050, these **mayors took a stand to protect their citizens, their resources, their businesses, and the future of their cities**.

It has become obvious that cities play a critical role in adapting to climate change and delivering on the ambition of the Paris Agreement. Urban areas account for most of the world’s carbon emissions, and their share will continue to increase as two-thirds of the world will call cities home by 2050. **Such booming populations bring with them challenges, but also myriad opportunities to adapt and grow sustainably. As Cities100 showcases, cities around the world are already capitalizing on these opportunities and employing local solutions** that not only reduce CO₂ emissions and boost resilience, but also promote health, bolster economic vitality, and alleviate social inequities.

What happened during COP21 in Paris will guide our global thinking for the coming decades. As newly-elected C40 Chair, it is my duty to ensure that mayors around the world will look to and learn from front-running cities’ innovative projects and plans showcased in Cities100, as we all work to build a better future and cultivate strong, sustainable societies. This is how cities will keep on getting the job done.

ANNE
HILDALGO
WILL SERVE AS
C40 CHAIR AS OF
DECEMBER 2016



"THESE 100 CITY SOLUTIONS BRING TO CENTER
STAGE THE FACT THAT LOCAL ACTION IS
THE FOUNDATION FOR MITIGATING AND ADAPTING
TO CLIMATE CHANGE GLOBALLY."

Anne Hidalgo

C40 Chair-Elect and Mayor of Paris



Introduction

→ City Solutions for an Urbanizing World

Last December, the Paris Agreement signed at COP21 cemented the fact that urgent action is needed to solve the many challenges of climate change. Cities100, now in its second year, proves that innovative and progressive climate action is well underway in cities around the world. From reducing waste to promoting walkability, retrofitting buildings to installing green infrastructure, the 100 solutions from 61 cities presented here showcase how local governments around the world are taking the necessary steps to mitigate and adapt to climate change, while at the same time creating valuable co-benefits for their economies, communities, and citizens' health.

These 100 solutions were selected after a review of 160 submissions from 75 cities spread across the globe. By identifying 100 readily available city solutions, the partners behind Cities100 – C40, Realdania, and Sustainia – wish to highlight the potential for a sustainable urban future and inspire other change makers throughout the world.

How we uncovered the 100 projects

Cities100 is a mission shared by Sustainia, C40, and Realdania to find the 100 leading city solutions to climate change. To identify groundbreaking projects from around the world, C40 and Sustainia launched a public campaign for applications, which yielded 160 eligible project submissions. In order to find the projects with the largest potential to create low-carbon and resilient cities, the applications were vetted and assessed by city and climate change experts at C40 and Sustainia, who used a detailed scoring system based on five criteria:

1

CLIMATE ACTION

The expected or achieved CO₂ reduction and/or climate risk mitigation of the project.

2

CO-BENEFITS

The extent to which the project has positive co-benefits for other aspects of society, in addition to its climate change mitigation and CO₂ reductions.

3

INNOVATION

The extent to which the project takes an entirely new or groundbreaking approach to address major environmental issues.

4

GOVERNANCE

How well the project is incorporated into larger city plans, collaborates with other entities in the city, and engages citizens in the project's development and implementation.

5

SHARING AND SCALING

The extent to which the project experience is shared with other cities and regions, and the future potential to scale the project within the city.



WHAT IS SUSTAINIA?

Sustainia is an international sustainability think tank and consultancy working to accelerate action towards a sustainable future. In order to realize this, we partner with companies, cities, and organizations to map their position, navigate the changing landscape, and communicate with impact. Sustainia is founded by Scandinavian think tank Monday Morning and developed in close collaboration with UN Global Compact, Regions20, Connect4Climate, and world-leading companies and organizations, DNV GL, Realdania, Storebrand, and WWF.



WHAT IS C40?

The C40 Cities Climate Leadership Group, now in its 11th year, connects more than 85 of the world's greatest cities, representing 650+ million people and one quarter of the global economy. Created and led by cities, C40 is focused on tackling climate change and driving urban action that reduces greenhouse gas emissions and climate risks, while increasing the health, wellbeing and economic opportunities of urban citizens. The current chair of the C40 is Rio de Janeiro Mayor Eduardo Paes; three-term Mayor of New York City Michael R. Bloomberg serves as President of the Board. C40's work is made possible by three strategic funders: Bloomberg Philanthropies, Children's Investment Fund Foundation (CIFF), and Realdania.



WHAT IS REALDANIA?

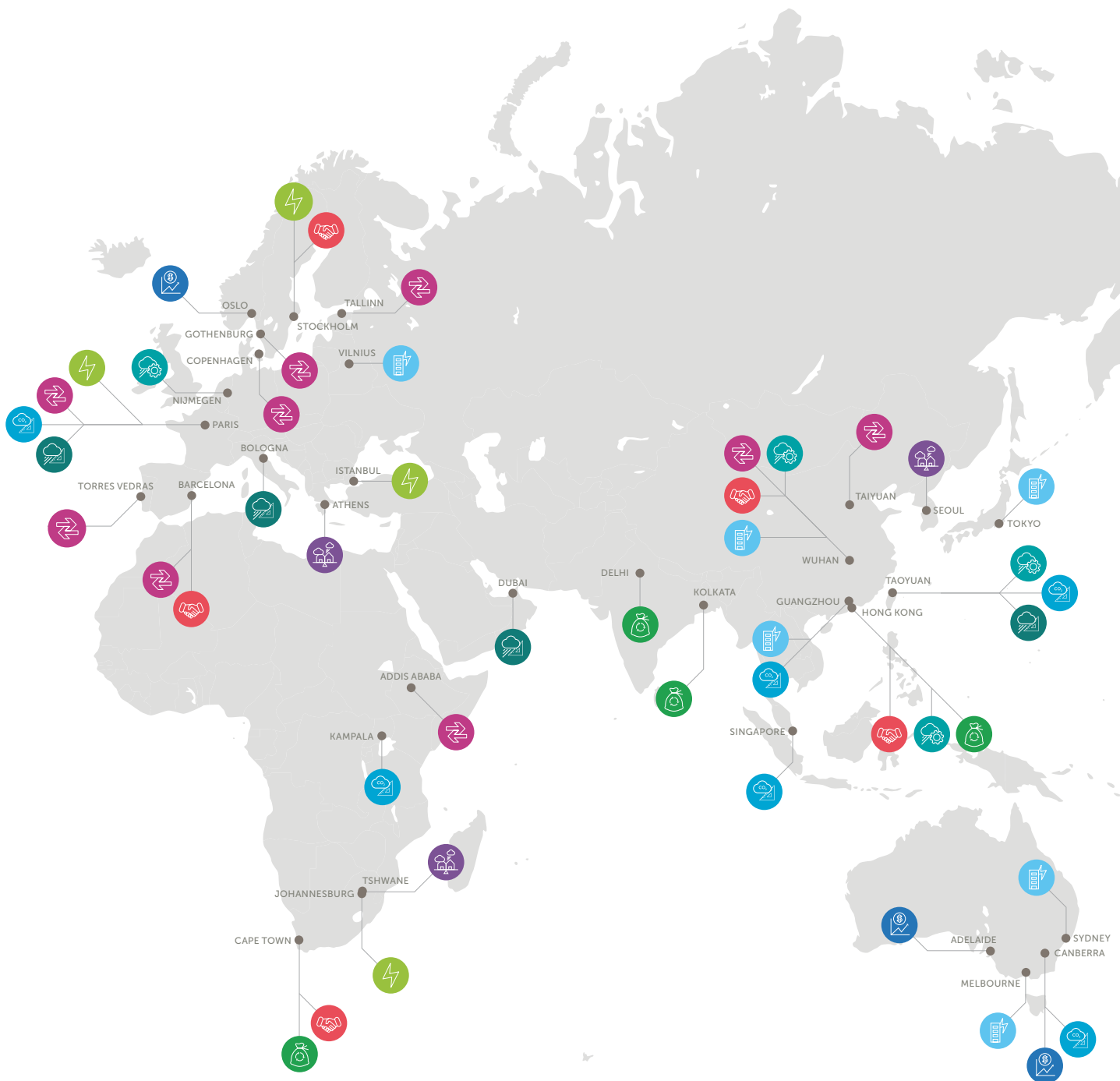
Realdania is a Danish, modern philanthropic association that works to create quality of life and benefit the common good by improving the built environment: cities, buildings, and the built heritage. Realdania is both a Strategic Funder of C40 and a Founding Partner of Sustainia.



World Map

→ Putting City Solutions on the Map

Cities100 is a testament to the fact that cities are leading the global movement toward a low carbon future.



THIS PUBLICATION PRESENTS SOLUTIONS WITHIN 10 CITY SECTORS:

-  CLEAN ENERGY
-  SOLID WASTE
-  ADAPTATION PLANS & ASSESSMENTS
-  ADAPTATION IN ACTION
-  CLIMATE ACTION PLANS & INVENTORIES
-  BUILDING ENERGY EFFICIENCY
-  FINANCE & ECONOMIC DEVELOPMENT
-  SOCIAL EQUITY & CLIMATE CHANGE
-  TRANSPORTATION
-  SUSTAINABLE COMMUNITIES





CLEAN ENERGY



STOCKHOLM

*Large Biomass Plant Powers
Fossil Fuel-Free Future*
P. 18



ISTANBUL

*Automated Measuring
Supports Biogas Project*
P. 16



PARIS

*Greening District Heating
Cuts Emissions*
P. 20



JOHANNESBURG

*Waste-to-Energy
Partnership Saves Money*
P. 19

→ The solutions in the Clean Energy sector highlight the use of policy to usher in widespread adoption of renewable energy, the growing role of data to deliver efficiency clean energy rollouts, and how new technologies increase the viability of waste to energy systems to deliver large scale outputs.



VANCOUVER

*North America's First
Renewably Powered City*
P. 15



BOSTON

*Mapping Energy Use to
Boost Resilience*
P. 22



WASHINGTON, D.C.

*World's Largest
Thermal Hydrolysis Plant*
P. 14



NEW YORK CITY

*Legal Ordinance
for Solar-Powered Buildings*
P. 23

CITY: WASHINGTON, D.C.



World's Largest Thermal Hydrolysis Plant

↓219

METRIC TONS OF CO₂ EMISSIONS ARE ELIMINATED EVERY DAY BY THE WALTER F. BAILEY BIOENERGY FACILITY

THE CHALLENGE

Similar to other major cities, Washington, D.C. is affected by fluctuating energy prices. By investing in the thermal hydrolysis facility, the city provided itself a self-sufficient energy system that decreases its vulnerability to energy price fluctuations and increases its long-term resilience to climate change.

CO-BENEFITS



Environmental

DC Water, the District's water utility, will process 200,000 tons of biosolids per year into nutrient-rich soil that meets or exceeds all Environmental Protection Agency standards for soil production and use in rural and urban settings.



Economic

DC Water is saving \$10 million per month. The savings are reflected in customer rates.



Health

The efficient thermal hydrolysis process eliminates the need for 40 daily truck trips to haul biosolids offsite for land application in Virginia, improving air quality in the region.

→ The largest thermal hydrolysis installation in the world helps Washington, D.C. produce bioenergy more efficiently while turning waste into a productive resource.

Washington, D.C. has brought to scale one of the most innovative waste-to-energy technologies by building the Walter F. Bailey Bioenergy Facility, the largest thermal hydrolysis installation in the world. The system **produces 10 MW of electricity** and supplies one-third of the power requirements of the connected Blue Plains wastewater facility. Thermal hydrolysis is a process in which remaining solids from wastewater treatment are exposed to high heat and pressure that weaken the cells' structure and accelerate the production of methane as the solids biodegrade. The methane is used to generate energy; steam generated in the process is then fed back into the system to assist the initial heating step.

As the procedure purifies the remaining waste solids, or biosolids, which can then be used as natural fertilizers, **thermal hydrolysis transforms waste into a productive resource** with positive benefits for the environment. The sanitized residue is used around the District as a natural fertilizer for urban gardens and green infrastructure projects, and the city is planning a large-scale commercialization of the fertilizer.



The facility includes a dewatering building, 32 thermal hydrolysis vessels, and four concrete anaerobic digesters that can hold 14.3 million liters of solids.

CITY: VANCOUVER



North America's First Renewably Powered City

↓ 80%

REDUCTION OF GREENHOUSE GAS EMISSIONS, FROM 2007 LEVELS, BY 2050 DUE TO THE RCS

THE CHALLENGE

In recent years, Vancouver has grown significantly and now uses more than 59.3 million gigajoules (GJ) of energy a year, resulting in 2.8 million tons of CO₂ emissions. By using innovative energy models to target the sectors most responsible for greenhouse gas emissions, buildings and transportation, the city is mitigating its carbon footprint and working toward its goal of using only renewable energy by 2050.

CO-BENEFITS

Environmental

The cumulative effect of the strategy, when fully implemented by 2050, is to reduce the city's total energy use by one-third compared to 2014 levels, saving 21 million GJ of energy a year.

Social

The city plans to permanently ban car traffic on a number of downtown streets under the RCS in order to create vibrant and active public spaces.

Economic

The shift to renewable energy promotes innovation and the development of new business models and technologies that can boost employment in green sectors.

Health

The RCS is closely tied to Vancouver's Healthy City Strategy, a comprehensive plan for social resilience and sustainability.

→ Vancouver's ambitious vision to power the city entirely on renewable energy will help curb emissions from its two biggest emitters: transport and buildings.

Vancouver is the first city in North America to develop a Renewable City Strategy (RCS) to derive **100% of the city's entire energy needs from renewable sources by 2050**. To achieve this goal, the city is prioritizing efforts around reducing emissions from its most polluting sectors, buildings and transportation, and increasing the use and supply of renewables. In the transport sector, this includes measures such as the promotion of renewably powered car-sharing fleets and the development of standards to support renewably powered private vehicles. Simultaneously, retrofits of existing buildings and ensuring the grid energy supply is 100% renewable will spur the clean energy shift for the city's building stock.

Underpinning the strategy is an **innovative energy system model that maps energy demand** across the year and by time of day, matching it with an energy supply model to identify the most economical ways energy demand can be met by renewable sources. In this way, Vancouver is using cutting-edge technology – employed for the first time by a municipality – to solve pressing energy concerns and guide plans for a 100% renewable future.



CITY: **ISTANBUL**



Automated Measuring Supports Biogas Project

↓ **5M**

TONS OF CO₂ EMISSIONS WERE REDUCED BETWEEN 2011 AND 2015 BY THE LANDFILL GAS-TO-ENERGY OPERATIONS

THE CHALLENGE

Half of Turkey's electricity generation is supplied by natural gas that has to be imported. By investing in its landfill gas-to-energy project, Istanbul is creating an affordable power source while decreasing its dependency on foreign gas.

CO-BENEFITS



Environmental

Between 2011 and 2015, the project avoided emissions equivalent to those from 800,000 cars.



Social

Ninety-three permanent workers are needed to operate the facilities and approximately 100 workers were employed during its construction.



Economic

By generating electricity locally from waste at Istanbul's two landfills, the project decreases the need for government expenditure on foreign energy sources.



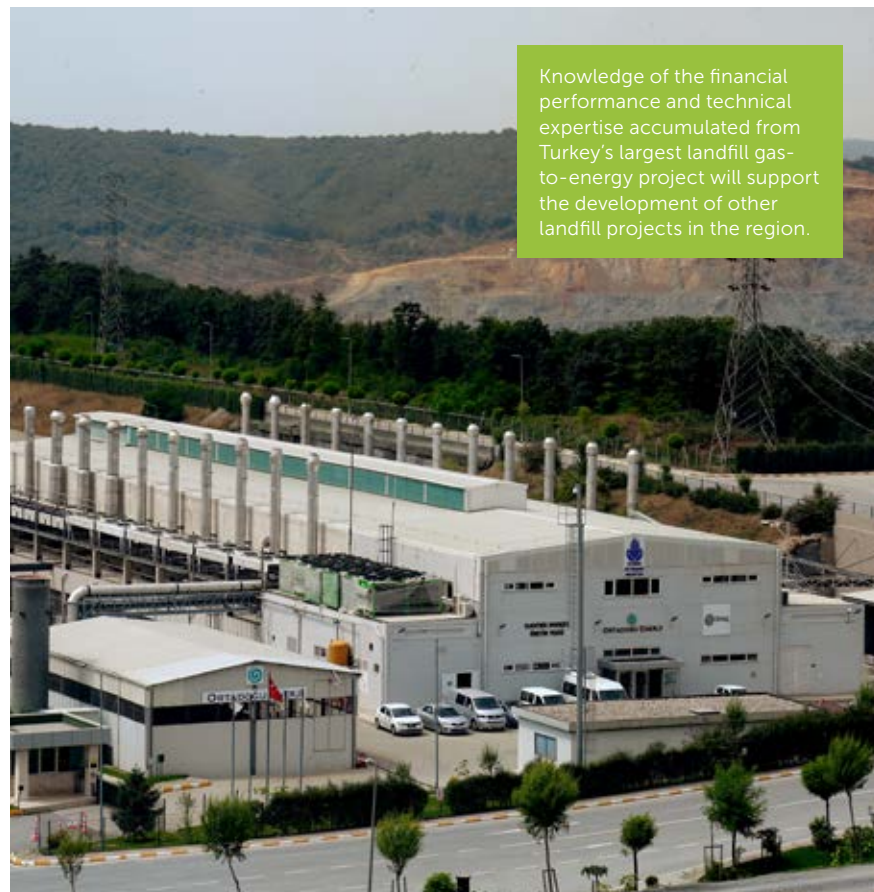
Health

The project's collection system prevents methane from polluting the nearby air and groundwater, which is detrimental to residents' health.

→ Istanbul now boasts Turkey's largest landfill gas-to-energy facility, equipped with automated measuring and able to adjust to gas flows, which delivers energy for almost 200,000 families.

Located in Istanbul, Turkey's largest landfill gas-to-energy project **generates 50 MWh, enough to provide electricity for 200,000 families**. The project consists of two power plants, located close to the Kömürcüoda and the Odayeri landfills. At each landfill site, wells and pipes dug through solid waste collect methane gas and transfer it to a heat exchanger and demister for cooling and dehumidification. The treated gas feeds a combustion engine that drives an electric generator that supplies power the national grid.

Setting Istanbul's landfill gas-to-energy site apart from others is the fact that its facilities are equipped with an automatic measurement and adjustment system that **controls the flow of gas from the 500 wells and 50 pipelines** dispersed throughout the landfill sites. As a result of the landfill gas-to-energy project, potent methane gas emissions are mitigated and the equivalent of approximately 1.2 million tons of CO₂ emissions per year were avoided between 2011 and 2015.





CITY: **STOCKHOLM**



Large Biomass Plant Powers Fossil Fuel-Free Future

↓ **126K**

TONS OF CO₂ EMISSIONS WILL BE REDUCED ANNUALLY BY THE CHP PLANT

THE CHALLENGE

Stockholm aims to reduce per capita greenhouse emissions to 2.3 tons by 2020 and rely on 100% renewable energy by 2050. Powered by sustainably and locally sourced wood waste, prevalent in the region, the large CHP KVV8 will play a key role in growing and diversifying the city's renewable energy system while reducing the global climate impact of the district heating system.

CO-BENEFITS



Environmental

The plant will decrease greenhouse gas emissions equivalent to approximately 12% of the annual emissions from the Stockholm's area transport sector.



Economic

This project will help secure and create jobs in sustainable forestry.



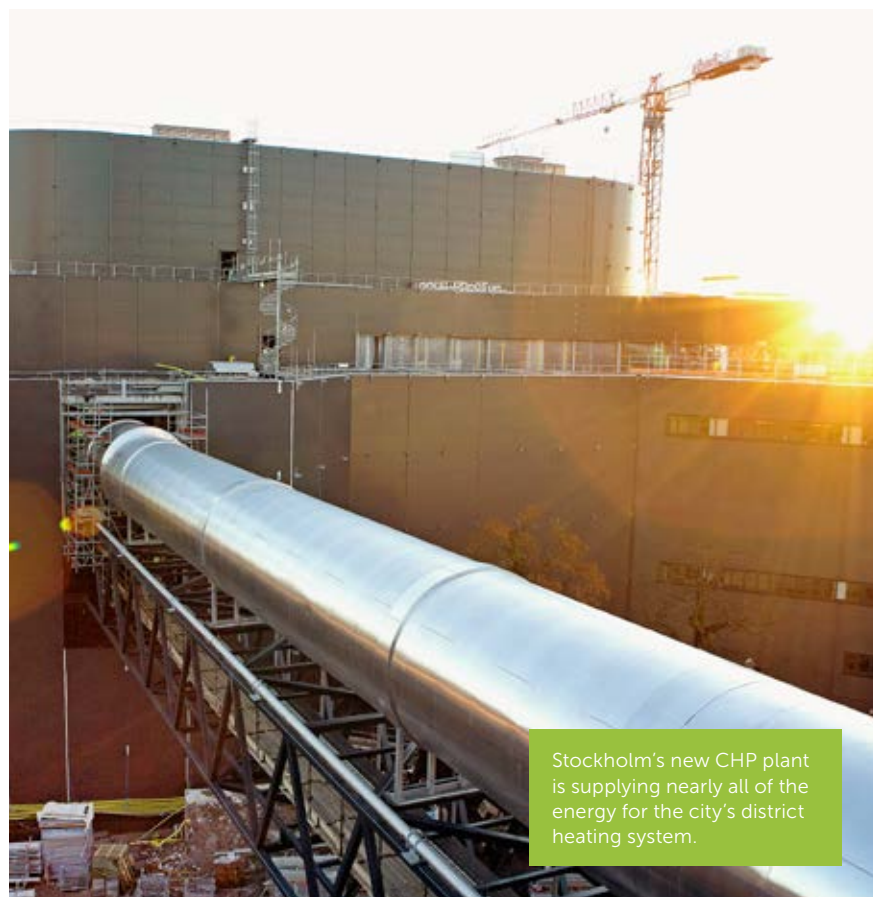
Health

CHP KVV8 reduces the use of fossil fuels and will reduce emissions of NO_x and particulates in the area, which will help mitigate the incidence of related respiratory disease.

→ By using a large-scale biomass plant to power its district heating system, Stockholm is inching closer to its goal of using 100% renewable energy by 2050.

Through its new combined heat and power plant, CHP KVV8, Stockholm is **powering 90% of its district heating system with renewable energy**. The biomass used to power the plant consists mostly of locally sourced forest residue and wood waste that has received Forest Stewardship Council certification. Flexible operations enable the plant to adjust the production of both heat and electricity to meet current demand, helping the city achieve energy efficiency gains. When fully operational in 2017, CHP KVV8 will provide 1,700 GWh of heat and 750 GWh of electricity annually, generating enough heat for 190,000 households.

The large-scale plant contributes to Stockholm's goals of reducing CO₂ emissions, improving air quality, and ultimately becoming **a fossil fuel-free city by 2050**. Along with wind and solar power, the CHP KVV8 plant, managed by Fortum Värme, a joint venture between the city and the energy company Fortum, will form the backbone of the city's renewably powered future.



Stockholm's new CHP plant is supplying nearly all of the energy for the city's district heating system.

CITY: **JOHANNESBURG**



Waste-to-Energy Partnership Saves Money

↑13

MW OF ENERGY FROM BIOFUEL WILL BE HARNESSSED FROM THE CITY'S LANDFILLS WHEN THE PROJECT IS EXPANDED TO INCLUDE ALL FIVE LANDFILLS

THE CHALLENGE

The procurement and use of energy is an expensive and often polluting endeavor for cities. Through its biogas-to-energy project, Johannesburg is mitigating those impacts while also reducing methane emissions and turning waste into a productive resource.

CO-BENEFITS



Environmental

The project helps mitigate methane gas emissions, which are more potent than CO₂.



Economic

With the biogas-to-energy project, the Northern Water Treatment plant saves money previously used to purchase electricity from the local power utility.



Health

The project ensures better waste management at landfills and wastewater treatment plants, which reduces potential environmental contamination, and related negative health impacts for nearby communities.

→ Johannesburg is putting its wastewater and landfill methane emissions to productive use with a biogas-to-energy project, at a minimal cost for the city.

In 2011, Johannesburg launched a project to transform methane emissions from wastewater and landfill waste into energy. The project currently **supplies 1.1 MW of electricity to the Northern Water Treatment plant**, the largest in the city, which is equivalent to 12% of the plant's operational needs. The city plans to expand the project to four other wastewater plants. In addition, to further scale up this solution, Johannesburg will partner with an energy management services company to develop biodigestors that will process organic waste from the city's five landfills, turning it into biogas used to fuel the city's bus fleet.

Recognized as a Clean Development Mechanism project by the United Nations Framework Convention on Climate Change, this initiative is the result of a public-private partnership wherein the city provides the rights to the landfill gas to the developer, who is responsible for financing and operating the project. This arrangement enables the city to **undertake the project risk-free** while receiving royalties from the developer.



The project has been allocated a 20 year power sale agreement for 13MW of generation capacity from the five landfill sites under this program.

CITY: **PARIS**



Greening District Heating Cuts Emissions

↓350K

TONS OF CO₂ REDUCED PER YEAR BY POWERING 50% OF PARIS'S DISTRICT HEATING WITH RENEWABLE ENERGY

THE CHALLENGE

Paris' district heating network is the largest in France, and the 11th largest in the world. By applying proven technology on such a large scale, and divesting from coal in order to adopt a renewable energy mix to power the heating system, the city is realizing significant reductions in CO₂ and improving urban air quality.

CO-BENEFITS



Environmental

The shift from coal to gas plants led to better air quality in the Paris region due to a 90% decrease in dust and 85% decrease in NO_x.



Social

Due to the project, the tax on energy prices decreased from 20% to 5%, which will lead to cheaper heating bills for citizens.



Economic

By diversifying the district heating system's renewable energy mix, the city is fostering the development of new technologies and innovation in new energy sources.



Health

The end of heavy fuel exploitation in the heat plants is reducing noise pollution for the nearby communities.

→ Paris is transforming its energy portfolio by powering 50% of its district heating network with a mix of new renewable energy sources.

In 2016, Paris halved the use of coal in its extensive district heating network, and now powers **50% of the heating network with renewable and recovered energy**. The new energy mix comprises 1% geothermal, 2% biofuel, 10% biomass, and 41% heat generated by the thermal treatment of waste. The city is also converting five power plants from coal to natural gas. This shift will contribute to a 25% decrease in CO₂ emissions, a 98% decrease in SO₂ emissions, and will generate enough energy to heat 500,000 houses.

This large-scale transition helps the city **increase its share of renewable energy sources by up to 10%**, and works towards fulfilling Paris' commitment that 25% of its energy consumption will be powered by renewable or recovered sources by 2020. The goal works within the larger framework of Paris's Climate Action Plan, which aims to reduce the city's CO₂ emissions by 25% by 2020.



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CITY: **BOSTON**

Mapping Energy Use to Boost Resilience

↓ **21%**

REDUCTION IN CO₂ EMISSIONS CAN BE ACHIEVED THROUGH UPTAKE OF SUSTAINABLE HOUSING MICROGRIDS

THE CHALLENGE

Boston aims to supply 15% of its energy through combined heat and power by 2020 and reduce its greenhouse gas emissions by 80% by 2020. The energy map project is crucial to achieving these goals as it provides a better understanding of the city's energy use and identifies opportunities for local energy supply while reducing the vulnerabilities of communities and businesses.

CO-BENEFITS



Environmental

By tailoring local clean energy generation to fit demand, multi-user microgrids can reduce greenhouse gas emissions by 15%.



Social

The project aims to educate residents and businesses in Boston on the potential for district energy and microgrids, especially those located in areas where community energy solutions are suitable.



Economic

An analysis of potential projects calculated a return on investment of \$629 million when CO₂ reductions were optimized.

→ Boston has created a detailed map that tracks hourly building energy use in order to show patterns of energy demand and assess the feasibility of potential local generation.

As part of the Boston Community Energy Study, the city developed one of the most detailed city energy maps in existence in order to scope where local clean energy generation, district energy, and microgrids are feasible at a community scale. The map **tracks the hourly energy use of 85,000 buildings in Boston**, including commercial buildings, affordable housing, and critical facilities like shelters and food warehouses. With a 94% accuracy level for detecting electricity consumption, the map also takes into consideration hypothetical engineering solutions and assesses the feasibility of local clean energy generation. Using this information, potential projects are assessed according to their contribution to community resilience, energy costs, and greenhouse gas emissions reduction.

To date, the map has **pinpointed 42 districts where renewable energy supply is feasible**. The city plans to reach out to communities and partner with energy utilities in the second step of the project in order to realize community energy solutions. Boston will work with a local electric utility to study its first pilot project, a multi-user microgrid in the city's industrial park.





Legal Ordinance for Solar-Powered Buildings

↓ 35K

METRIC TONS OF CO₂ EMISSIONS WILL BE REDUCED BY SOLAR PROJECTS BY 2025

THE CHALLENGE

Buildings are responsible for nearly three-quarters of New York City's greenhouse gas emissions. Recognizing that the expansion of renewables is key to a comprehensive strategy to mitigate the climate impact of building energy use, the ordinance is reducing the city's own carbon footprint and serving as an example to the private sector.

CO-BENEFITS



Environmental

Energy storage is coupled with solar PV in flood-prone areas in order to prepare for power loss or urgent need for additional electricity.



Social

Solar installations at schools are paired with a renewable energy educational curriculum in classrooms.



Economic

The city's initiative will create 160 jobs in the renewable energy sector by 2025.

→ New York City's government agencies are now legally required to assess potential solar PV retrofits at all municipal buildings.

In 2016, New York City passed a law requiring local government agencies to **assess all city-owned rooftops for solar photovoltaic (PV) potential**, in order to support the city's goal to install 100 MW of solar PV on municipal property by 2025. Agencies must report on factors including the potential reduction in energy use and greenhouse gas emissions, the financing of the project, and whether buildings' rooftops are suitable for a solar installation. In keeping track of the projects, the city will also take into consideration the financial savings accruing from CO₂ emissions reductions in order to better reflect the value of the retrofits.

To date, **the city has installed 8.8 MW of solar PV across 52 municipal buildings**. Informed by the government agencies' evaluations, New York City plans to develop a strategy to expand the initiative to 4,000 city-owned buildings, which include schools, hospitals, libraries, courthouses, firehouses, offices, police precincts, wastewater treatment plants, and recreation centers, and which will help the city reach its goal to reduce city-wide greenhouse gas emissions 80% by 2050.



Every two years the city will report on the solar potential of all viable city-owned buildings covering at least 929 m².



SOLID WASTE



KOLKATA

Segregating Waste Leads to a Better Quality of Life
P. 28



DELHI

Turning Waste into Energy and Better Livelihoods
P. 31



HONG KONG

Recycling Centers Cut Waste and Spur Behavior Change
P. 34



CAPE TOWN

Turning Trashed Bins into Trash Bins
P. 37



AUCKLAND

System Overhaul Reduces and Diverts Waste
P. 26

→ Solutions in the Solid Waste sector help cities transform waste resources into clean energy and raw materials, effectively manage waste collection and separation, and promote behavioral change among residents, proving the potential to reduce greenhouse gas emissions from city waste while providing co-benefits such as reduced air and soil pollution and fossil fuel consumption.



EUGENE

*Food Waste
Is Given New Value*
P. 32



BOGOTA

*Waste-to-Energy Project
Supplies National Grid*
P. 33



BUENOS AIRES

*Four Waste Streams
Processed at One Facility*
P. 30



QUITO

*Creating Electricity and
Compost from Organic Waste*
P. 27



SALVADOR

*Tree Planting Project
Sequesters and Reduces
CO₂ Emissions*
P. 36

CITY: **AUCKLAND**



System Overhaul Reduces and Diverts Waste

↓ **8.4%**

REDUCTION IN CO₂ EMISSIONS
PER CAPITA SINCE LAUNCHING
THE PROJECT

THE CHALLENGE

In 2013, 9.3% of Auckland's greenhouse gas emissions came from waste, with 1.2 million metrics tons sent to landfill in 2011. At the same time, around 65% of curbside collected waste could be recovered, re-used, or recycled. The Auckland Waste to Resources project mitigates these issues and puts the city on track to achieve zero waste status by 2040.

CO-BENEFITS



Environmental

Domestic curbside waste has dropped from 160 kg per person in 2010 to 152 kg per person in 2015, before city-wide service changes had even been rolled out.



Social

The 20 community recycling centers opened under the project are expected to provide at least 85 new jobs, with one-quarter of current positions filled by those who were among the long-term unemployed.



Economic

Under the Waste to Resources project, community groups are repurposing materials into saleable goods, creating a new source of revenue for the city.



Health

In its efforts to promote waste reduction and diversion, the project encourages healthy eating and community gardening, with one Maori community planting 80,000 sweet potato plants as part of the project.

→ In a complete overhaul of the city's waste management system, Auckland's Waste to Resources project has put the city on track to achieve zero waste by 2040.

In efforts to achieve zero waste by 2040, Auckland initiated the Waste to Resources project in 2012, diverting materials from the waste stream and improving resource efficiency throughout the city. As one of the biggest changes in waste management in the Southern Hemisphere, **seven regional services were folded into one** improved city-wide waste management system. The city aims to have new services rolled out progressively by 2020, such as a network of community-led resource recovery centers, a third bin collection for food waste, and a new inorganic waste service that diverts useful material to community organizations.

Waste reduction is being encouraged through right-sizing of refuse bins and pay-as-you-throw pricing, while an innovative community-based approach is using creativity to engage residents in driving locally inspired and owned solutions. This active citizen engagement plays a critical part in helping the Waste to Resources project contribute to the city's overall goal of **reducing CO₂ emissions by 40%** by 2040.



Children learn about composting through Auckland's The Waste to Resources project.

© Luke Harvey

CITY: QUITO



Creating Electricity and Compost from Organic Waste

↓ 13.2%

REDUCTION OF CO₂ EMISSIONS BY 2016 IN BURNING BIOGAS FOR ELECTRICITY

THE CHALLENGE

In Quito, an average of 1,877 tons of waste is sent to the Inga landfill per year, accounting for 13% of the city's carbon footprint. Sixty percent of waste in Inga landfill is organic, and its decomposition results in the generation of methane, contributing to climate change. By recycling, composting, and generating biogas through the Organic Waste and Climate Change project, Quito is reducing emissions and giving waste a new purpose.

CO-BENEFITS



Environmental

Since 2015, 37,723 tons of paper and cardboard have been recycled through the project, preventing CO₂ emissions from future logging and production.



Social

The project will link 280 small-scale recyclers, a vulnerable sector of the population, ensuring access to minimum wage.



Economic

The waste market is expected to expand, with 13,249 new jobs for material traders arising through the project.



Health

By diverting waste from the landfill, the project improves the hygiene of municipal markets, reducing the risk of infections.

→ Quito is reducing emissions and changing the definition of waste by generating clean energy, creating compost, and recycling paper and cardboard as part of the Organic Waste and Climate Change project.

Under its Development and Land Use Plan, in 2015 Quito launched an integrated waste management project based on the concept of a circular economy, while encouraging social and environmental co-responsibility. The Organic Waste and Climate Change project has three elements: generate 5 MW of electricity by 2017 with landfill biogas, **process 12 million tons of organic waste into compost** through the construction of a municipal organic waste processing plant, and improve paper and cardboard recycling by means of waste recovery, processing, and commercialization. The project aims to achieve a 33% reduction in greenhouse gas emissions from waste, which is equivalent to approximately 300,000 tons of CO₂, by 2017.

Citizen engagement is key to the project's success, and has been carried out using a combination of **outreach campaigns, public meetings, environmental forums**, and social media. Information about the project has been made open and transparent for everyone, aiming to include all sectors of society in decision-making.



Each of Quito's two biogas generators capture and utilize 230,000 m³ of methane gas per day.

CITY: **KOLKATA**



Segregating Waste Leads to a Better Quality of Life

↓ **35%**

REDUCTION IN OPEN DUMPING SINCE THE PROJECT LAUNCH

THE CHALLENGE

Mounds of waste at the Kolkata dumping site have measured up to 16 m high, causing land, water, air, and visual pollution. Furthermore, disposal of untreated sewage and waste dumping in the River Ganges has resulted in the extinction or endangerment of biodiversity in the area. The Kolkata Solid Waste Management Project has taken actions, through the segregation and appropriate management of waste, to reduce these hazards to the natural environment and the people of the city.

CO-BENEFITS



Environmental

Under the Kolkata Solid Waste Management Project, uncontrolled decomposition of waste that generates methane and carbon dioxide has been reduced and will eventually be prevented.



Social

Many job opportunities have been provided through the implementation of the project, particularly to unskilled citizens, in waste collection and producing and selling compost.



Economic

A new market has been created for compost, as one of Kolkata's boroughs, covering 10.9 km², can produce more than 25 metric tons and earn approximately \$1,026 per day.



Health

Since the launch of the Solid Waste Management Project, the city reports a gradual decrease in disease, such as skin and liver ailments, jaundice, malaria, and poliomyelitis, reducing pressure on the health system.

→ In an effort to end waste burning, Kolkata is segregating its waste under the Solid Waste Management Project, creating a cleaner, healthier city while raising community awareness.

The Kolkata Solid Waste Management Project encourages segregation of waste, a feat that had never been accomplished before in the city. Targeting 1 million people across six boroughs and covering over 65 km² of land on the western bank of the River Ganges, the project focuses on recycling, composting organic waste, burying inert waste, and treating septic sludge. The project takes an engineering approach, through the development of infrastructure, but also incorporates a soft approach, including an **eight-year mass awareness program**, ensuring community participation. A common Regional Waste Management Centre, which houses a sanitary landfill, leachate treatment plant, and septic tank sludge treatment plant, as well as five composting centers, have been constructed, as part of the project.

Eventually, the ambitious project aims to **reduce open dumping and waste burning by 100%** and achieve 100% waste segregation at the source. In addition, the project will monitor air quality, reduce the concentration of landfill methane, and preserve groundwater within 50m of the periphery of the Regional Waste Management Centre. Since the program launched, the rate of segregation has increased by up to 80%.





CITY: **BUENOS AIRES**

Four Waste Streams Processed at One Facility



↓ **31K**

METRIC TONS OF CO₂ EMISSIONS REDUCED IN 2016 DUE TO THE ENVIRONMENTAL PARK

THE CHALLENGE

In 2012, Buenos Aires sent more than 2 million metric tons of waste to landfill, generating a huge amount of greenhouse gas emissions and costing the city \$18 per metric ton. In constructing the Environmental Park, with the ability to treat construction, pruning, organic and plastic waste, the city has reduced the amount of waste sent to landfill and, by doing so, reduced associated costs and greenhouse gases.

CO-BENEFITS



Environmental

18,000 metric tons of pruning waste was treated at the Environmental Park and reused for mulch or soil stabilizer from June 2015 to April 2016.



Social

The Ministry of Environment works with the Ministry of Education to encourage primary schools, secondary schools, and universities to visit and tour the Environmental Park to instill in youth the importance of waste management and other environmental issues.



Economic

The Construction and Demolition Facility in the Environmental Park can process 2,400 metric tons of waste daily, saving the city about \$20,600 per day.

→ The recently constructed Environmental Park in Buenos Aires has the ability to process construction and demolition, pruning, organic, and plastic waste, reducing waste sent to landfill and emissions, while saving money.

The Environmental Park, constructed in 2012, processes almost 35% of waste generated in Buenos Aires, reducing waste sent to landfill and preventing greenhouse gas emissions. The Environmental Park processes four waste streams: construction and demolition, pruning waste, organic, and plastic, and includes an education center, making Buenos Aires **one of the first cities in South America to process different waste streams** at a single facility. Covering 85 hectares, the treatment plants and education center are connected by footbridges, allowing visitors to walk safely through the facility and learn the importance of recycling, reducing, and reusing waste as well as composting.

In addition to reducing waste sent to landfill and educating the public, the Environmental Park was created using principles of sustainable design, with rainwater collected for irrigation, a solar thermotank, floors made from recycled materials, a green amphitheater, and native and non-native plants that create a forest curtain between the facility and the surrounding suburb. With the help of the Environmental Park, Buenos Aires **aims to treat 100% of waste** generated in the city by 2020.



CITY: **DELHI**



Turning Waste into Energy and Better Livelihoods

↓ **8.2M**

TONS OF CO₂ EMISSIONS
PREDICTED TO BE REDUCED
DURING THE NEXT 25 YEARS DUE
TO THE PLANT

THE CHALLENGE

Without intervention, Delhi expects to generate about 15,750 tons of garbage each day in 2021, which will further stress the city's inadequate waste-to-landfill disposal system, exacerbating leachate, air pollution, and disease. Meanwhile, it is estimated that 60% of the population has experienced respiratory illness due to dumpsites. To address these concerns, Delhi is changing its waste management system with the introduction of the Ghazipur Waste to Energy Plant, preventing further environmental degradation and community agitation.

CO-BENEFITS



Environmental

In reducing the amount of waste in landfill, the plant will help reduce surface runoff carrying toxins into waterbodies.



Social

The Gulmeher initiative, associated with the plant, provides literacy programs, childcare services, and medical care to former waste collectors and their families.



Economic

It is estimated that the plant will prevent more than 200 acres of land, valued at more than \$308 million, from becoming landfill sites over the next 25 years.



Health

Processing municipal solid waste will drastically reduce diseases such as dengue, malaria, as well as eye, skin, gastrointestinal, and respiratory illness, which occur due to open dumping.

→ A new waste-to-energy plant in Delhi is turning would-be landfill waste into a resource, while at the same time reducing illness, encouraging better livelihoods, cleaning the city, and reducing greenhouse gas emissions.

Established in Delhi in 2011, the Ghazipur Waste to Energy Plant is India's state-of-the-art facility, creating energy out of would-be landfill waste and contributing to the country's goal of achieving 40% non-fossil fuel-based energy by 2030. **The facility processes 2,000 tons of waste per day**, generating 12 MW of power and 127 tons of fuel, which can be used in cement and power plants as an alternate source of energy. The plant has also invested heavily into air pollution control devices that conform to the European Industrial Emissions Directive, which is much more stringent than Indian norms. Estimates show that dumping of municipal solid waste at the Ghazipur dumpsite should drop by 90% within 25 years.

In addition to reducing waste to landfill and generating power and fuel, the plant focuses on the community as well. The plant provided support to set up Gulmeher, a community center that provides about 200 local women, who previously earned a living picking waste at the Ghazipur dumpsite, with **direct employment, capacity building, micro-enterprise support**, and artisan training.



Delhi's waste-to-energy plant is significantly reducing the amount of waste sent to landfill.

CITY: **EUGENE**



Food Waste Is Given New Value

↓ **2.4K**

TONS OF CO₂ EMISSIONS ESTIMATED TO HAVE BEEN REDUCED SINCE 2011 UNDER THE PROGRAM

THE CHALLENGE

Food waste is a big contributor to the city's emissions, with approximately 4,000 tons of greenhouse gases produced per 8,000 tons of food waste to landfill. The Love Food Not Waste Program reduces the amount of greenhouse gases released into the atmosphere and generates a product that sequesters carbon.

CO-BENEFITS



Environmental

The creation of compost under the project has resulted in healthy soil production in school gardens, increasing the city's ability to sequester carbon.



Social

The Love Food Not Waste program builds social capacity around the issue of food waste in the region by partnering with local non-profits to explain the importance of food waste prevention.



Economic

The Love Food Not Waste program has developed a market for food waste in Eugene, with seven local retailers selling the compost.

→ Eugene is engaging businesses and making a profit by converting food waste to compost through the Love Food Not Waste program.

Launched in 2011, Love Food Not Waste is a commercial food waste collection program encouraging **200 participating locations** to appropriately dispose of food waste, considering its full life-cycle and upstream impacts. A partnership between the City of Eugene, local waste haulers, commercial compost facilities, local businesses, and local retailers, Love Food Not Waste makes waste collection appealing by offering free support services, marketing materials, and monetary incentives. The waste collected is turned into compost and sold as a 100% recycled product on the retail market. A portion of the proceeds go back to the city outreach program, along with a portion donated to local non-profits and schools in Eugene.

By engaging stakeholders from the start, the project has blossomed into a community messaging platform about food waste prevention, diversion, recovery, and rescue. Since its inception, more than **8,000 tons of food waste have been collected**, and bagged compost is now sold in more than 80 locations in four states, as well as incorporated into numerous soil amendments sold in Eugene.



The city provides environmental education on sustainable materials management and healthy soils to over 10,000 students each year through the project.

CITY: **BOGOTÁ**



Waste-to-Energy Project Supplies National Grid

↓ **5.4M**

TONS OF CO₂ EMISSIONS REDUCED BETWEEN 2014 AND 2020 AS A RESULT OF THE ELECTRICITY GENERATED BY THE PROJECT

THE CHALLENGE

Bogotá faced serious waste management challenges in the past, as the Doña Juana Landfill had received 2 million tons of waste annually,¹ putting human health at risk and increasing greenhouse gas emissions. Under the Doña Juana Landfill Gas to Energy project, emissions are reduced by converting methane to electricity, and communities benefit from cleaner air as well as investments in their well-being from the profits.

CO-BENEFITS



Environmental

Before beginning to convert biogas to electricity this year, the capture and destruction of methane at the plant alone reduced CO₂ emissions by more than 4.4 million tons between 2009 and 2016.



Social

Vocational training has been provided to local youth through the project, providing opportunities not previously accessible.



Economic

More than \$2 million has been allocated to the city for social investment because of electricity sales through the project.



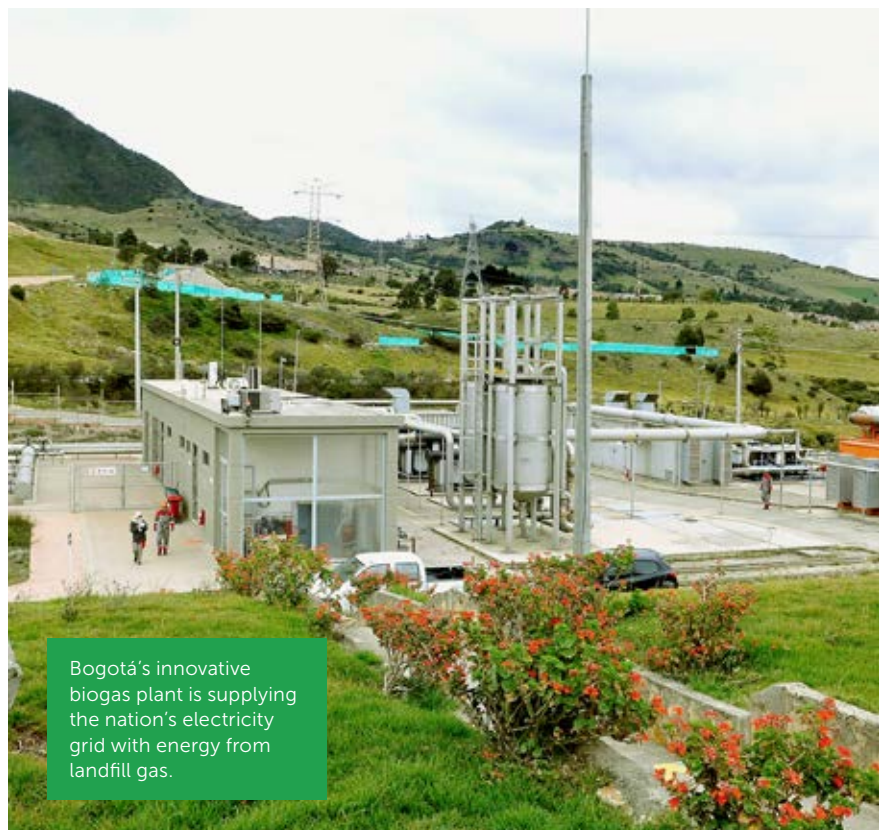
Health

In capturing biogas, neighboring communities are no longer exposed to poisonous gases such as ammonia and hydrogen sulfide.

→ Bogotá is the first city in Colombia turning waste into electricity delivered to the grid, while investing a portion of the profits in social projects.

With the Doña Juana Landfill Gas to Energy project, Bogotá is capturing landfill biogas and turning it into electricity delivered to residents via the national grid. While the city had been capturing and destroying methane from landfill waste since 2009, this past year it became the first Colombian city to go a step further and create electricity from this waste. The process is undertaken at the landfill's plant, which boasts one of the largest biogas systems in the country. The plant has a capacity of 30 MW of electricity, operating 24 hours a day, seven days a week. The project **reduces CO₂ emissions by 900,000 tons per year**, and, by 2018, the city plans to construct two additional plants, further increasing the production of biogas and decreasing CO₂ emissions.

In addition to reducing greenhouse gas emissions, the project has an innovative social component. Twenty-four percent of the proceeds from the sale of carbon emission reduction credits and 4% of electricity sales are allocated to **social investment in surrounding communities**. Projects constructed with this funding include kindergartens, a multipurpose community center, pedestrian paths, and basic sanitation infrastructure, among other initiatives.



¹ C40. "Case Study: Bogotá's Doña Juana Landfill Gas-to-Energy Project." 2012.

CITY: **HONG KONG**



Recycling Centers Cut Waste and Spur Behavior Change

↓ 17K

TONS OF CO₂ IS ESTIMATED TO BE REDUCED PER YEAR BY DIVERTING RECYCLABLES FROM LANDFILL AND INTO COMMUNITY GREEN STATIONS

THE CHALLENGE

Hong Kong is facing an urgent crisis, with the city's per capita waste generation rate at nearly 1.35 kg per day, and landfill forecasted to be exhausted within a few years. Furthermore, waste management accounts for about 5% of the city's CO₂ emissions. To address these issues, Hong Kong is constructing Community Green Stations that serve as drop-off centers for recyclables and a place to increase awareness of waste separation and segregation.

CO-BENEFITS



Environmental

Each Community Green Station is designed to process up to 750 metric tons of recyclables annually, all of it diverted from landfill.



Social

A Community Green Station in the Sha Tin district has increased the area's recycling coverage from 56% to 92% of the population, while providing new green employment opportunities.



Economic

Ninety-seven percent of materials used to construct the Community Green Stations are sourced locally, supporting the economy.

→ Hong Kong is diverting waste from landfill and reducing CO₂ emissions using its Community Green Stations, which double as recycling and education centers.

In 2015, Hong Kong constructed its first Community Green Stations as part of the city's 10-year plan to **reduce waste per capita by 40% in 2022**. Currently being rolled out in each of the city's 18 districts, Community Green Stations serve as facilities for collecting recyclables and sparking behavioral change by teaching residents about waste separation and segregation. Institutionalizing recycling practices today not only reduces emissions from waste generation, but will also help save residents money in the future, as Hong Kong plans to introduce a pay-as-you-throw waste system in the coming years.

The Community Green Stations are built as low-carbon structures, using green building technologies and materials such as **recycled timber, skylights, and solar panels** to reduce their CO₂ emissions. Located on unused public land, the stations also bring activity into otherwise disregarded areas, helping to facilitate community engagement while also promoting recycling. In all, these stations signify specific, targeted, and tangible actions Hong Kong is taking to reduce waste and usher in a greener mindset among residents.





CITY: **SALVADOR**



Tree Planting Project Sequesters and Reduces CO₂ Emissions

↓ **31.5K**

TONS OF CO₂ EMISSIONS REDUCED
ANNUALLY BY USING SLUDGE FOR
FERTILIZER

THE CHALLENGE

Due to years of unregulated waste disposal, Canabrava Park is severely degraded, unable to sequester CO₂ emissions, which increases the local temperature and spreads disease. Furthermore, approximately 8% of Salvador's greenhouse gas emissions are the result of waste, 59% from wastewater plants. The Environmental Recovery Program is transforming the area by planting native trees and using treated sludge as fertilizer, capturing greenhouse gases, improving the local climate, and providing green spaces to one of the poorest neighborhoods in the city.

CO-BENEFITS

Environmental

It has been estimated that approximately 2.8 million tons of CO₂ will be captured over 20 years by trees planted under the project.

Social

The Environmental Recovery Program of the Canabrava Park provides a new meeting place for the extremely dense and underprivileged neighborhood, where there are otherwise few leisure options and green spaces.

Health

Reforestation of the park will reduce public health risks for residents in the area, such as respiratory diseases, that are associated with an open-air garbage dump.

→ Locals and students in Salvador are planting 20,000 native species as part of the Environmental Recovery Program of the Canabrava Park, beautifying an old waste dump and using treated sludge as fertilizer.

Launched in 2015, Salvador's Environmental Recovery Program of the Canabrava Park is reforesting an old 52,000 m² outdoor dump that received 22 million tons of waste in the last year, while transforming the area into a new ecosystem and a much-needed green space for the underprivileged neighborhood. The Brazilian city's program is **planting 20,000 trees native to the Atlantic Forest biome**, and using sludge from the city's sewage, treated by anaerobic digestion, and biosolids from an industrial wastewater plant as fertilizer. Consequently, the project is a measure for CO₂ sequestration and reduction, as well as local temperature control.

The program is a partnership with the private sector, where different parties plant and maintain different sections of the park, creating ownership of the program. So far, two large **plantations have been planted with the assistance of 300 participants**, including environmental engineering students from the local university, and inhabitants of the surrounding areas. The program has encouraged the planting of even more trees, with a goal to reach 100,000 across the city in the coming years.



As part of the program, students learn about the rehabilitation of degraded areas, sequestration of CO₂ emissions, and remediation, among other topics.

CITY: CAPE TOWN



Turning Trashed Bins into Trash Bins

↓491

TONS OF WHEELIE BINS HAVE BEEN DIVERTED FROM LANDFILL BY BEING RECYCLED INTO FIFTY/50 WHEELIE BINS SINCE DECEMBER 2015

THE CHALLENGE

With increased urbanization and population growth in Cape Town, waste sent to landfill is growing, as is demand for city services. Therefore, diverting as much waste from landfill as possible is a city priority. The Fifty/50 Wheelie Bin program is a smart and targeted effort to achieve these goals, as recycling old wheelie bins into new bins not only diverts waste from landfill but lowers costs and reduces lifecycle CO₂ emissions.

CO-BENEFITS



Environmental

A 63% reduction in global warming potential, which is the heat trapped in the atmosphere by a given greenhouse gas, has been predicted using the program's recycled bins versus virgin HDPE.



Social

Twenty-two new jobs have been created in the manufacturing of Fifty/50 Bins.



Economic

The city has saved nearly \$160,000 under the program, as each Fifty/50 bin costs approximately \$26.85 as opposed to \$28.70 for each 100% virgin HDPE bin.

→ Cape Town is recycling its old wheeled garbage collection bins, or "wheelie bins," into new ones, diverting waste from landfill and adopting the concept of a circular economy.

Cape Town is giving new life to old, worn out, or damaged garbage collection wheelie bins by recycling them into new 240-L wheelie bins in an effort to circularize municipal waste management. With the project, the city's Solid Waste Management Department embarked on its first closed-loop procurement scheme between a public authority and a private manufacturer. Launched in 2014, the Fifty/50 Wheelie Bin program **utilizes 50% virgin material and 50% old bins that have been recycled**, rather than using solely 100% virgin high-density polyethylene (HDPE). This has been identified as a safe ratio of virgin and recycled plastics based on months of research and development.

Under this program, Cape Town is taking a targeted and progressive step towards implementing a new approach to recycling in local government. With the Fifty/50 Wheelie Bins estimated to have up to a **25% smaller environmental impact than manufacturing new bins**, the project earned the city the South African Plastics Recycling Organization Trophy for the Recycled Product of the Year in 2015.



Cape Town is embarking on a circular approach to waste management with its Fifty/50 Wheelie Bin.



ADAPTATION PLANS & ASSESSMENTS



PARIS

*Adaptation Strategy
Secures Crucial Resources*
P. 43



DUBAI

*Decision Support
System Sends Extreme
Weather Warnings*
P. 47



BOLOGNA

*Bottom-up Plan
Protects Against Rain,
Drought, and Heat*
P. 45



TAOYUAN

*New Water Sourcing for
Farm Productivity*
P. 41

→ The solutions in the Adaptation Plans & Assessments sector showcase how targeted risk assessments and plans can make cities more resilient and adaptable for future climate changes, such as extreme weather, sea level rise, and increased temperatures, while at the same time increasing recreational opportunities and providing significant social benefits to city residents.



CITY: **NEW YORK CITY**



Resilience Study Prepares Communities for Future Flooding

↑ **400K**

RESIDENTS POSITIVELY IMPACTED
THROUGH THE RESILIENT
NEIGHBORHOODS STUDY

THE CHALLENGE

Hurricane Sandy demonstrated that New York City is highly at risk from coastal storms, and climate change and sea level rise will only increase this risk in the future. To respond to these concerns, the New York City Department of City Planning has completed a coastal risk assessment, taking into account the impact of flooding from sea level rise and changes in weather patterns, resulting in changes to zoning regulations, and securing resilient neighborhoods for the future.

CO-BENEFITS



Environmental

More than 250 hectares of tidal and freshwater wetlands in Queens and Staten Island will be better protected thanks to the Resilient Neighborhood Studies.



Social

In each study area, the Department of City Planning has met with key community leaders and stakeholders, whose first-hand experiences shaped the study.



Economic

The new zoning regulations will enable businesses to better manage flood risk through resilience investments, protecting 271,000 jobs and encouraging the development of new businesses.

→ New York City has conducted comprehensive studies over areas at risk of flooding due to climate change, increasing the resilience of buildings and livelihoods.

New York City's Resilient Neighborhoods Study was launched in 2013 as a way to develop locally tailored strategies for land use and zoning changes that are responsive to the coastal hazards the city faces now and in the future. Ten studies were completed across a range of coastal neighborhoods in the city which analyzed damage from Hurricane Sandy; risks from coastal storms, including 10-, 50-, and 100-year storms; flood elevations; wave threats; future floodplains; and sea level rise. Information from these studies will help shape how and where development occurs on vulnerable coastal land and **protect the 71,500 buildings** currently located along these shorelines.

In addition, the city is producing a web-based mapping tool for each study area, informing property owners about the current and future flood risks in their neighborhood, and enabling them to make better investments in resilient infrastructure. The city hopes the recommendations created from **this study will influence the future growth and development of these 10 neighborhoods**, as well as districts across New York City's 837 km of coastline that are at risk from flooding and sea level rise.



Zoning changes made because of the Resilient Neighborhood Studies allow property owners to take retrofitting measures and reduce their insurance premiums.

CITY: TAOYUAN



New Water Sourcing for Farm Productivity

↓ 2K

TONS OF CO₂ SEQUESTERED DAILY BY MAINTAINING RICE PADDIES UNDER THE PLAN

THE CHALLENGE

Taoyuan expects that, in the coming decades, its dry season precipitation will drop by 13% and the average temperature will increase by 16%, increasing water demand of agriculture by 20%. Agriculture already competes with domestic water use, with five agricultural irrigation suspensions and two rationings of water supplies imposed since 2000. Under this new plan to protect against drought and develop new water sources, Taoyuan is securing its supply for drinking and agriculture.

CO-BENEFITS

Environmental

The plan will enhance aquatic ecosystems by improving existing ponds and constructing new ones.

Social

As a new industry in the city, reclaiming water will create new job opportunities for residents.

Economic

It is estimated that the plan will save almost \$45 million in compensation for agricultural irrigation suspension, as well as avoid affecting nearly \$700 million in output value of industry and commerce.

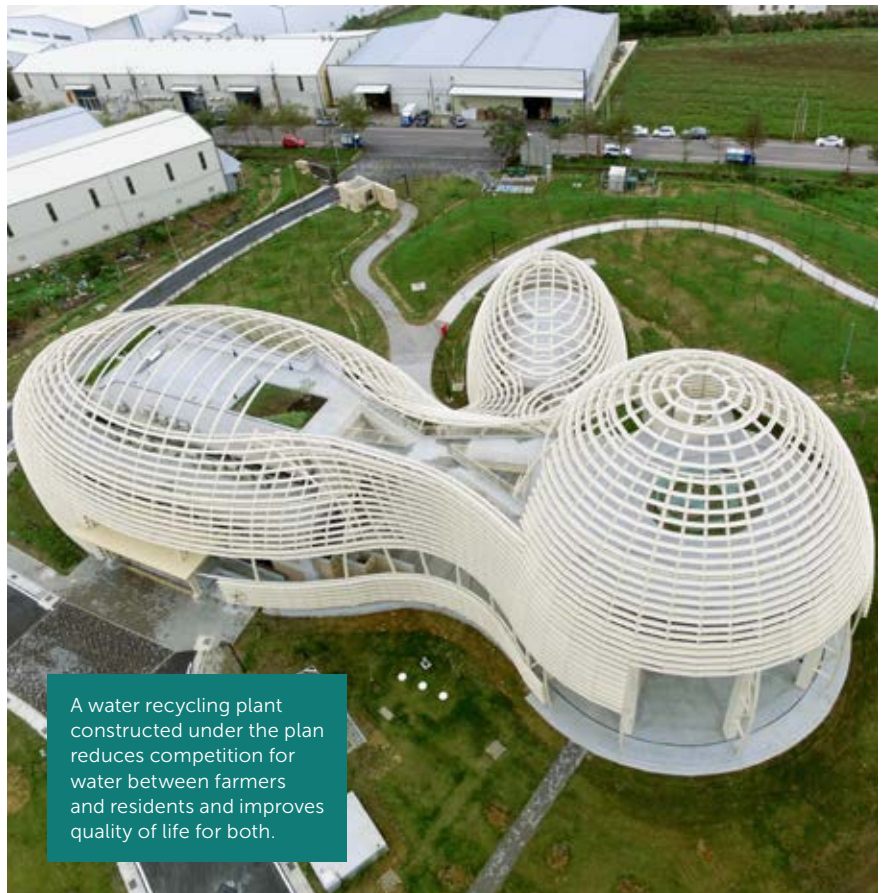
Health

During water supply suspensions, internal pressure on pipes causes sewage to leak into drinking water, resulting in illness. Reducing the risk of disruption of water supply, and therefore contamination, will sustain people's hygiene and health.

→ Taoyuan is securing its water supply and agricultural productivity from rising temperatures and decreasing rainfall by utilizing new sources of water.

Released in 2015, Taoyuan's Drought Resistance Strengthening and Diverse Water Sources Regulation Plan is better managing scarce water resources in the Taiwanese city by utilizing existing supplies, such as ponds and wells, and developing new supplies, such as deep groundwater, subsurface flow, and reclaimed water. The plan aims to **increase the city's water supply by nearly 400,000 m³**, accounting for 33% of the current daily tap water usage, and source 26,000 m³ of daily tap water with reclaimed water.

These innovative strategies allow the city to maintain existing water scheduling policies, most importantly those directed at agricultural irrigation, which in turn provides Taoyuan with the ability to maintain 360 km² of rice planting area and **prevent hundreds of millions of dollars in lost commerce, trade, and employment**. In addition to maintaining the agricultural chain from planting to sales, the plan is expected to improve the local microclimate, stabilize the food chain, and sequester carbon via the water storage capacity of rice cultivation.



A water recycling plant constructed under the plan reduces competition for water between farmers and residents and improves quality of life for both.



CITY: **PARIS**



Adaptation Strategy Secures Crucial Resources

↑ 1M

M² OF GREEN ROOFS
CONSTRUCTED BY 2020 AS PART
OF THE ADAPTATION STRATEGY

THE CHALLENGE

Paris faces a wide range of challenges due to climate change, such as heat waves, drought, flooding, fires, food and water security, and many more. The Paris Adaptation Strategy takes into account all known climate-related challenges, and sets out clear objectives for how the city can respond and adapt to these challenges while improving the resilience of the city.

CO-BENEFITS

Environmental

Greening actions taken under the strategy will help preserve and encourage more biodiversity in the city.

Social

By constructing pools and increasing the amount of green spaces, residents have a new place to socialize during the summer.

Economic

The strategy aims to have 25% of food consumed in Paris be locally produced by 2050, expanding the market for urban agriculture.

Health

Parisians have access to new cooling options during heat spells, reducing the amount of heat-related health issues.

→ The comprehensive Paris Adaptation Strategy is transforming the French capital into a climate-resilient city, focusing on securing resources and protecting the well-being of residents.

In 2015, Paris implemented its Adaptation Strategy, a framework unanimously approved by the Paris City Council, aiming to adapt to climate change risks and their impacts on the city's residents and resources. The strategy sets out four priority areas: protecting Parisians against extreme climate events; ensuring water, food, and energy supply; living with climate change; and fostering new lifestyles and boosting solidarity. As such, **30 goals and 35 actions have been identified** and are now under implementation, monitored continuously.

Such actions include securing the city's food supply, **aiming to reach 30 hectares of urban agriculture by 2020**; monitoring how much of the city will be impacted by power failure in case of 100-year river flood; and increasing the area and length of the city's cooling pathways during heat waves. Also helping Parisians cool down during extreme heat, the strategy ensures that all residents live within a seven-minute walk of a cool place and mandates that city parks remain open 24 hours a day during heat spells.



The increase of extreme weather in both winter and summer prompted the creation of the Paris Adaptation Strategy.

CITY: **EUGENE**



Assessment Identifies Risks to Interconnected Systems

→ Eugene and Springfield have produced a detailed and replicable assessment of how climate change will impact essential urban systems, and lessons learned have shaped a new mitigation plan.

↑ \$4

SAVED BY THE COMMUNITY FOR EVERY \$1 SPENT ON CLIMATE MITIGATION ACTIONS DUE IN PART TO THE LESSONS LEARNED THROUGH THE CLIMATE AND HAZARDS VULNERABILITY ASSESSMENT

THE CHALLENGE

Eugene has already suffered from severe rains and earthquakes, and faces threats from further flooding, reduced snowpack, and wildfires because of climate change. In order to understand the likely effects of these threats on essential community systems, the city conducted a Climate and Hazards Vulnerability Assessment, setting the foundation for strategies aiming to reduce the impact of climate change.

CO-BENEFITS



Environmental

By implementing building codes for fire-resistant construction as recommended by the assessment, fewer homes will be damaged, meaning fewer raw materials will need to be extracted for re-building purposes.



Social

The cities have conducted educational outreach programs from the assessment, linking the new strategies directly to residents.



Economic

Based on the assessment's recommendations, the cities have completed earthquake evaluations and retrofits of municipal buildings.



Health

Successful wildfire mitigation through the plan will reduce smoke intrusion into the metro area, reducing the health impacts on the young, elderly, and those with existing heart and lung ailments.

In 2013, the neighboring cities of Eugene and Springfield, Oregon, conducted a Climate and Hazards Vulnerability Assessment, which evaluated the local impacts likely to result from future climate change, in addition to impacts from existing hazards. **The process evaluated 12 essential community sectors**, such as drinking water, electricity, transportation, and stormwater, and scored them based on their adaptive capacity. Results indicated, for example, that housing and public safety are the least adaptive sectors, and that drinking water, transportation, and public safety should be considered for prioritized funding. The assessment also showcased the interdependencies between systems and the nature and magnitude of vulnerabilities.

Lessons learned from the Vulnerability Assessment were used to develop numerous strategies to reduce risk from climate change and natural hazards, such as **securing alternative water sources, as well as creating updates to floodplain maps**. These updates are now contained within the new 2015 Eugene/Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan and being actively implemented. After taking care to ensure their method is replicable and sharable, Eugene and Springfield hope other cities can utilize and learn from their Vulnerability Assessment.



The Climate and Hazards Vulnerability Assessment relied on expert input from a dozen different agencies and partners.



Bottom-up Plan Protects Against Rain, Drought, and Heat

↑10

PUBLIC BUILDINGS TO UNDERGO GREENING ACTIONS BY 2025

THE CHALLENGE

In recent years, Bologna has experienced a growing frequency and intensity of heavy rain, droughts, and heat waves. Under the BLUE AP project, the city has solicited public opinion and stakeholder engagement to create a local climate profile, detailing its strengths and weaknesses, a risk assessment map, and a full-fledged adaptation plan in order to address these vulnerabilities in the years to come.

CO-BENEFITS



Environmental

The plan's guidelines for improved water drainage will not stress the sewage system and consequently will contribute to preserving the city's water quality.



Social

The bottom-up nature of the entire project, including the climate profile, risk map, and adaptation plan, have bolstered community engagement throughout Bologna.



Economic

The adaptation plan aims to reduce recovery costs associated with landslides, floods, and water-damaged infrastructure.



Health

The plan includes an alert system in case of heat waves, designed to protect the city's vulnerable residents from dangerous temperatures.

→ Bologna has created a local climate profile, risk assessment, and 10-year adaptation plan based on extensive community engagement in order to safeguard the Italian city from heavy rain, drought, and extreme heat.

Under the Bologna Local Urban Environment Adaptation Plan for a Resilient City (BLUE AP) project, the northern Italian city utilized an active, bottom-up participatory process to create a local climate profile, which analyzes the municipality's climate vulnerabilities, a risk assessment mapping, and, ultimately, an adaptation plan for the next decade. Goals of the plan, many of which are underway through pilot programs, include the creation of more than **28,000 m² and 15,000 m² of semi-permeable and permeable surfaces throughout Bologna** and cultivating 30 hectares of vegetable gardens around the city by 2025.

Sixty meetings with at least 500 participants were held during the project in order to engage citizens and bring them into the decision-making process. The city also created working sessions on five main topics, including greening, agriculture and garden, unconventional weather events, permeability projects, and economic development of the city area, where **stakeholders from public, private, and civic organizations could weigh in** on their area of expertise and contribute to the design and development of the local climate profile, risk map, and ultimate adaptation plan.



CITY: **BOSTON**



Data and Stakeholders Build Adaptation Roadmap

→ Boston has taken a data- and stakeholder-driven approach to climate adaptation, creating Climate Ready Boston in an effort to develop projections, assess risks, and create resilience strategies.

↑ **6K**

RESPONSES FROM THE PUBLIC VIA AN ONLINE ENGAGEMENT PLATFORM AS PART OF CLIMATE READY BOSTON

THE CHALLENGE

Extreme weather events such as Hurricane Sandy and winter storm Juno make it increasingly important for the City of Boston to prepare for impacts relating to climate change. By developing an understanding of projected climate change impacts, assessing how these will affect the city, and forming strategies to tackle these impacts, Climate Ready Boston ensures that the city is ready for the next extreme weather event, while adapting to long-term effects of climate change.

CO-BENEFITS



Environmental

Because of the Climate Ready Boston initiative, the city is seeking to create green spaces to mitigate both flooding and heat impacts.



Social

By engaging with community groups to discuss experiences of climate impacts, such as blizzards and heat waves, the city is ensuring that adaptation measures will enhance quality of life of residents, particularly among its most vulnerable populations.



Economic

Climate Ready Boston aims to quantify the potential economic impacts of climate change on the city.



Health

As part of the project, Boston is consulting with health authorities to identify initiatives to reduce public health impacts, specifically those related to an increase in extreme temperatures.

Born out of the city's 2014 Climate Action Plan, Climate Ready Boston was launched in 2015 as an initiative to develop resilient solutions to the impacts of long-term climate change. The initiative has three key deliverables: consensus on updated projections on the impacts of climate change; an integrated vulnerability assessment of these impacts, including identification of neighborhoods, properties, and infrastructure assets that are most at risk; and **specific resilience strategies and a guiding roadmap** that will reduce the city's vulnerabilities and prioritize implementation. Based on data and stakeholder engagement, these strategies will include a portfolio of solutions and interventions, such as policies, regulations, financial incentives, and design standards.

The initiative has not only provided the city with physical damage estimates, such as the cost of repairing buildings and infrastructure, but also costs to the community, at-risk individuals, business operations, and social networks. This has been possible through comprehensive cross-sector partnerships, which have funded the program, supplied data, and discussed and implemented recommendations. These partnerships include **more than 30 stakeholder committees**, including city, state, and private sector agencies and community groups, that participate on an advisory level.



Climate Ready Boston was launched to start planning for end-of-century effects of climate change, one of the priorities of the city's 2014 Climate Action Plan.

CITY: DUBAI



Decision Support System Sends Extreme Weather Warnings

↓ 75K

VISITORS TO THE DUBAI COAST WEBSITE IN 2015, BENEFITING FROM THE WEATHER INFORMATION AVAILABLE FROM THE SYSTEM

THE CHALLENGE

The Dubai coastline faces many risks because of climate change. Sea level is forecast to rise a minimum of 4 mm annually, while storm events are expected to be more frequent and severe. The Decision Support System for Marine and Waterways Management has integrated the latest technology to forecast extreme weather events and flooding, enabling the city to better respond and adapt to these climate change challenges.

CO-BENEFITS



Environmental

In addition to forecasting extreme weather events, the system also records data for coastal environmental indicators, including turbidity and algal blooms, quantifying these events in order to mitigate their impacts in the future.



Social

The system is designed to help protect and maintain cultural heritage features along the coastline through their identification on maps and targeted monitoring.



Economic

Data produced by the system is sold to developers and other stakeholders to assist in commercial planning.



Health

Residents avoid injury and death via the provision of severe weather warnings from the system.

→ Dubai created a Decision Support System using the latest weather forecasting technology in order to predict extreme weather events and protect the city's coastline.

Dubai launched its Decision Support System for Marine and Waterways Management in 2012, the first of its kind in the region, reducing climate change-induced risks to the coastal zone. The system consists of an **integrated suite of meteorological, hydrodynamic, and wave models**, combined with real-time data management and Web-based tools, creating a coastal monitoring and forecasting system. The system has been successful in predicting extreme weather events 24 hours in advance, delivering data and decision support to the municipality and public users on everything from sea level rise; change in wave frequency, height, and direction; increased precipitation rates; coastal erosion; and increased sea water acidity.

Not just providing actionable, real-time information, the system has allowed for the creation of a comprehensive historical database, as well as a coastal inundation tool, capable of **forecasting and mapping the extent of coastal flooding**. By collecting weather and oceanographic information, the municipality is able to account for future risks of climate change in its infrastructure planning and design for the Dubai coastline.



The support system minimizes property damage and ensures optimal use of Dubai's coastal zone for fishing, tourism, recreation, and other activities.





Vulnerability Assessment Quantifies Risk

↓ 20%

REDUCTION IN CO₂ BY 2030 AS PART OF THE CITY'S CLIMATE CHANGE POLICY, WITH WHICH THE ASSESSMENT IS INTEGRATED

THE CHALLENGE

Belo Horizonte is experiencing an increased magnitude and frequency of extreme weather events and changes in precipitation and temperature patterns, causing landslides, floods, heat waves and dengue fever. Furthermore, exposure to climate change-related impacts is not distributed equally across the city. The Vulnerability Assessment has provided a foundation to bring adaptive measures into urban planning, prioritizing investments in order to mitigate climate change impacts and vulnerability inequality.

CO-BENEFITS

Environmental

The assessment provides evidence for the implementation of adaptation measures, such as investments in public transport, increase of tree coverage, ecological corridors, and green infrastructure.

Social

The project aims to provide decision-makers with evidence for developing public and private investment in low-income areas disproportionately affected by climate change impacts.

Economic

With advanced planning, the assessment expects to avoid future economic losses, such as damages to infrastructure and assets, loss of livelihoods, and emergency expenditures following extreme events.

Health

The identification of dengue fever hotspots will enhance the effectiveness of actions aimed to control the expansion of the disease.

→ By assessing the city using a quantified vulnerability index, Belo Horizonte has identified areas most in need of adaptation investment, protecting infrastructure and residents from climate change.

Completed in 2016, the Climate Change Vulnerability Assessment of Belo Horizonte has identified and quantified the city's preparedness and ability to cope with the adverse effects of climate change, as the first step towards a climate adaptation plan. The assessment was based on a vulnerability index, made up of all climate change-related information available for the city, including landslides, floods, heat waves, and incidence of dengue fever, in the form of high-resolution georeferenced maps and basic statistics. The assessment identified **four hotspots in the city with a vulnerability index in the 75th percentile**, vulnerable to a range of climate change impacts. It also indicated that the area of such hotspots has increased over time and now covers 88 km², or 27% of the city area.

The assessment was integrated with city-level urban planning, driving public and private investment in resilient urban infrastructure, public health, and adaptive measures. By gaining a sound and **quantified understanding of vulnerability** and providing guidelines for the prioritization of investments, the assessment will lay the groundwork for projects to improve the resilience of vulnerable areas and social groups, while improving the efficiency of public spending.



The assessment will lead to improvements in vulnerable communities that are more exposed to the risks of climate change.



Adaptation Report Informs Cross-Sector Collaboration

→ Toronto has published a policy report outlining an approach that will see climate change resilience integrated into decision-making and coordination across city agencies and with private sector partners.

↑60

ORGANIZATIONS PARTICIPATED IN WEATHERWISE, A FORUM FOR LARGE ORGANIZATIONS OPERATING CRITICAL INFRASTRUCTURE IN THE CITY, RECOMMENDED BY THE REPORT

THE CHALLENGE

In addition to flooding and winter storms, Toronto faces increased instances of heat waves, with modeling suggesting that by 2040-2050 daily maximum temperatures could reach 44°C. To adapt to these pressing concerns, Toronto is laying the groundwork for action through the Resilient City report, ensuring that services and operations – both in and outside the city's jurisdiction – are coordinated.

CO-BENEFITS



Environmental

The report recommends improved care for the city's trees in order to reach its overall goal of increasing canopy cover to 40%.



Social

The report recommends updating floodplain maps for vulnerable areas to incorporate 3-D modeling and future extreme weather projections, which will help protect at-risk residents from future impacts.



Economic

The report details recommendations that could cost the city \$1.3 million annually, a fraction of the costs incurred through climate change impacts, such as rain storms in 2005 and 2013 that cost the city \$47 million and \$70 million, respectively.



Health

Toronto hopes that the adaptation measures recommended by this report will prevent more illness and death from extreme heat, poor air quality, and vector-borne disease.

In 2014, Toronto unveiled Resilient City – Preparing for a Changing Climate, a policy paper that lays the groundwork for comprehensive adaptation action. The report outlines how climate change resilience can be integrated into decision-making and coordination of city operations and services. Furthermore, it proposes specific recommendations, such as the creation of a **geospatial risk assessment tool** that tracks data like heat vulnerability, locations of flood zones, locations of previously flooded areas and electrical outages, and areas of heavy tree damage from different departments and utilities, recognizing interdependencies between city departments.

Keeping with the theme of coordination and collaboration, the report underpinned the creation of the cross-sectoral Resilient City Working Group (RCWG), made up of 16 city organizations, plus several outside agencies, including utilities and transit agencies. Collectively these organizations work to **develop and support a broad range of new actions to address climate change** impacts on infrastructure, services, and city operations in a coordinated and cohesive way to ensure that Toronto is prepared for and capable of adapting nimbly to the effects of climate change.



Toronto was recognized by the Grosvenor Group real estate investment company as one of the most resilient cities in the world for real estate investment.

© Toronto and Region Conservation (TRCA)



Input and Collaboration Shape Resilience Strategy

↑4.4K

CITIZENS WERE INVOLVED IN THE CREATION OF VISION RIO 500, THE LONG-TERM PLANNING DOCUMENT SUPPORTED BY THE RIO RESILIENCE STRATEGY

THE CHALLENGE

Climate impacts, such as strong winds and rain, sea level rise, and flooding, combined with increased heat waves and heat islands, threaten Rio de Janeiro's residents and infrastructure. The Rio Resilience Strategy serves as a guiding document for how, in both the short and long term, the city can protect itself from these challenges and transform into a global leader in urban resilience measures.

CO-BENEFITS



Environmental

Improved management of water resources, particularly sanitation, will reduce pollution in waterways, improving local ecosystems.



Social

The city aims to create and implement a "Massive Online Open Course (MOOC) on Urban Resilience," as part of the plan, educating the public on the importance of resilience and climate action.



Economic

By calling for the implementation of circular economic measures, the plan will help shape a new market for compost and solid waste, which have immense potential for job creation.



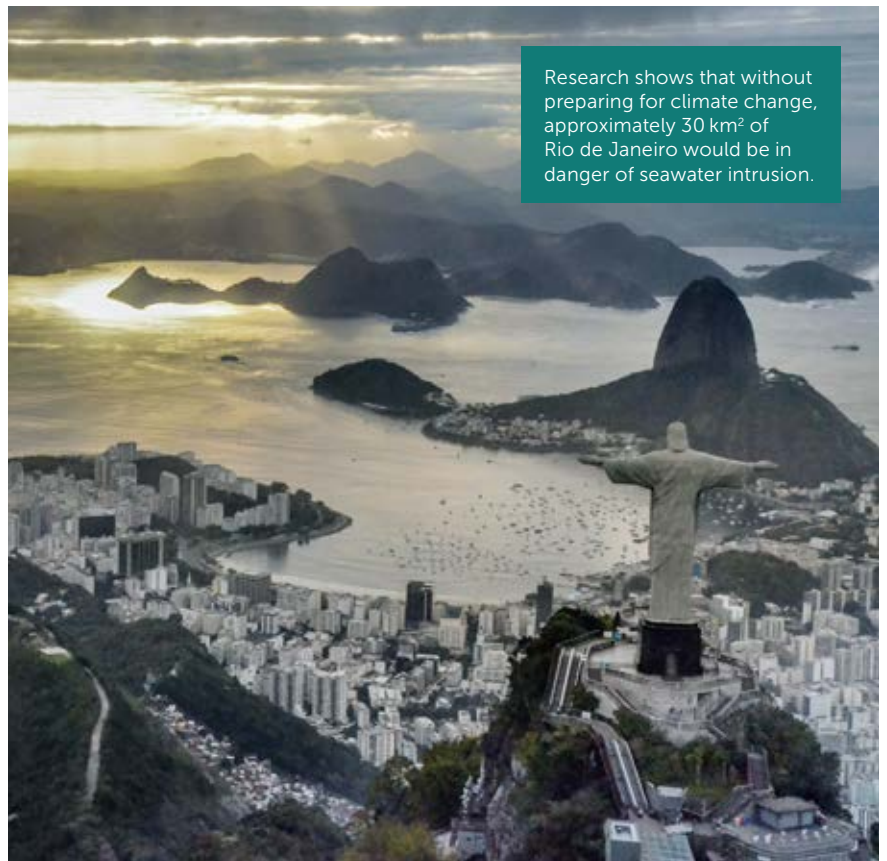
Health

By reducing temperatures in the city through the introduction of green and cool spaces, the plan aims to reduce epidemics and pandemics such as dengue fever, Chikungunya, and Zika.

→ Rio de Janeiro engaged citizens, municipal employees, and private stakeholders in creating its resilience strategy, identifying climate shocks in the city, and creating targeted measures to reduce the impacts.

The Rio Resilience Strategy was born in 2016 as a guide for Rio de Janeiro to become a global leader in resilience by 2035. Developed with the support of a group of sector-specific experts, **interviews with 39 city departments**, and workshops with private sector stakeholders, the strategy defines six key goals: understand and mitigate the impacts of severe weather; prepare the city to respond to extreme weather events; cultivate green, cool, and safe urban spaces; provide high-quality basic services to all citizens; promote a circular and low-carbon economy; and increase the overall resilience and cohesion of the city and its people.

The specific actions that will help Rio de Janeiro achieve these **goals address flooding, drought, lack of access to clean water**, and securing a safer supply of energy by decreasing dependence on hydropower. The city hopes that this strategy, underpinned by targeted stakeholder engagement, will serve as a necessary intermediary between the city's short-term goals, as set forth in the Strategic Plan 2017-2020, and long-term roadmap, Vision Rio 500.





ADAPTATION IN ACTION



NIJMEGEN

*Embracing the River to
Combat Flooding*
P. 56



WUHAN

*Waterlogging Prevented by
Sponge Infrastructure*
P. 61



HONG KONG

*Water Security through Supply and
Demand Management*
P. 54



TAOYUAN

*River Remediation
Protects and Beautifies Land*
P. 62

→ The Adaptation in Action sector highlights solutions that ensure urban resilience by protecting vulnerable infrastructure from sea level rise and storm surges, improving water supply management, and redesigning streetscapes to cope with future climate hazards.





Water Security through Supply and Demand Management

↓ 88K

METRIC TONS OF CO₂ SAVED ANNUALLY BETWEEN 2011 AND 2030 THROUGH WATER LOSS MANAGEMENT

THE CHALLENGE

Until recently, Hong Kong had been importing 70% to 80% of its freshwater resources from mainland China. Faced with uncertainty of access to this supply due to the effects of climate change, the city's Total Water Management Strategy lays out efforts to reduce demand, prevent water loss, and source water through innovative means.

CO-BENEFITS

Environmental

Through the Total Water Management Strategy, freshwater and saltwater usage is predicted to be reduced by 200 million m³ and 24 million m³, respectively, by 2030.

Social

To help curb demand and promote citizen engagement regardless of income level, the city installed 160,000 water flow controllers in 33 public housing estates.

Economic

The city will benefit from savings of up to \$24 million by 2030 via reductions in operating expenditure and by delaying the expansion of waterworks infrastructure which would otherwise be required.

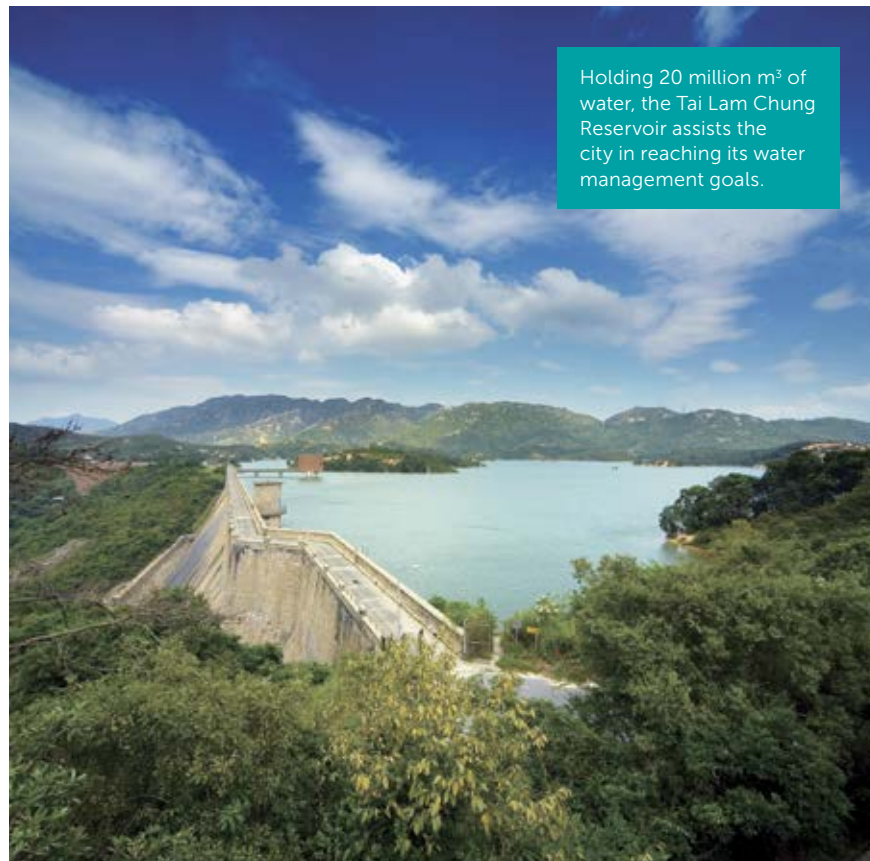
Health

By enhancing the reliability and security of freshwater, the future health of Hong Kong's citizens is safeguarded from the impacts of climate change.

→ The Asian megacity of Hong Kong is capitalizing on existing infrastructure and seawater to withstand future droughts caused by climate change.

Acknowledging future risks of reduced water availability, Hong Kong has adopted a Total Water Management Strategy to enhance water security and reliability. The project focuses not only on **improving and expanding water resources but curbing demand as well.**

To reduce demand, the city is reducing water loss by repairing and upgrading water mains, lowering leakage rates. The city also encourages water conservation methods through collaboration, active participation, and mutual commitments between public, private, and civic sectors. In terms of supply, Hong Kong is expanding its already world-leading sourcing strategies. While the city has used seawater for toilet flushing for many years, as part of the Total Water Management Strategy, this technique is now applied to 85% of the population as of 2015, **saving 27 million m³ of freshwater** and accounting for 27% of Hong Kong's target for the 2020s. Hong Kong is exploring further alternative resources for the remainder of the target including reclaimed water, recycled grey water, and desalinated water.



Holding 20 million m³ of water, the Tai Lam Chung Reservoir assists the city in reaching its water management goals.

CITY: CHICAGO



Adsorptive Playgrounds Foster Social Cohesion

↑ 6.8M

LITERS OF WATER IS ABLE TO BE
RETAINED BY THE COMPLETED
PROJECTS

THE CHALLENGE

With climate change causing new rainfall patterns, flooding risks for poor communities have increased to new levels. In the last eight years, the city has experienced four storms exceeding the rainfall amount of a "10-year-storm." Space to Grow mitigates the problem by providing green infrastructure to soak up stormwater.

CO-BENEFITS



Environmental

Damage from flooding events and land subsidence are expected to be reduced.



Social

With 90% of the students served by the project from low-income families, Space to Grow fosters social connections and builds cohesion within communities by providing new and alternative meeting points.



Economic

Due to the implementation of Space to Grow, property values in surrounding neighborhoods are expected to increase.



Health

Running tracks, permeable turf fields, and basketball courts aim to reduce obesity.

→ Revitalizing school lots to capture stormwater reduces the risk of flooding in Chicago's poorest neighborhoods, while fostering community engagement.

Launched in 2013, Space to Grow has revolutionized everyday asphalt school lots into **green stormwater infrastructure playgrounds** that serve as educational amenities and community gathering spaces. The project targets low-income areas facing flood risks as well as social and economic challenges.

The design focuses on capturing stormwater, with the city's current infrastructure unable to withstand the new rainfall patterns caused by climate change. By redesigning playgrounds, the project aims to reduce flood risk in the surrounding school neighborhoods, each **designed to manage a 24-hour, 100-year storm**, exceeding requirements in Chicago's Stormwater Management Ordinance. At the same time, outdoor classrooms, vegetable gardens, and sporting facilities promote environmental education, social engagement, and physical activity. Access is provided to families and the community outside school hours, fully utilizing the new spaces. Overall, six school lots have been transformed by Space to Grow and 28 more are expected to be completed by 2019.



CITY: NIJMEGEN



Embracing the River to Combat Flooding

↑ 8 cm

MORE RIVER HEIGHT REDUCTION WAS ACHIEVED THROUGH THE PROJECT THAN INITIALLY PLANNED

THE CHALLENGE

The narrow watershed of the Waal River creates a bottleneck in Nijmegen that has long been prone to flooding. Rather than blocking the river with high levies, the city chose to embrace the water, creating a new river channel to help manage water flows and prevent flooding to nearby homes and businesses.

CO-BENEFITS



Environmental

As part of the project, 80 hectares of agricultural land were transformed into a natural reserve area.



Social

Room for the River Waal ensures the safety of at least 250,000 residents who live behind the dikes.



Economic

An environmental assessment and a social cost-benefit analysis have been made for this project, indicating a more than \$295 million positive effect.



Health

Recreational facilities created as part of the project encourage healthy activities like hiking, cycling, and rowing.

→ By creating more space for the Waal River, Nijmegen is proving that targeted adaptation not only improves resilience but also brings social and economic benefits.

Faced with increased risk of flooding, the Dutch city of Nijmegen has adapted by giving more room to the Waal River, while protecting nearby natural habitats and providing recreational space. In 2012, the city began manipulating the river and its shores at 30 key locations, moving the main dike 350 m inland, and digging an extensive new river channel parallel to the original. To overcome this new channel, the Waal Bridge was extended and three new bridges were created. By its completion in 2016, the **project succeeded in achieving a 35 cm river height reduction** instead of the 27 cm target, and during high river tides, one-third of the total amount of water is discharged through the new ancillary channel.

While the primary goal of the project, dubbed Room for the River Waal, is to reduce the river level and prevent flooding of homes and businesses, the **recreation areas created by the project are improving quality of life** for residents and visitors as well. Showcasing the far-reaching importance of the project, positive effects are even noticed 20 km upstream in Duisburg, Germany.



The project has transformed 250 hectares marginal farmland into a wilderness reserve in the heart of the city, providing opportunities for recreation, festivals and leisure at an estimated 45,000 visitors yearly.



CITY: **NEW ORLEANS**



Capturing Rainwater Curbs Flooding Events

↑ 350

INDIVIDUALS ENGAGED IN THE DEVELOPMENT OF THE RESILIENCE STRATEGY IN 2015, WHICH DIRECTLY INFORMED THE CREATION OF THE PROJECT

THE CHALLENGE

New Orleans faces threats of flooding from intense rainfall events and sinking soils, which exacerbate flood risk, especially in low-lying districts like Gentilly. The urban heat island effect is also an issue due to the quantity of unnatural surfaces. The city has found a solution through various gray and green infrastructure solutions that collect rainfall and, as an added bonus, address the urban heat island effect.

CO-BENEFITS



Environmental

The project will improve water quality through natural filtration of pollutants, improving the health of the whole ecosystem.



Social

Heat islands in the city will be reduced through the reduction of impervious surfaces and increased shade, lowering local temperatures and encouraging more people to be outside.



Economic

Each dollar spent on the Gentilly Resilience District project will result in more than one dollar of estimated benefits through improved property values, reduced flood risk, avoided costs to infrastructure maintenance, environmental value, and recreational benefits.



Health

Due to the reduction of water standing in urban in environments for prolonged periods of time, the Gentilly Resilience District project prevents mosquito-borne illnesses.

→ In New Orleans, the Gentilly Resilience District project is transforming the city's approach of urban water management while beautifying neighborhoods.

Implemented in 2016, the Gentilly Resilience District project is transforming streets, parks, schoolyards, open lots, and homes by facilitating the construction of green roofs, bioswales, and pervious pavements throughout Gentilly, a particularly vulnerable, mixed-income neighborhood. With flooding and slow land subsidence posing a significant threat to the city, **the aim is to capture and store rainfall in the urban environment**. The project adopts a suite of approaches, acknowledging that one solution is not enough to ensure a secure future for New Orleans in a changing climate.

The initiatives under the Gentilly Resilience District project not only capture rainfall but help to beautify neighborhoods, encouraging more recreational activities and improving walkability. The project also **benefits the significant portion of city residents who are unemployed**, in particular the 52% of African-American males of working age, with new job and training opportunities in water management specifically targeting this group.



The Gentilly Resilience District is protecting a vulnerable New Orleans neighborhood from future extreme weather events.

CITY: MEDELLÍN



Restoring Ecosystems Provides Opportunities for Locals

↑70K

NATIVE TREES HAVE BEEN PLANTED AS PART OF THE PROJECT

THE CHALLENGE

Unregulated urban growth on hillside areas of Medellín has caused environmental degradation of land and water resources. This socially integrated approach to managing vulnerable land not only improves the environment, but encourages economic growth and social inclusion in existing communities.

CO-BENEFITS



Environmental

The project restores native species and protects the region from further environmental degradation from urban development.



Social

The Peripheral Garden includes two educational facilities, which have already provided environmental education and construction training to 1,000 community members.



Economic

Inhabitants of the Peripheral Garden have access to a new source of revenue from new farming opportunities, with 5,000 benefiting from direct employment.

→ Medellín is tackling hillside urban growth and protecting these areas from flooding and landslides by adopting a socially inclusive approach to restoring ecosystems.

The Peripheral Garden of Medellín was established in 2012 in response to the risks of urban growth in uphill neighborhoods. Covering more than 65 hectares, the garden features footpaths, bike lanes, and clean mobility corridors, while facilitating ecological restoration, environmental preservation, and sustainable housing. **Thousands of native trees have been planted to restore ecosystems**, and organic orchards have been developed to encourage new eco-businesses and preserve regional farming traditions.

Conscious of the communities that already inhabit these areas, the city included them in the process by providing employment and educational opportunities. At least **300 families are working to cultivate their food** and start their own businesses, while 150 new leaders have been trained to manage their territory on the hillside. Another achievement is the establishment of the Figue Association of Pan de Azucar, consisting of 100 families with the goal to commercialize the native plant.



Families cultivating food at the Peripheral Garden of Medellín.

CITY: **NEW YORK CITY**



Innovative Data Analysis Leads to Coastline Protection

→ Addressing the risk of rising sea levels, New York City implemented its Raise Shorelines Citywide project, which, through a comprehensive analysis of its coastlines, is protecting inhabitants and their livelihoods.

↑ **1.7K**

HOUSES WILL BE PROTECTED FROM INUNDATION THROUGH RAISE SHORELINES CITYWIDE

THE CHALLENGE

Between 1900 and 2000, sea levels in New York Harbor rose by an average of just over two and a half centimeters per decade, about twice the global average, with projections showing these trends will continue or accelerate. As part of Raise Shorelines Citywide, New York City is working proactively to secure critical assets, infrastructure, and neighborhoods, addressing the risks presented by sea level rise.

CO-BENEFITS



Environmental

The project will provide at least \$2.5 million in ecological benefits, creating or improving access to 14 hectares of public space.



Social

Aware of the need for social equity, at least 30% of new hires for the construction of these projects will be low-income individuals.

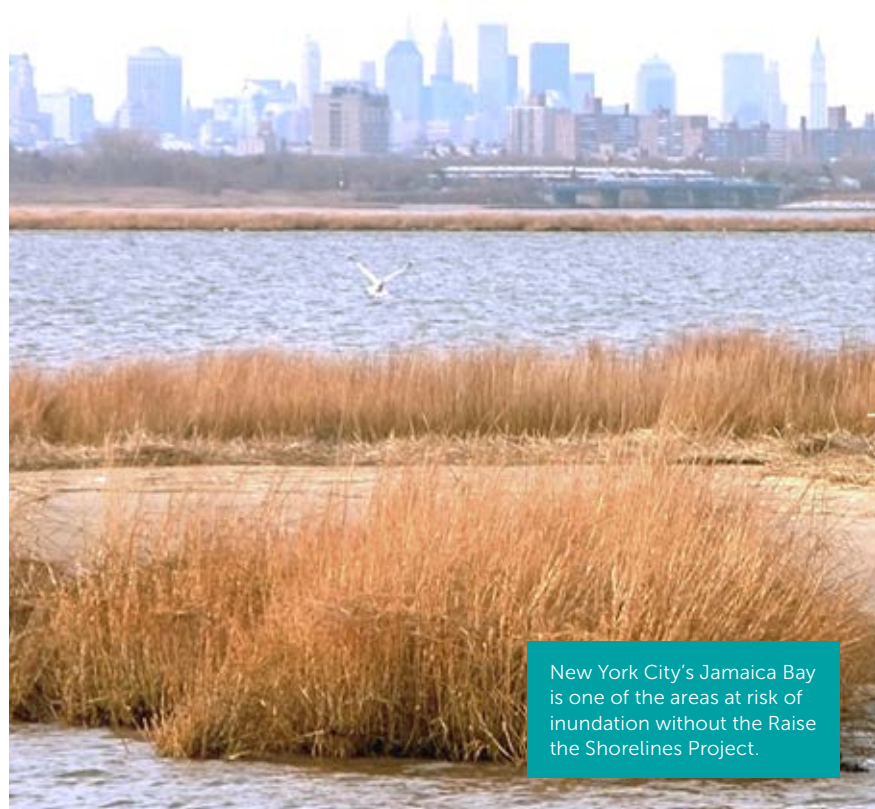


Economic

Raise Shorelines Citywide will protect at least 65 businesses from flooding, preserving over \$15 million in revenue.

Raise Shorelines Citywide began in 2014, a project specifically designed to address sea level rise rather than storm surge. New York City is **identifying vulnerable shorelines with comprehensive and detailed analyses**, including data on daily high tide inundation, calculated using localized sea level rise projections from the New York City Panel on Climate Change (NPCC) and a wave atlas produced specifically for this project.

Using the 90th percentile of projections for the 2050s produced by NPCC, projects were identified that will fortify vulnerable stretches of shoreline to prevent inundation of buildings and infrastructure in a future where the highest average level of the New York Harbor could rise by 81 cm. Analysis of New York City's more than 965 km of shoreline led to the selection of **15 projects that will make the city's coastline more resilient** to the risks posed by sea level rise.



New York City's Jamaica Bay is one of the areas at risk of inundation without the Raise the Shorelines Project.

© Jeffrey Barry



Waterlogging Prevented by Sponge Infrastructure

↑70%

OF RAINFALL IS ESTIMATED TO BE ABSORBED THROUGH INITIATIVES IN THE PROGRAM

THE CHALLENGE

Rapid urbanization and industrial development in Wuhan has increased the city's impermeable area, causing flooding, pollution, and, at the same time, overconsumption of existing water supplies. By increasing the ability to absorb rainfall and improving the quality of the urban water system, the Wuhan Sponge City Programme is preparing the city for growth and extreme weather events.

CO-BENEFITS

Environmental

It is estimated that initiatives in the project will result in a 70% reduction in pollution carried via runoff in certain catchment areas.

Social

It is estimated that 20,000 new jobs will be created through the Wuhan Sponge City Programme.

Economic

By focusing on the protection and utilization of the natural water system, the Wuhan Sponge City Programme prevents considerable costs caused by damage from waterlogging.

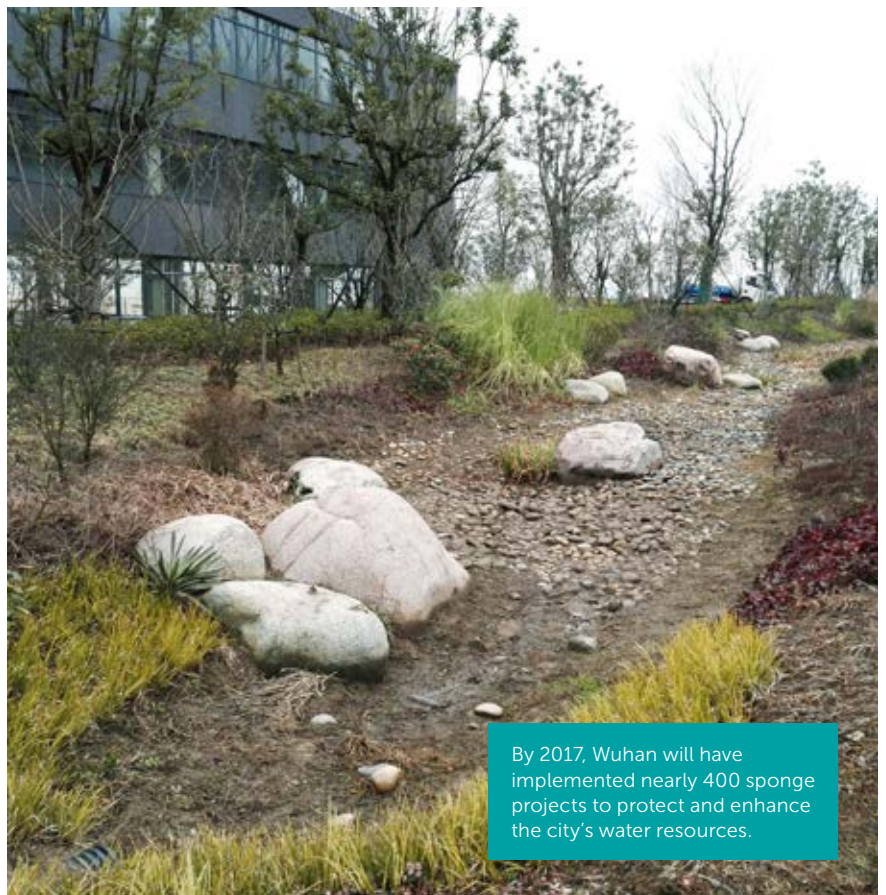
Health

The project increases the quality of drinking water for the people of Wuhan.

→ The Chinese megacity Wuhan has launched a 15-year program using green and blue sponge projects to prepare for increased waterlogging caused by rapid urbanization and natural disasters.

The Wuhan Sponge City Programme focuses on reducing waterlogging and increasing water quality via the ecological remediation of existing urban water systems and the construction of blue and green spaces to capture and store rainwater. The first phase of the project, from 2015 to 2017, will see the **development of 389 so-called sponge projects, such as urban gardens** and waterbodies in parks, roads, residential communities, and commercial and public buildings. These will cover 38 m² of the city and provide habitat for plants and wildlife.

By the end of the pilot period, two new rainwater pump stations will have been constructed, providing at least 25% of the city's water. Furthermore, **13 ports and channels will be repaired**, drain pipelines will be improved, and at least one lake will be ecologically restored. Overall, the project is expected to reduce the occurrence of severe waterlogging events from once annually to once in 10 years in the pilot zone, a strong start to adapting the city to climate change.



By 2017, Wuhan will have implemented nearly 400 sponge projects to protect and enhance the city's water resources.

CITY: **TAOYUAN**



River Remediation Protects and Beautifies Land

↓ **73%**

REDUCTION IN POLLUTION LEVELS IN THE LAOJIE RIVER DUE TO THE REMEDIATION PROJECT

THE CHALLENGE

Addressing water pollution, poor water drainage networks, and a lack of inviting green spaces, the remediation of the Laojie River and its surrounding waterfronts is helping Taoyuan achieve its goals of climate adaptation while cultivating a physical landscape that will help the area grow into a commercial and transportation hub.

CO-BENEFITS



Environmental

In addition to decontaminating the river and creating absorptive green spaces, the project seeks to end illegal wastewater discharge and improve environmental education.



Social

The improvement of the river is leading to a spike in tourism, as visits per month have risen steadily between 2012 and 2013.



Economic

The present value of land along the remediated river is 14% higher than it was before the improvement process began.



Health

20 km of bicycle paths will be created along the river under the project, providing visitors with an attractive area in which to exercise.

→ Taoyuan is cleaning its water, improving the city's absorptive capacity and reducing flooding, and attracting visitors to a beautiful waterfront with a project to remediate the Laojie River.

In 2011, the Taiwanese city of Taoyuan initiated a project to remediate the 36.7 km Laojie River and its surrounding waterfronts in an effort to improve the river's water quality and resilience capacities and provide green public spaces for an area that will continue to grow as a commercial and transit node. The completed first phase of the project **reduced the amount of flood-prone land by 192,500 m²**, allowing the region to successfully ride out the flood of 2012 without major damages. In an effort to revitalize the river's shorelines, adaptable and low-maintenance native plants were added to the area, protecting the land and making the riverfront more attractive and inviting for residents.

The Laojie River remediation **is one of several adaptation projects in the city seeking to conserve water bodies** and increase the amount of green public space in the city. Together with other leading projects such as the restoration of the Nankan riverfront and the revitalization of Taoyuan's city ponds, the river remediation project is helping Taoyuan climate-proof its future.







CITY: **BOGOTÁ**

Ecosystem Upgrade Secures City Water Supply

↑ **49.8K**

TREES PLANTED AS PART OF
THE PROJECT

THE CHALLENGE

Bogotá, a city situated at an elevation of 2,640 m, is surrounded by mountains that contain the water supply for approximately 80% of its inhabitants. As water security is under threat due to mining and farming, as well as climate change, Bogotá is securing its water supply through the Conservation Corridor, restoring ecosystems to increase the natural capture and storage of water, and including local communities in the process.

CO-BENEFITS



Environmental

New protected areas were declared in the mountains surrounding the city to ensure the continuous maintenance of the improved ecosystems.



Social

The project included the participation of 1,827 mountain inhabitants in the planning and planting processes, enhancing the quality and quantity of local food production.



Economic

By restoring the existing natural water supply, Bogotá avoids the cost of pumping water from sources at lower elevations and expanding infrastructure.

→ In Bogotá, a project is greening the city's surrounding mountains through conservation, restoration, and sustainable land management to secure water supplies for its people.

Bogotá is strategically increasing vegetation cover and removing invasive species that negatively impact the water cycle through the Chingaza-Sumapaz-Guerrero Conservation Corridor. Launched in 2014, the project is **a means to ensure water security in the city**, with 184.4 hectares going through a restoration process and 164.5 hectares going through a reconversion process. Sixteen micro watersheds and more than 12 municipalities were identified as critical focal points. Research is underway on plants that can absorb higher quantities of water, and vegetation cover is increasing. By buffering high mountain ecosystems, more water is able to be absorbed naturally and flow to the reservoir for storage.

Local communities are included in the planning process and encouraged to take ownership of their water resources. Through education on sustainable land management and training on risk and impact analysis, fewer pesticides are being used and pressures have been reduced on the water supply.



Locals participate in planting along the Conservation Corridor.

CITY: MEXICO CITY



Reshaping Streets Prevents Flooding and Ensures Safety

↓ 30%

REDUCTION IN CO₂ EMISSIONS CITY-WIDE BY 2020, SUPPORTED BY CALLE VERDE¹

THE CHALLENGE

Faced with increased instances of flooding and extreme heat, the Mexican mega-city is combining smart climate adaptation with urban planning improvements in an effort to not only improve drainage and mitigate heat, but also ensure that streets, transit corridors, and public spaces are safe and inviting.

CO-BENEFITS

Environmental

Local vegetation is used throughout the green spaces along Calle Verde, ensuring that all plants are appropriate for the climatic conditions of the city.

Social

Interventions and redesigned streets will provide wider sidewalks and more inviting public spaces, which make the city safer and more enjoyable for pedestrians, cyclists, and public transit users.

Economic

The city expects that shops in the area will experience a 25% increase in sales after the project is fully implemented.

Health

By preventing flooding, the improved drainage network and green infrastructure will also hinder the spread of waterborne diseases.

→ Mexico City is redefining its streetscape by improving drainage conditions, adding green infrastructure, and ensuring that key city spaces are safe and attractive for pedestrians, cyclists, and public transit users.

In 2016, Mexico City launched a “complete streets” initiative, dubbed Calle Verde, in an effort to improve drainage, add green spaces, and cultivate a safer and more attractive streetscape that caters to the needs of pedestrians, cyclists, and public transit users while better preparing the city for the effects of climate change. Consisting of both grey and green interventions, the program will repair drainage pipes under key corridors and **repave streets and sidewalks with permeable pavement** in order to prevent flooding during extreme weather events. Furthermore, corner extensions at intersections will improve pedestrian safety, and planting trees and green spaces will help the city manage rainwater, mitigate urban heat island effects, and serve as attractive public spaces.

The project is financed by the city’s bus rapid transit system, Metrobus, and aligns with the objectives of the larger, city-wide Comprehensive Mobility Program. As such, the project takes care to ensure that **these newly renovated and redesigned streets are accessible and well-connected** by adding and improving existing bicycle paths and integrating transit lines along these corridors.



Mexico City’s Calle Verde initiative combines adaptation infrastructure with improved public transit access.

¹ Compact of Mayors, Mexico City, 2015.



CLIMATE ACTION PLANS & INVENTORIES



PARIS

*Renewed Plan Advances
Climate Action*
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GUANGZHOU

*Low-Carbon Megacity
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TAOYUAN

*Plan Seeks Behavior
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SINGAPORE

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AUCKLAND

*Collective Action Spurs
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KAMPALA

*Strategy Drives Resilient City
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CANBERRA

*Working towards Carbon Neutral
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→ The Climate Action Plans & Inventories sector presents comprehensive and far-reaching plans and actions taken by cities to lower their CO₂ footprints and pursue long-term social, economic, and environmental agendas. These solutions demonstrate the strategic role that greenhouse gas emissions reduction targets can have in cities' overall green development strategies.



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RIO DE JANEIRO

Carbon-Neutral Commitment in Global South
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BUENOS AIRES

Inventory Upgrade Improves Climate Strategy
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CITY: **AUCKLAND**



Collective Action Spurs Emissions Reductions

↓ **5.3M**

METRIC TONS OF CO₂ EMISSIONS
REDUCED BY 2040 BASED ON 1990
LEVELS

THE CHALLENGE

Projections indicate that without intervention Auckland's greenhouse gas emissions could increase by 46% by 2025 and energy use by 65% by 2040. Low Carbon Auckland was launched by the city in an effort to address these challenges, accelerate collective climate action, and decouple urban growth and environmental impacts.

CO-BENEFITS



Environmental

The Low Carbon Auckland plan has a goal to create a city within a forest, aiming to increase carbon sequestration levels by 50% by 2040.



Social

A key component of the plan is securing sustained access to clean, efficient, and affordable energy for all by maintaining electricity prices at 2012 levels.



Economic

The installation of 40,000 LED streetlights is predicted to save between \$32.4 million and \$35.7 million over 20 years.



Health

The expansion of the cycling network provides more opportunities for exercise, aiming to reduce health issues related to inactivity, particularly among Māori and Pacific children.

→ Auckland is collaborating with a wide range of stakeholders and preparing for the low-carbon future with the help of a city-wide action plan.

Launched in 2014, Low Carbon Auckland was developed in partnership with more than 150 stakeholders in order to deliver on the city's target to reduce CO₂ emissions by 40% in 2040, while securing access to clean, efficient, and affordable energy. Based on innovative engagement and co-governance arrangements with industry, NGOs, youth, knowledge institutions, and Māori, more than **100 actions have been outlined across five areas of transformation**: travel; energy use and generation; the built environment and infrastructure; zero waste; and forestry, agriculture, and natural carbon assets. So far, actions include the roll out of electric trains, expansion of the city's cycle network, sustainable design standards for buildings, and a city-wide organic waste collection scheme, owned by different stakeholders.

The plan is based on global best practices, aiming to keep energy prices low, and including an emissions inventory developed using the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). As the country's first regional climate action plan, it was designed to draw on existing programs, revealing the benefits of climate actions to encourage people to move further and faster in reducing emissions.



Low Carbon Auckland will expand the city's network of bicycle paths.



Comprehensive Plan Yields Quick Results

↓ 36%

REDUCTION IN EMISSIONS INTENSITY IS EXPECTED BETWEEN 2005 AND 2030

THE CHALLENGE

As a dense and low-lying city-state, Singapore must be conscious of its energy consumption, as it is vulnerable to the impacts of climate change. The Climate Action Plan allows Singapore to use this density to its advantage, by ensuring building efficiency and low-carbon transport while at the same time prioritizing adaptive measures. Results are already showing that the plan's dual focus on mitigation and adaptation is yielding impressive results, reducing the city-state's environmental footprint and boosting its resilience.

CO-BENEFITS

Environmental

Under the plan the use of solar power is expected to increase to 350 MW by 2020.

Social

Residents have access to new career opportunities with the creation of approximately 60,000 jobs in green industries.

Economic

Under the Singapore's Climate Action Plan, the green economy has expanded, boosting GDP by about \$4.4 billion.

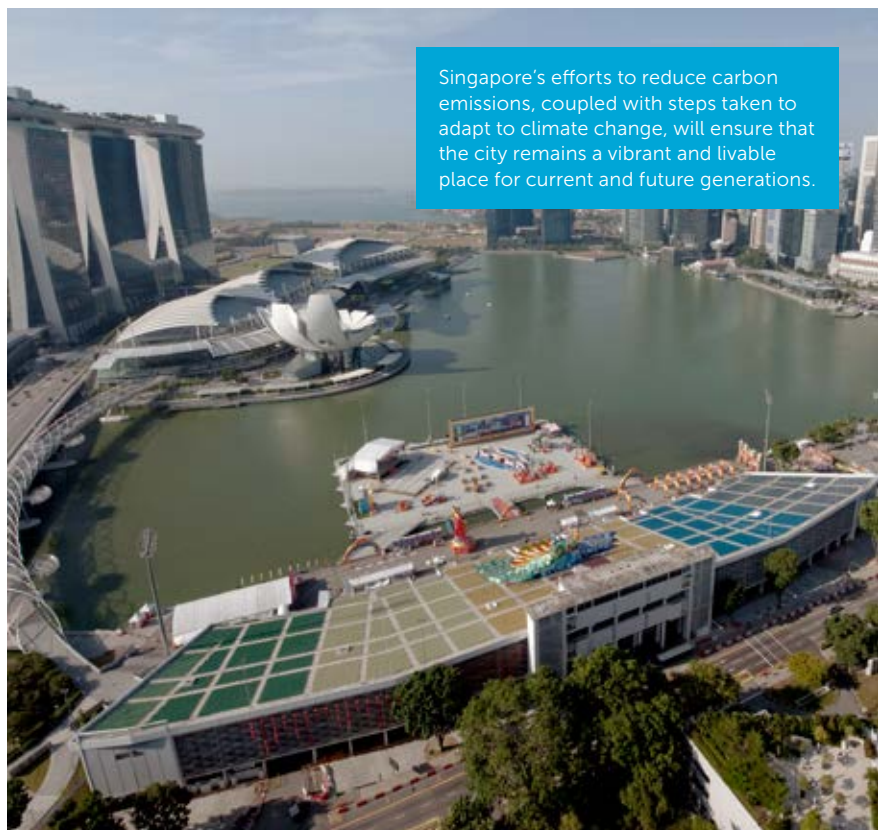
Health

The construction of bike paths provides a new and active commuting option for residents, contributing to the general health and well-being of the city.

→ With ambitious and targeted mitigation and adaptation plans, Singapore is already seeing clear results in its efforts to secure the city's resilience and future as a global hub for green industries.

Singapore's Climate Action Plan provides the framework for both mitigating and adapting to climate change impacts. Within three years of adoption, the plan already has seen an increase in solar power capacity, from 5.9 MW in 2011 to 33.1 MW in 2014. Furthermore, the plan includes a target of having **80% of buildings certified by Green Mark by 2030**, with more than 30% already certified. Transport carbon efficiency will also improve under the plan, with the construction of 700 km of cycling paths and expansion of the rail network by 2030, putting 80% of households within a 10-minute walk of a train station.

In terms of adaptation, protection structures, such as sea walls and stone embankments, have been constructed along 70% to 80% of Singapore's coastline. In 2011, minimum reclamation levels were raised from 3m to 4m above the mean sea level in order to build resilience to sea level rise. Singapore has also invested some **\$1.5 billion in building and upgrading drainage infrastructure**, reducing flood-prone areas from 3,200 hectares in the 1970s to 36 hectares in 2013. In all, the plan showcases that mitigation and adaptation truly go hand in hand.



Singapore's efforts to reduce carbon emissions, coupled with steps taken to adapt to climate change, will ensure that the city remains a vibrant and livable place for current and future generations.

CITY: **CANBERRA**



Working towards Carbon Neutral City Operations

↓ 19%

REDUCTION IN MUNICIPAL CO₂ EMISSIONS SINCE 2013

THE CHALLENGE

The ACT Government is responsible for around 5% of the region's greenhouse gas emissions. In an effort to reduce emissions and lead by example, Canberra's Carbon Neutral Government Framework enables a whole-of-government approach to responding to climate change, focused on achieving zero net government emissions by 2020 and contributing towards the city's target of zero net emissions by 2050.

CO-BENEFITS



Environmental

Through the 2015-2016 carbon budget trial, the government is on track to achieve a 3.2% reduction in electricity use and a potential 2% reduction in natural gas, despite service growth, compared to the previous year.



Social

The Framework influences the city's major events like the spring celebration, Floriade, where more than 450,000 visitors demonstrate and support sustainability behaviors.



Economic

Savings of approximately \$1.3 million per year are generated by investing in energy efficiency across the city under the ACT Carbon Neutral Government Framework.



Health

Through two programs of the Framework, the Healthy Weight Initiative and Transport for Canberra, it is anticipated that 10.5% of commuters will use public transport, 6% will cycle, and 6% will walk to work in 2016.

→ The government of the Australian capital, Canberra, has developed a holistic framework to reach zero net emissions in 2020 by, among other initiatives, going 100% renewable for electricity.

Leading by example, the Australian Capital Territory (ACT) Carbon Neutral Government Framework underpins Canberra's target of **becoming carbon neutral in its operations by 2020**. Anchored by a goal of sourcing 100% of municipal energy use through renewable sources by 2020, the city is also collecting energy consumption data across government operations; holding heads of agencies accountable for meeting reduction targets; implementing sustainable work travel options, including electric vehicles, bike fleets and workplace public transport cards; and ensuring that sustainability criteria is embedded in procurement, which influences the supply chain. These actions have been implemented across the region's multiple agencies, in 600 facilities, affecting 20,000 employees.

The plan is already seeing results, as **since 2013, 44,770 metric tons of CO₂ emissions have been reduced** from a baseline of 232,000 metric tons. By 2020, the 100% renewable energy target will have reduced electricity emissions to virtually zero, with total government emissions down by 65%. Remaining emissions sources, such as transport and natural gas, will be addressed through expansion of an electric vehicle fleet, and transitioning away from gas for temperature control in commercial buildings.





CITY: **PARIS**



Renewed Plan Advances Climate Action

↓ 25%

REDUCTION IN CO₂ EMISSIONS BY 2020 UNDER THE PLAN

THE CHALLENGE

The Paris Climate Action Plan was initially developed in 2007 in response to heat waves, flooding, and water scarcity caused by climate change. With energy consumption expected to increase and temperatures expected to rise, the city has renewed its commitment with new measures in order to promote renewable energy generation and reduce energy use, creating a climate resilient and livable city for Parisians.

CO-BENEFITS



Environmental

So far 5,000 trees have been planted as part of the plan, increasing biodiversity.



Social

More than 55,000 housing units will be refurbished under the Paris Climate Action Plan, reducing energy consumption and saving tenants money through lower utility bills.



Economic

\$1 billion was invested to retrofit housing under the plan, creating about 5,000 jobs.



Health

The plan aims to reduce atmospheric pollutants by at least 50% by 2020, improving the respiratory health of Parisians.

→ By revising and renewing its Climate Action Plan, Paris is working to reduce energy use and promote renewable energy generation, while preparing the city for the long-term effects of climate change.

Paris' Climate Action Plan was renewed in 2012 and covers six main themes: low-energy urban planning; energy efficient and affordable housing; the service industry; low-carbon transport; sustainable consumption; and the city's first adaptation strategy. Since 2012, specific roadmaps on housing, commercial development, and adaptation have been published, in addition to the creation of web tools for citizens. The ultimate goal of the Climate Action Plan is to achieve a **25% reduction in greenhouse gas emissions and energy consumption** by 2020. By the same year, one-quarter of energy consumed in the city should be powered by renewable or recovered energy.

So far, the plan is already achieving impressive results. **By 2014, 75% of energy production in Paris came from renewable sources**, and by the end of 2015, 80% of the plan's initiatives had been launched and the city had succeeded in reducing greenhouse emissions by 10%. With yearly reports released to monitor progress, Paris hopes that this large scale plan will lay the groundwork for a more resilient and climate-proof future.



CITY: **SAN DIEGO**



Bipartisan Plan Accelerates Climate Change Action

↓ **24%**

REDUCTION IN CO₂ EMISSIONS BY 2020 THROUGH THE PLAN

THE CHALLENGE

San Diego faces serious vulnerabilities from climate change, including increased temperatures resulting in hotter, drier days and heat waves, increasing the risk of bushfires and pressure on freshwater resources. In recognition of the severity of these issues, San Diego's Republican mayor adopted the Climate Action Plan, with a focus on reducing fossil fuel use and securing a stable water supply for the city.

CO-BENEFITS



Environmental

The plan aims to achieve 100% renewable electricity city-wide by 2035.



Social

It is expected that the city's Climate Action Plan will create 25,000 jobs, with efforts particularly focusing on disadvantaged communities by training youth and veterans in solar energy careers.



Health

The plan aims to have 50% of residents commute by foot, bike, or transit by 2035, creating new opportunities for exercise, which can lower obesity rates and improve cardiovascular health.

→ Both Democratic and Republican city council members unanimously agree on San Diego's Climate Action Plan, creating an innovative and bold vision for the city's resilient future.

In December 2015, San Diego adopted a new Climate Action Plan with bipartisan support, demonstrating that climate action can appeal to everyone, regardless of political affiliation. With this plan, **San Diego aims to cut its carbon footprint in half by 2035** via five strategies: energy- and water-efficient buildings; clean and renewable energy; bicycling, walking, transit and land use; zero waste; and climate resilience.

So far, 4,000 solar panel installation permits have been issued and more than 260 km of bicycle lanes have been completed, with **80 km of new or improved bike lanes planned every year**. The plan aims to have 20,000 additional residential units built within walking distance to existing transit stations, and has set a target of 35% urban tree canopy cover. In terms of water, the plan's recycling purification program includes the construction of purification facilities, pipelines, and pump stations to provide a local source of water to the city. Eventually this will replace purchases of imported water, which currently account for at least 85% of the demand.



Promoting urban cycling is a key element of San Diego's Climate Action Plan.

CITY: **BUENOS AIRES**



Inventory Upgrade Improves Climate Strategy

↓450K

TONS OF CO₂ EMISSIONS REDUCED IN 2015 DUE TO ACTIONS SET FORTH IN THE PLAN

THE CHALLENGE

Buenos Aires has faced challenges from urbanization since the 1950s. This, combined with the increase of heavy rainfall and heat waves due to climate change, has increased the city's vulnerability, particularly in flood-prone areas occupied by informal settlements. The inventory upgraded through the Climate Change Action Plan has allowed the city to more appropriately and accurately plan projects to reduce CO₂ emissions and lessen the impacts climate change.

CO-BENEFITS



Environmental

So far, waste handling measures implemented under the plan have reduced CO₂ emissions by 181,000 tons.



Social

As part of the strategy, more than 6,000 municipal agents, in addition to community institutions such as schools and senior centers, have been trained to respond in emergency situations caused by climate change.



Health

The plan aims to plant more trees, which will reduce the urban heat island effect and place less pressure on the public health system.

→ By upgrading the methodology of the city's emissions inventory, Buenos Aires identified a new focus area for its Climate Change Action Plan.

In 2011, Buenos Aires enacted the Climate Change Law in support of its Climate Change Action Plan, confirming its commitment to reducing emissions. The law enforces checks and updates of the plan every five years, the first of which occurred in 2015 and resulted in the **conversion of the city's initial emission inventories to a more accurate, robust version** based on the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC).

The process of upgrading the inventories has helped the city define a new focus area of the Climate Change Action Plan for 2020. In addition to the three core pillars of the initial Action Plan – waste, transport, and energy – the city has proposed a fourth pillar on tree planting in urban areas, aiming to improve carbon sequestration and rainfall capture, while reducing the urban heat island effect. Moving forward with these four pillars, combined with efforts already in place, Buenos Aires **plans to reduce emissions by 10% by 2020** and by 30% by 2030.



The city is working to engage the community in reducing CO₂ emissions by increasing environmental education, public awareness and participation.





Strategy Drives Resilient City Operations in Africa

↓ 22%

REDUCTION IN EMISSIONS PREDICTED BY 2030 AS PART OF THE STRATEGY

THE CHALLENGE

Temperatures have already increased in Kampala by 1.5° C between 1950 and 2005, causing urban heat islands, intense rains, and changes in rainfall patterns. Most affected are the poor, constituting 60% of the city's residents, who often live in the low-lying areas. The goal of the Kampala Climate Change Action Strategy is to build a climate resilient city, and overcome impacts like flooding, heat waves, and food insecurity, protecting the lives and livelihoods of the city's most vulnerable residents.

CO-BENEFITS

Environmental

In plans to green the city, the strategy has set a goal of planting 500,000 trees.

Social

By reducing energy use and improving the city's resilience to climate change impacts, the strategy helps protect more than 300,000 people.

Economic

The strategy is expected to yield at least \$33 million in savings by 2050 by focusing efforts not only on mitigation but also adaptation actions.

Health

The city aims to reduce the amount of wood charcoal used for cooking, which currently accounts for more than 90% of the approximate 366,000 metric tons of charcoal use each year and poses respiratory health risks.

→ Kampala's new Climate Change Action Strategy is instituting energy efficiency and sustainability in the Ugandan capital's operations, serving as an example for other African cities.

Leading the way in Sub-Saharan Africa, the Kampala Climate Change Action Strategy addresses climate change mitigation and adaptation, starting with the city's own operations. The foundation of the strategy is the city's first energy and climate profile, developed in 2015. Under the strategy, the Kampala Capital City Authority (KCCA), the body that governs and oversees city operations, is incorporating energy and climate goals into its policies and services, with **plans to build a denser city with improved transit options**, cultivate more green space, increase renewable energy usage, improve waste and water management, and implement a green public procurement policy. The ultimate goal is to reduce CO₂ emissions by nearly a quarter over the next 15 years.

In order to achieve the most effective outcomes, KCCA has educated its employees on climate issues, **holding more than 15 workshops to date**. They are also urging the rest of the city to join their efforts by launching campaigns encouraging citizens to build away from wetlands and promoting urban agriculture, with more than 1,200 farmers having already received training and small grants.



The city's workshops ensure that officials are informed about climate change strategies.

CITY: GUANGZHOU



Low-Carbon Megacity Encourages Green Growth

↓ 35.9M

TONS OF CO₂ EMISSIONS REDUCED BETWEEN 2010 AND 2014

THE CHALLENGE

With energy consumption already high and demand increasing in urban and industrial areas, Guangzhou aims to reduce its carbon emissions while maintaining growth by focusing on industrial planning, architecture, transportation, government agencies, and residential communities.

CO-BENEFITS



Environmental

The plan promotes environmental improvements by strengthening forest carbon sequestration with afforestation and the low-carbon disposal of biochemical waste.



Social

In constructing new rail transit, the plan reduces traffic on the roads, with residents spending less time commuting to and from work.



Economic

Guangzhou's target is to reduce CO₂ emissions per \$1,500 of GDP by 40% or more by 2020 compared to 2010.



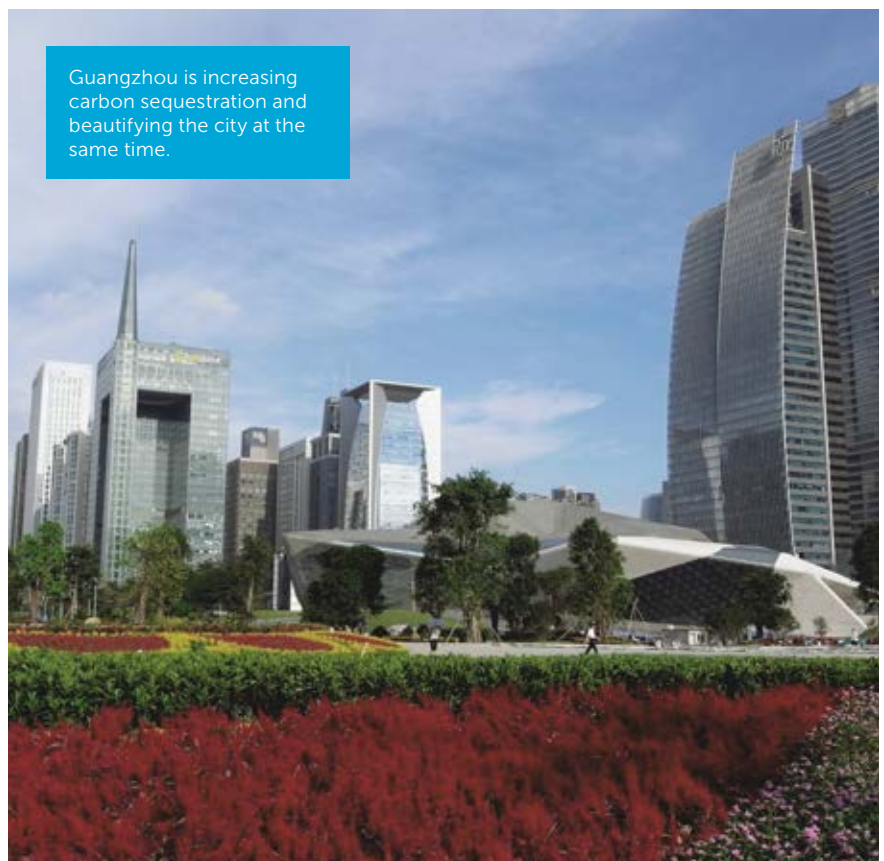
Health

Due to the plan's initiatives, Guangzhou's air quality standard was met 85% of days in 2015, an increase of 8% compared to the year before.

→ Guangzhou is planning for an increasing population and rising demand for energy with the a multi-sector, low-carbon plan for green growth, targeting industry, infrastructure, and buildings.

Guangzhou, a megacity with a population exceeding 13 million, is still in a stage of rapid economic development and urban construction. In 2012, Guangzhou launched the Pilot Low Carbon City Implementation Plan in an effort to reduce greenhouse emissions through systematic measures in the growing city. The plan includes the elimination of outdated industrial capacity and equipment and the **promotion of energy-efficient technologies** and green, low-carbon buildings. Transport infrastructure is also being targeted, with a new public transport system mainly based on rail transit.

Both market mechanisms, such as **limiting entry permits for high-carbon projects** to control greenhouse gas emissions, and institutional mechanisms, such as stricter emissions standards, have been used to promote low-carbon development under the plan. Green industries have developed quickly in the city, with an added value of \$4.2 billion in 2014, an 11.1% increase compared to the previous year. As a commitment to the plan, Guangzhou announced in 2015 it will reach its carbon emissions peak by 2020.



Guangzhou is increasing carbon sequestration and beautifying the city at the same time.

CITY: **OAKLAND**



Consumption Inventory Shows True Emissions

↓ **83%**

REDUCTION IN CO₂ EMISSIONS BY 2050 SUPPORTED BY THE INVENTORY

THE CHALLENGE

In order to reduce CO₂ emissions, cities must undertake the challenging task of understanding where these emissions originate. Oakland's approach of analyzing the entire life-cycle of goods and services consumed within its jurisdiction – not just what happens in Oakland – takes a more holistic look at this challenge and sets the framework for accurate decision-making, helping the city learn how to reduce its global emissions footprint.

CO-BENEFITS



Environmental

The city's goal is that the consumption-based inventory can help lead to reductions in energy use and waste generation.



Economic

The inventory aims to increase job opportunities in clean and green technology fields, where there are already 7,000 employees.



Health

Significant health benefits will be realized from implementation of the city's CO₂ reduction goals and programs stemming from the inventory, including reductions in black carbon, nitrogen oxides, and other pollutants that adversely affect local air quality.

→ Oakland established a solid foundation for climate policy-making by determining where the majority of the city's emissions come from via a consumption-based greenhouse gas emissions inventory.

The 2016 Oakland Greenhouse Gas Emissions Inventory is among the few in the world that have **incorporated the consumption of the city's goods and services**, including upstream elements of resource extraction, processing, manufacturing, and transportation, as well as downstream impacts from waste management, in their carbon footprint. The city created greenhouse gas inventories for the 2005, 2010, and 2013 calendar years with the assistance of academic and NGO partners. By analyzing emissions back to the city's baseline year of 2005, the inventory makes it easy to compare life-cycle impacts over time.

The baseline (2005) emissions associated with Oakland are 2.9 million metric tons under the traditional inventory methodology, but 8.9 million metric tons using this new consumption approach. Also telling, **life-cycle emissions account for up to 65% of the total greenhouse gas emissions** associated with transportation, buildings, and waste. While the inventory does not directly reduce emissions, it provides the analysis, quantification, and perspective for city leaders and the public to understand which efforts are the most effective in reducing emissions.



Oakland's consumption-based emissions inventory aims to lay the foundation for the uptake in green technology industries, such as solar generation.



EV
CHARGING STATIONS
HERE.

FOOTSTEPS TO YOUR FLIGHT

FOOTSTEPS TO YOUR FLIGHT
PARK OAK

EV
PARK CLOSE.
GET CHARGED.



PARK OAK

ELECTRIC
VEHICLE
PARKING
ONLY

ELECTRIC
VEHICLE
PARKING
ONLY

ELECTRIC
VEHICLE
PARKING
ONLY

CITY: **RIO DE JANEIRO**

Carbon-Neutral Commitment in Global South



↓20%

REDUCTION IN EMISSIONS BY 2020 THROUGH THE STRATEGY

THE CHALLENGE

Rio faces climate change threats due to a change in rainfall patterns, impacting the availability of water and energy, with hydropower production accounting for more than 70% of current electricity usage. Rio is securing a sustainable future for its people by planning for water and energy efficiency measures with a commitment to carbon neutrality through the Neutral Carbon Rio Strategy.

CO-BENEFITS



Environmental

The strategy will see cleaner air through the use of clean fuels, improving the quality of local ecosystems.



Social

The strategy promotes a more inclusive city, due to a better and more efficient public transportation network, available to more people.



Economic

Through the implementation of the Neutral Carbon Rio Strategy, Rio de Janeiro will focus and develop its sustainable construction industry, making use of green technology and renewable energy.



Health

It is expected that there will be fewer occurrences of waterborne diseases due to better water management and measures to decrease urban flooding that are included in the strategy.

→ Rio de Janeiro's Neutral Carbon Rio Strategy is improving the city's outlook for its water and energy supply while leading the way in carbon-neutral planning in the global south.

As one of the first cities in the global south to commit to long-term carbon neutrality as a municipal policy, Rio de Janeiro has launched its 50-year Neutral Carbon Rio Strategy to **achieve carbon neutrality by 2065**, putting the city on a low-carbon, resilient, and inclusive path to development. Rio has established a greenhouse gas inventory based on the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), acting as the foundation for establishing climate goals and actions, which will be regularly revisited and updated.

So far, the city plans to improve the public transport network, as well as water and energy efficiency, with a goal to reuse more than 80% of all water consumed, preserve floodplains within the city, and **produce 30% of energy consumed in the city from renewable and decentralized sources**. Overall, the project aims to reduce the city's annual carbon emissions from a baseline of 11.6 million tons to 9.2 million tons by 2020, and further to 2.3 million tons by 2050, a full 80% reduction.



Rio's new light-rail network is part of the city's plan to improve public transport.



Plan Seeks Behavior Change and Green Industry Growth

→ The Taiwanese city of Taoyuan has launched a development plan targeting lifestyle changes and the creation of a renewable energy industry in an effort to shrink the city's CO₂ emissions.

↓ 11K

TONS OF CO₂ EMISSIONS ESTIMATED TO BE REDUCED PER YEAR BY SOLAR POWER ALONE UNDER THE PROGRAM

THE CHALLENGE

Taoyuan's new development plan lays the groundwork for a more climate-proofed city in which citizens and industries work together to reduce CO₂ emissions and cultivate a greener future. In doing so, Taoyuan is reducing energy and resource use, preventing unnecessary waste generation, and guiding more sustainable urban growth and land use.

CO-BENEFITS

Environmental

In reaching its solar capacity goals in the next year, Taoyuan will generate enough solar energy to power 5,700 households per year.

Economic

Developing a green technology industry focused on solar generation enables Taoyuan to develop economic opportunities in complementary fields such as research and development and consulting.

Health

The city plans to conduct 28 educational sessions on low-carbon and healthy eating per year by 2019.

The Flagship Program of Low-Carbon Green City Development in Taoyuan was released in 2016 in an effort to **reduce the city's greenhouse gas emissions by 210,000 tons by 2020**. The program's 30 action plans are shaped by a number of themes, including fostering behavioral and consumption changes among the public and promoting industry growth in green technology fields. Specific actions to foster low-carbon lifestyles among residents include educational campaigns, incentives, and nudging programs related to food, clothing, housing, transportation, education, and recreation.

In terms of green industry growth, the city **promotes the sale and lease of municipal buildings' roofs for solar installations**, encourages communities to set up solar power generation systems, and nurtures private sector development and consulting in the solar and wind industries. Taoyuan expects these efforts to boost the total capacity of solar energy to 20 MW by 2017. Annual performance indicators are tracked to ensure that the city reaches its CO₂ reduction goal in the coming years.



The program guides the city on how to appropriately plan land use and construction in a low-carbon manner.



BUILDING ENERGY EFFICIENCY



TOKYO

*Owners and Renters Collaborate
to Reduce Energy Use*
P. 89



WUHAN

*Research Center Built with
Green Design Principles*
P. 91



VILNIUS

*Online Tool Tracks
Apartment Energy Use*
P. 95



GUANGZHOU

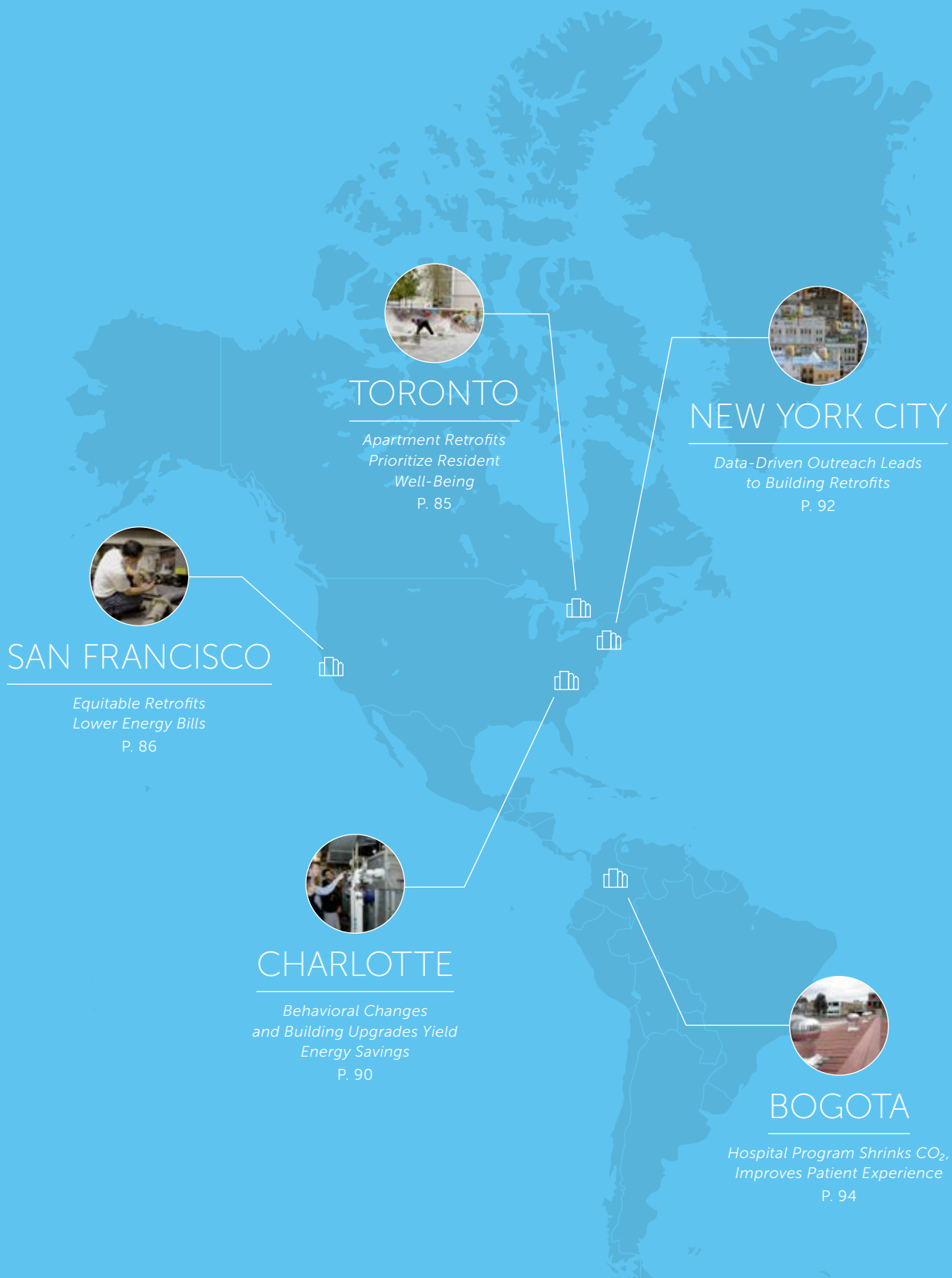
*Energy Audits and
Retrofits Mandated for Large
Public Buildings*
P. 84



SYDNEY & MELBOURNE

*City Alliance Yields Nationwide
Energy Savings*
P. 88

→ The Building Energy Efficiency sector focuses on solutions that mitigate the high environmental impact of the built environment. By refurbishing buildings with energy-efficient innovations, targeting residential buildings for upgrades, and encouraging greener building regulations, these solutions showcase how cities are taking action against the most energy-intensive sector of society.



TORONTO

*Apartment Retrofits
Prioritize Resident
Well-Being*
P. 85



NEW YORK CITY

*Data-Driven Outreach Leads
to Building Retrofits*
P. 92



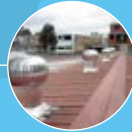
SAN FRANCISCO

*Equitable Retrofits
Lower Energy Bills*
P. 86



CHARLOTTE

*Behavioral Changes
and Building Upgrades Yield
Energy Savings*
P. 90



BOGOTA

*Hospital Program Shrinks CO₂,
Improves Patient Experience*
P. 94

CITY: **GUANGZHOU**



Energy Audits and Retrofits Mandated for Large Public Buildings

↓ 98k

TONS OF CO₂ EMISSIONS
EXPECTED TO BE REDUCED IN 2018
UNDER THE PROGRAM

THE CHALLENGE

Due to rapid urbanization and higher living standards, buildings, particularly those operated by large public institutions, constitute a major part of energy consumption and greenhouse gas emissions in Chinese cities. In order to address these challenges and ensure that future development is energy efficient, Guangzhou mandated that large, energy-guzzling public buildings must undergo energy retrofits in order to reduce CO₂ emissions.

CO-BENEFITS



Social

By undertaking these initiatives at major public institutions, visited regularly by thousands of citizens, the project aims to improve public awareness of energy-saving measures.



Economic

Guangzhou estimates that participating public institutions' electric bills will be cut by about \$15 million annually with full implementation of the program.



Health

As the goal of this project is significant CO₂ emissions reductions from buildings, the city anticipates corresponding improvements in air quality.

→ Large public institutions in Guangzhou, China, are now required to conduct energy audits and install efficiency upgrades by the end of 2017 in order to cut energy use by one-fifth.

Guangzhou has instituted a plan requiring large public institutions, such as government agencies, hospitals, schools, and cultural and sports venues, to complete comprehensive energy audits and undertake energy efficiency improvements by the end of 2017. In order to target the biggest energy consumers, the plan applies to 206 institutions with annual power consumption of at least 1,500 MWh or a gross floor area of 20,000 m², **mandating a 20% reduction of energy demand per unit of floor area** after improvements are completed.

The plan builds on impressive results from previous years, in which 31 energy efficiency improvement projects implemented at public institutions in Guangzhou **cut annual power consumption by 21,000 MWh** and reduced CO₂ emissions by 12,000 tons from 2012 to 2015. The intent of requiring energy audits and efficiency improvements for these key energy consumers is to provide examples of green public buildings and formulate the energy consumption standard for all public institutions in Guangzhou.

Guangzhou is the first Chinese city to call for such a comprehensive and systematic energy efficiency upgrade mandate in its public buildings.





Apartment Retrofits Prioritize Resident Well-Being

↓ 1.4M

TONS OF POTENTIAL GREENHOUSE GAS EMISSIONS REDUCED YEARLY AFTER RETROFITS ARE COMPLETED AT THE 1,200 POTENTIAL BUILDINGS

THE CHALLENGE

Toronto's residential building sector generates approximately 44% of its greenhouse gas emissions, with older buildings as key emissions contributors. Through its Tower Renewal Program, the city is able to encourage property owners and managers to improve the environmental performance of older buildings and accrue social and economic benefits for surrounding communities.

CO-BENEFITS



Environmental

Field tests and outreach at 10 Tower Renewal Program sites demonstrated ways to improve waste diversion, rates of which have already doubled since 2007 due in part to the program's support.



Social

The STEP program guides owners to improve lighting and sightlines at the property, allowing residents to feel an increased sense of safety in and around their buildings and reclaim spaces formerly deemed unsafe.



Economic

As retrofits are completed on buildings each year, jobs will be created in planning, design, construction, and maintenance.



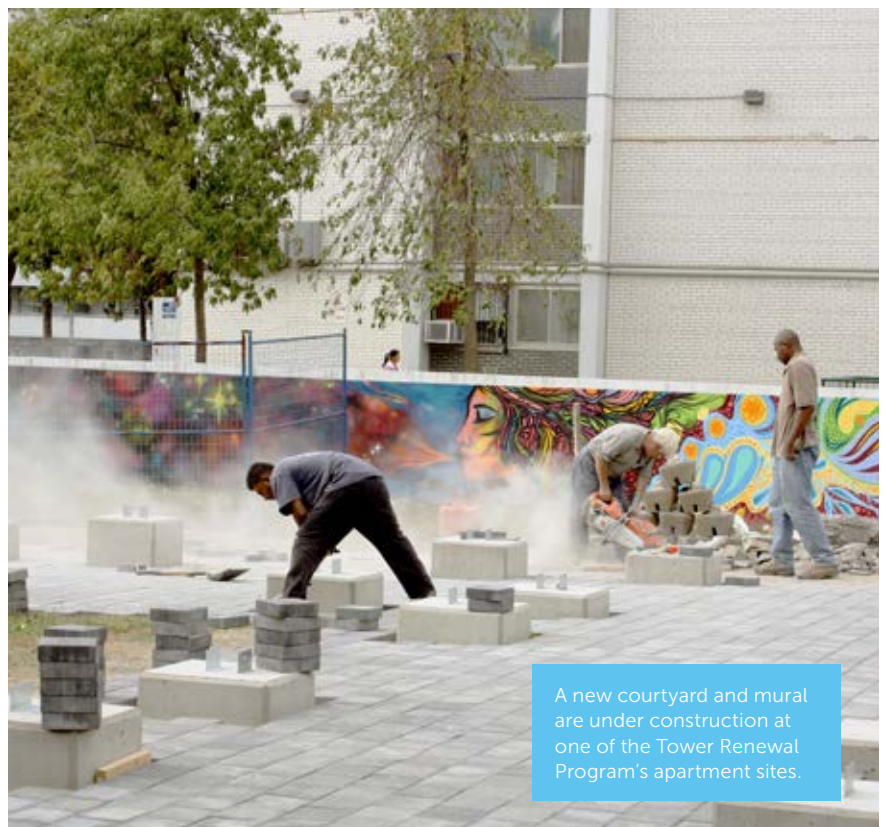
Health

The Tower Renewal Program has hosted more than 75 health and nutrition sessions with approximately 750 residents who have learned and shared healthy cooking and nutrition tips.

→ Toronto is renovating its older building stock via a community-focused program that engages property owners, building managers, and residents in improvements.

With the Tower Renewal Program, Toronto is engaging residents in the renovation of its older apartment building stock through a suite of complementary initiatives that drive energy efficiency, social cohesion, and economic development. A key initiative under the program is Sustainable Towers, Engaging People (STEP), which supports property owners and building managers in benchmarking and incrementally improving the energy, water, waste, safety, operations, and community-building performance of their buildings. So far, the city has **benchmarked 230 buildings and created customized action plans for 120**, while STEP participants have realized energy savings of 5% to 20%.

To date, the Tower Renewal Program has reached a quarter of the 1,200 old buildings in its scope. Taking care to ensure that the program is well integrated with other city services, it is supported by Hi-RIS, Toronto's innovative and low-cost financing tool for energy upgrades. The city expects significant results from the Tower Renewal Program as the pilot phase demonstrated that **buildings' greenhouse emissions could decrease by up to 74% after retrofits**.



A new courtyard and mural are under construction at one of the Tower Renewal Program's apartment sites.

CITY: **SAN FRANCISCO**



Equitable Retrofits Lower Energy Bills

↓ **300K**

TONS OF ANNUAL CO₂ EMISSIONS REDUCED BY 2030 VIA THE CITY'S ENERGY EFFICIENCY INITIATIVES

THE CHALLENGE

Buildings, especially older commercial and residential ones, are responsible for approximately half of San Francisco's emissions. However, building owners and occupants often lack capital for energy efficiency investments. To remedy this, the city adopted an ambitious approach to enable previously unattainable energy retrofits for residents and spur investment in energy efficiency with commercial users.

CO-BENEFITS



Environmental

To date, San Francisco has achieved a 24% reduction in greenhouse gas emissions, including a reduction of more than 27,000 metric tons of CO₂ annually from energy efficiency projects.



Social

The program ensures that low-income communities, which are the most vulnerable to climate change impacts, have access to resources to build their energy resilience.



Economic

The program has provided \$18 million in incentives, and secured more than \$3.8 million in financing, for efficiency projects, saving customers an average of \$3,000 in utility costs per year.



Health

Upgrades completed under San Francisco's program have helped low- and fixed-income residents enhance health and indoor comfort by reducing cold indoor temperatures, condensation, and mold.

→ Through a range of diverse and ambitious initiatives targeting everything from small homes to large commercial properties, San Francisco has accelerated the equitable uptake of energy efficiency retrofits.

To achieve the city's goal of reducing greenhouse gas emissions by 80% by 2050, San Francisco, in 2011, adopted a holistic approach to energy efficiency in a range of buildings, with a focus on energy equity and market impact. The city has since facilitated energy efficiency upgrades in **3,000 commercial, 1,000 multi-family, and 500 single-family buildings** via a suite of programs, many of which are specifically designed to target small businesses and low-income housing. One such program is an energy efficiency undertaking in the Chinatown Development Center's affordable housing project, which reduced energy use by 49,235 kWh and saved 30% in annual average utility costs.

In addition to offering energy upgrades and incentives, San Francisco is working to transform the market for energy efficiency by, for instance, passing the Existing Commercial Building Benchmarking Ordinance (ECBO) which requires commercial property owners to report total energy use annually and obtain an energy audit or conduct retro-commissioning every five years. The audits found that in the first 800 buildings subject to the policy, an **investment of \$60.5 million would yield \$25 million in annual energy savings.**



Energy advisors help residents and business owners understand and implement energy efficiency upgrade options.





City Alliance Yields Nationwide Energy Savings

↓ 638K

TONS OF CO₂ EMISSIONS HAVE BEEN COLLECTIVELY REDUCED BY CITYSWITCH MEMBERS SINCE 2011

THE CHALLENGE

In Australia, building owners are not responsible for their tenants' environmental impacts, creating not only a knowledge and resource gap but also a split incentive for action. Sydney and Melbourne's CitySwitch bridges that gap by providing office-based businesses with the tools to undertake energy efficient measures as well as a large network to share experiences.

CO-BENEFITS



Environmental

Since 2011, 850 CitySwitch projects have committed to expand efforts to decrease waste and increase renewable energy use.



Economic

Cost savings is a large part of the CitySwitch program, and, in three years, members have saved more than \$26 million in avoided energy costs.



Health

Since 2011, the program's signatory businesses have undertaken 130 projects to improve the well-being and health of employees.

→ Sydney and Melbourne expanded their successful CitySwitch Green Office program, which is now improving businesses' energy performance in cities across Australia.

Initiated by Sydney and Melbourne, the CitySwitch Green Office program provides training, network access, and tracking tools to businesses to help them reduce day-to-day energy use and improve their overall sustainability performance. Although Melbourne and Sydney have been collaborating for a decade, the program recently expanded to seven cities, and now partners with both states and the federal government. To date, CitySwitch supports 12% of Australia's commercial office space. As demonstrated by its widespread adoption, the program has positively impacted businesses' energy performances in participating jurisdictions. On energy and carbon, verified data shows that signatory **businesses deliver 25% savings on average during their time in the program**. In 2015 alone, the program's 1,500 projects achieved almost 350,000 metric tons of CO₂ reductions.

In addition to a wide business network, the program also provides structured performance management tools that help measure and quantify outcomes and integrate other business priorities like costs, employee health, social sustainability, and technology. In 2015, nearly **30% of completed CitySwitch projects related to health, technology, or staff engagement**, and the program's members' combined actions helped avoid \$9.7 million in energy-related expenses.



The CitySwitch program is closely integrated with both Melbourne's and Sydney's sustainability strategies.



Owners and Renters Collaborate to Reduce Energy Use

↓ 17%

POTENTIAL DECREASE IN ENERGY USE IN RESIDENTIAL BUILDINGS BY 2020

THE CHALLENGE

Split incentives are one of the most important barriers to energy efficiency upgrades in tenant-managed buildings, as tenants receive the benefit of lower energy consumption while owners often have to pay for the initial investment. With mandatory disclosure of energy use for tenant buildings, Tokyo forces renters and owners to collaborate transparently and encourages all actors involved to improve energy performance.

CO-BENEFITS



Environmental

The program also aims to increase tenants' awareness of climate issues such as resource scarcity, water use, and waste management.



Social

Increasing tenant and owner collaboration has positive effects on their preparedness and resilience to crises such as extreme weather events.



Economic

When implemented, energy-saving measures will reduce the energy expenditure of each tenant building – benefiting both unit renters and building owners.

→ By mandating that large residential buildings disclose their energy use, Tokyo is getting tenants and owners to collaborate on prioritizing energy efficiency upgrades.

Large residential buildings included in Tokyo's Cap-and-Trade Program must report their energy use and efforts to reduce consumption, under the city's mandatory Tenant Rating and Disclosure Program. As part of the program, each apartment unit receives an evaluation and a grade, which is disclosed on the city's website. While Tokyo already works with owners to reduce energy use, tenant engagement is essential to accelerate the uptake of energy efficiency upgrades. The program not only increases awareness and transparency, but also **incentivizes owners and tenants to collaborate** by making tenants responsible parties. In addition, the city supports the disclosure program by providing important information on how to improve energy performance, as well as pilot projects for retrofits and environmental performance attached to leases.

The city also encourages the participation of medium and small tenant buildings with a Carbon Certification Program, which **rewards well-performing buildings**, and releases energy performance to tenants and potential tenants. Through the new initiatives, Tokyo aims to reduce building energy use in all tenant buildings by approximately one-sixth by 2020.



Tokyo aims to reduce city-wide energy use by 30% by 2030.

CITY: CHARLOTTE



Behavioral Changes and Building Upgrades Yield Energy Savings

↓ 51K

METRIC TONS OF CO₂ REDUCED IN 2015 COMPARED TO 2010 LEVELS BECAUSE OF ENVISION CHARLOTTE PROJECTS

THE CHALLENGE

To reduce energy use in the city's commercial buildings sector, one of the most significant contributors to CO₂ emissions in the North Carolina capital, Charlotte collaborated closely with local universities and the private sector to implement a series of measures to encourage energy-saving habits among the employees in large buildings and boost the uptake of energy efficient equipment, which resulted in a significant decrease in energy use.

CO-BENEFITS

Environmental

The city and Duke Energy are rolling out a mobile application to complement energy-saving measures with further education on water efficiency, waste, and transportation.

Social

Active engagement was a key component of Envision Charlotte; behavioral change initiatives alone accounted for a 6.2% reduction in energy use.

Economic

Participating buildings lowered their utility bills due to the decrease in energy use.

→ By focusing on both energy efficiency upgrades and changing individuals' energy-savings habits, Charlotte was able to substantially reduce the energy used in the city's largest commercial buildings.

In 2011, Charlotte, North Carolina, launched Envision Charlotte, a program with a goal to **reduce large buildings' energy use by 20%** by the end of 2016 through behavioral change and equipment improvements. The city engaged a number of local stakeholders in the effort, partnering with the local utility, Duke Energy, to encourage individuals in office buildings to adopt energy-saving practices, like turning off lights, with creative games, while working closely with property managers and engineers to optimize systems for energy efficiencies. The program also lent the services of university students and professors, inviting them to audit buildings to identify the best options for equipment upgrades.

From its launch, Envision Charlotte was able to secure **pledges from 61 of the city's 64 major commercial buildings**, with participating properties committing to reduce energy consumption by 20% over the course of the project. As part of this commitment, building owners also installed meters to gather data and track improvements from implemented projects. The initiatives were largely successful, yielding a 17.2% annual reduction in energy use compared to the 2010 base year.



Professors and students from the University of North Carolina at Charlotte partner with Envision Charlotte to perform energy audits of city's commercial buildings.

CITY: WUHAN



Research Center Built with Green Design Principles

↓ 15%

REDUCTION IN THE BUILDING'S CO₂ EMISSIONS BETWEEN 2014 AND 2015

THE CHALLENGE

In recent years, China's building sector has been characterized by rapid new construction and demolition of older buildings. A key challenge is therefore to ensure that new buildings reduce energy use and optimize resources. The Wuhan New Energy Research Institute is a prime example of engineering and design excellence that can reduce CO₂ emissions and serve as a model to other new construction in Wuhan and cities throughout China.

CO-BENEFITS



Environmental

The research center's innovative design features provide natural light and shading, which reduces the need for artificial lighting and air-conditioning.



Economic

The building will save 530,000 kWh of electricity and 4,800 tons of water annually, which will yield financial savings for the building owner.



Health

A natural ventilation system in the building controls the cleanliness and flow rate of air, improving comfort and indoor air quality.

→ Wuhan's clean energy research center was built with a goal to emit zero carbon emissions, while the researchers inside focus on developing innovative wind and solar technologies.

In 2011, Wuhan initiated construction on one of the largest green buildings in China. Covering 68,480 m², the Wuhan New Energy Research Institute is a home to forward-thinking research focused on developing wind, solar, and clean energy knowledge and technologies. Aiming to be a landmark of science and technology, the building has been **constructed according to BREEAM and "China Green 3-star" standards**.

The innovative design of the building takes into account the power of nature, forming the shape of a lily, and using this shape to reduce energy use and optimize the use of natural resources. The roof of the main tower, which resembles the flower, is covered with solar panels. The tower, or "stem," beneath the flower falls within its shadow, reducing the need for additional heating and cooling, while consuming no fossil fuels and emitting no CO₂. Furthermore, a **wind turbine at the center of the structure produces 480,000 kWh of energy** for the building. While this research institute, housed on 11 hectares of land, emitted only 2,863 tons of CO₂ in 2015, it aims to be emissions-free in the coming years.



The innovative design of the Wuhan New Energy Research Institute's flower-like shape contributes to its energy efficiency.



Data-Driven Outreach Leads to Building Retrofits

↓ 1M

METRIC TONS OF CO₂ EMISSIONS ARE EXPECTED TO BE REDUCED BY 2025 AS A RESULT OF RETROFIT ACCELERATOR'S UPGRADES IN 20,000 BUILDINGS

THE CHALLENGE

Nearly three-quarters of New York City's CO₂ emissions come from building energy use. Yet, barriers, including complex incentive schemes and bureaucratic hurdles, impede energy retrofits in the city, especially for low-income communities. By identifying buildings with high energy use and reaching out to owners via trusted local organizations, the city is able to offer to residents a streamlined, custom-made strategy to implement green retrofits.

CO-BENEFITS

Environmental

The initiatives include 280 projects that address water conservation to help reduce storm-related wastewater and sewer overflows that pose pollution risks.

Social

Energy efficiency upgrades will decrease buildings' electricity load, and increases the ability of the utility to provide stable electricity to customers during extreme weather events.

Economic

In its first three years, Retrofit Accelerator seeks to assist 450 affordable buildings with upgrades, reducing utility costs for low-income residents.

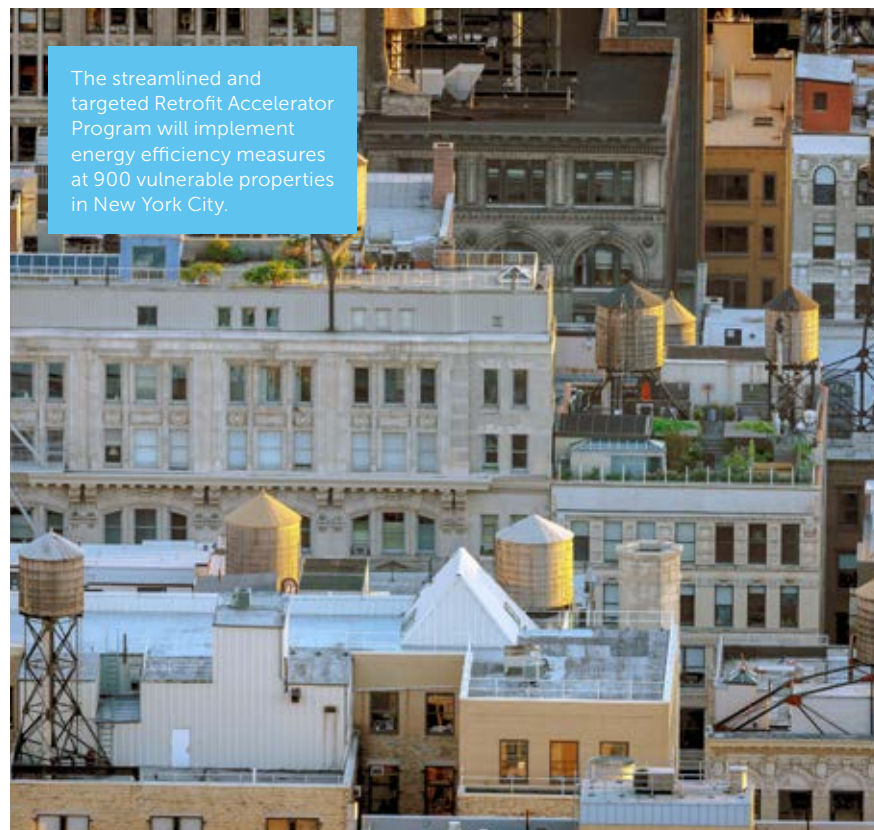
Health

The Retrofit Accelerator Program is helping buildings convert to cleaner fuels, which is expected to reduce PM 2.5 emissions by 90 tons each year.

→ New York City is facilitating energy efficiency retrofits in large buildings and those in low- and medium-income neighborhoods with a data-driven outreach strategy.

New York City's retrofit programs utilize data-driven analysis and community outreach to pinpoint properties which present the greatest opportunities for energy savings and are at greatest risk of climate change impacts. Using a sophisticated strategy combining benchmarking, audits, and other data sources, the Retrofit Accelerator program is **identifying and assisting owners of buildings larger than 4,600 m²** with upgrades. Meanwhile, a complementary program, Community Retrofit, reaches out to owners of buildings in low- and moderate-income neighborhoods with the help of influential community organizations and local utilities, offering free technical advisory services for the implementation of energy and water efficiency projects.

Since its 2015 launch, Retrofit Accelerator has identified 1,000 projects for energy upgrades and over the next three years, the program will assist at least 1,500 buildings in implementing energy or water efficiency projects. At the same time, Community Retrofit anticipates **greenhouse gas reductions of 9,000 metric tons of CO₂** over three years from at least 500 completed or initiated retrofits, resulting in \$5 million in annual cost savings.





CITY: **BOGOTÁ**



Hospital Program Shrinks CO₂, Improves Patient Experience

→ Bogotá has pioneered a holistic approach integrating renewable energy and environmentally friendly practices in the public hospital network in order to reduce CO₂ emissions and improve patient experience.

↑ 22

HOSPITALS IN BOGOTÁ'S JURISDICTION WILL BENEFIT FROM THE GREEN HOSPITAL PROGRAM

THE CHALLENGE

Hospitals in Bogotá have a significant ecological footprint, as they not only generate hazardous waste but also use twice as much energy as conventional office buildings in the city. By adopting the holistic Green Hospital Program, the city decreases the energy use of hospitals while improving patients' and nearby communities' well-being.

CO-BENEFITS



Environmental

The Green Hospital Program aims to better manage the hazardous waste generated by public hospitals and reduce the risk of contaminating nearby communities' land and water.



Economic

The utilization of alternative sources of energy will reduce the hospitals' utility bills.



Health

Installation of community gardens in hospitals helps improve patients' psychological health.

Bogotá is the first city in Colombia to implement the Green Hospital Program, which aims to improve the environmental performance of its public hospitals by adopting alternative sources of energy and environmentally responsible practices. In doing so, the city wants to reduce greenhouse gas emissions and **improve the quality of life for patients and workers** in the buildings. Bogotá is calculating the carbon footprint of its affiliated hospitals in order to establish a benchmark level for carbon reduction as well as mitigation strategies. Though the program is quite new, a number of pilot projects have already come online, such as a wind power installation at Santa Clara Hospital and solar water heater system at Suba Hospital. As a result of the new measures, there has been a 3.1% decrease in energy use in the pilot hospitals despite a 26.1% increase in services provided between 2012 and 2015.

Along with energy efficiency, the Green Hospital Program focuses on public hospitals' management of waste and green areas, and works to **add green walls and community gardens**, which help stabilize temperatures and improve patients' well-being.



The city has installed small-scale wind power turbines on the roof of Santa Clara Hospital to reduce the building's greenhouse emissions.



Online Tool Tracks Apartment Energy Use

↓ 12k

TONS OF CO₂ EMISSIONS
COULD BE REDUCED BY 2020 BY
RENOVATING 600 APARTMENT
BLOCKS

THE CHALLENGE

More than two-thirds of Vilnius' 600,000 citizens live in privately owned apartments located in large multi-story blocks built between 1960 and 1990, constructed with poor thermal insulation and outdated centralized heating systems, without unit-level metering or controls. By creating this detailed, user-friendly energy map, the city hopes apartment owners will see the benefits of undertaking energy efficiency upgrades.

CO-BENEFITS



Social
The public has been well-engaged with the initiative and, by January 2016, the energy map had already been viewed more than 150,000 times.



Economic
Energy retrofits, spurred by the interactive map, will save homeowners and renters on electricity bills and winter heating costs.



Health
Energy efficiency upgrades, as encouraged by the informative map, also improve indoor air quality which can improve residents' respiratory health.

→ Vilnius is encouraging energy efficiency upgrades in its aging apartment buildings via an interactive, user-friendly online energy map enabling residents to see the benefits of undertaking renovations.

In 2013, the Lithuanian capital, Vilnius, created an interactive online energy map allowing residents to access and **compare energy performance data for 4,799 apartment blocks** in the city. The city hopes the detailed and user-friendly information will spur homeowner associations to undertake energy efficiency upgrades that will help the city reduce its CO₂ emissions.

To make comparisons easier, buildings have been grouped into 15 classes based on energy efficiency and color coded for display on the map from green (very good) to purple (very poor). Users can select a particular building, and then view a pop-up window showing energy-related information, including the building's energy efficiency class for each winter for the three last seasons, building type and construction year, and monthly energy efficiency graphs to date. As a bonus feature, the online map **enables users to see the financial and energy use benefits from energy-saving solutions**, including roof insulation, window and door replacement, and heating and ventilation system modernization.



Vilnius officials showcase the interactive apartment building energy map of the city.



FINANCE & ECONOMIC DEVELOPMENT



OSLO

*Green Procurement
in the Construction Industry*
P. 103



AUCKLAND

*Revolving Fund Yields Large
Municipal Savings*
P. 105



CANBERRA

*Reverse Auctions Secure Low-
Cost Renewable Energy*
P. 98



ADELAIDE

*Financial Incentives Spur Green
Home Improvements*
P. 107

→ The Finance & Economic Development sector demonstrates how self-financing funding mechanisms and innovative public procurement are redefining the scope and scale of energy efficiency upgrades in cities and bolstering housing affordability. At the same time, these solutions demonstrate that environmental protection and climate change mitigation make good business sense for cities.



CITY: **CANBERRA**



Reverse Auctions Secure Low-Cost Renewable Energy

↓ 2M

TONS OF CO₂ EXPECTED TO BE REDUCED IN 2020 DUE TO THE FIRST REVERSE AUCTION CONTRACT

THE CHALLENGE

Australia has the highest per-capita greenhouse gas emissions of any developed country, and one-third of its emissions come from electricity generation; in Canberra, the figure is 60%. The reverse auction program demonstrates it is possible to source significant quantities of renewable energy at low cost and has shown the way for Australia to reduce power sector emissions.

CO-BENEFITS

Environmental

The increase in Canberra's renewable energy generation to date has helped the region reduce its CO₂ emissions from 4.5 million to 3.9 million tons from 2010 to 2015.

Social

Climate action enjoys strong community support. A survey conducted in 2015 showed 78% of city residents supported its target of achieving 100% renewable energy by 2020.

Economic

To date, more than \$310 million of local economic benefit has been secured for the Australian Capital Territory (ACT) due to the initiative, and renewable energy jobs have increased by more than 400% in the past five years.

→ Canberra's reverse auctions procure large-scale renewable energy supply at highly competitive prices while ensuring economic development and community engagement.

Thanks to its reverse auction process, Australia's capital, Canberra, has secured **440MW of wind and solar capacity** at the nation's lowest known prices. As opposed to a regular auction, where bidders compete on the highest prices, in a reverse auction, suppliers compete to win government contracts by offering increasingly lower prices. This ensures emissions reductions from large-scale projects are as cost-efficient as possible. The process also includes an innovative feed-in tariff with a contract-for-difference model, which guarantees payment of the difference between the per/kWh price for electricity delivered in the original winning project bid and wholesale power prices. Through the reverse auction process, which ensures financial stability to project developers, Canberra plans to achieve **75% of its 100% renewable energy goal by 2020**.

The cost of the power suppliers' proposals are not the only criteria for a successful bid. In addition to project readiness and a financial guarantee, 20% of the evaluation score is based on local economic development benefits and another 20% on proven community engagement and approval of the project.



The reverse-auction process provides price security to renewable energy providers, helping spur local growth in wind, solar, and energy storage industries.

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CITY: CHICAGO



Energy Savings Fund Efficiency Investments

↓ 21.5K

METRIC TONS OF GREENHOUSE GAS EMISSIONS ARE AVOIDED PER YEAR DUE TO THE IMPROVEMENTS FINANCED BY RETROFIT ONE

THE CHALLENGE

In Chicago, building energy use represents 71% of city-wide greenhouse gas emissions, and residents and businesses spend more than \$3 billion per year to operate buildings. Retrofit One is the first of several CIT initiatives enabling Chicago to overhaul its aging infrastructure and undertake upgrades necessary for efficient energy use.

CO-BENEFITS



Environmental

Retrofit One reduced the annual energy usage of municipal buildings by 18% since the program began.



Social

Retrofits took place in 35 of Chicago's 77 neighborhoods to ensure program benefits were shared broadly among central business districts and residential neighborhoods.



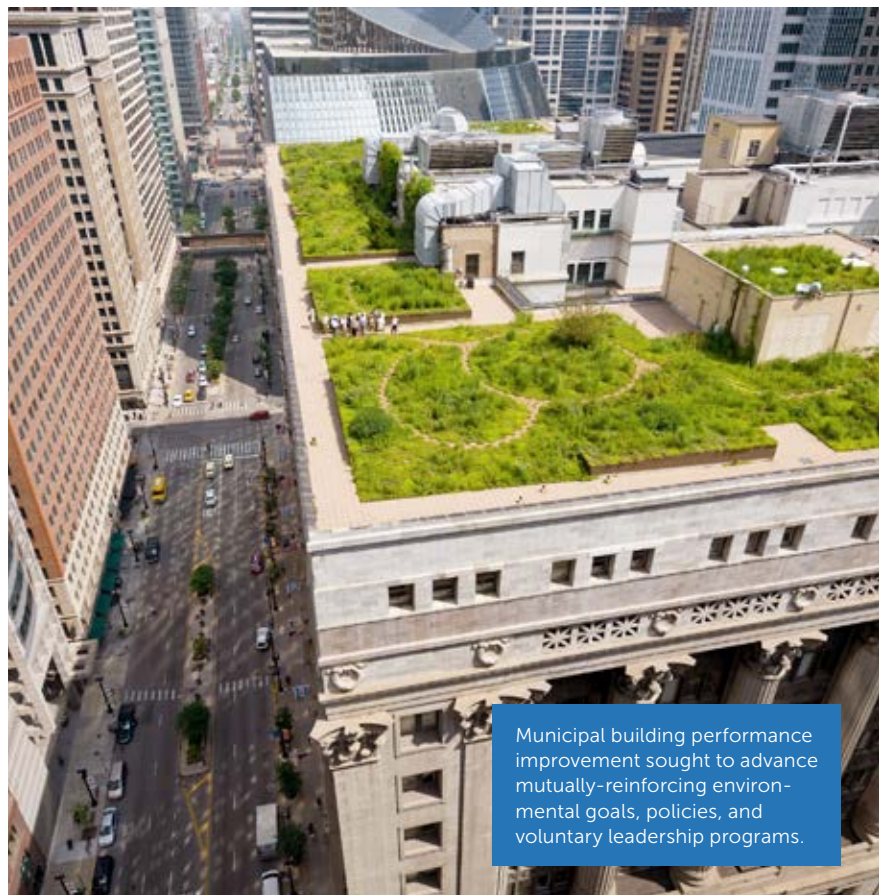
Economic

Retrofit One upgrades to public buildings in Chicago created 144 new construction jobs.

→ Retrofit One is an innovative financing mechanism that utilizes guaranteed energy savings and private investors to fund energy efficiency upgrades to Chicago's public infrastructure.

In 2012, the Chicago Infrastructure Trust (CIT), a financing vehicle used to secure private capital for innovative public infrastructure, inaugurated its pilot project, Retrofit One. It raised **\$13.7 million for 114 energy efficiency projects**, including advanced lighting management and building automation systems, in 60 public buildings in 2015. An Energy Savings Agreement serves as the core financing structure for the project, and municipal cost savings accruing from saved energy are shared with private investors according to specific terms. The agreement also includes a conditional payment structure requiring participating energy service companies to guarantee minimum project savings over 14 years.

To date, the scheme has generated \$1.4 million in annual cost savings and profit for investors. By involving third-party financing, the project will contribute to Chicago's Climate Action Plan, which aims to **reduce greenhouse gas emissions by 80% by 2050**, while minimizing both energy project risk and the city's financial responsibility.



Municipal building performance improvement sought to advance mutually-reinforcing environmental goals, policies, and voluntary leadership programs.

CITY: **TORONTO**



Affordable Loans for Home Efficiency Upgrades

↓ 3.2K

METRIC TONS OF GREENHOUSE GAS EMISSIONS WILL BE REDUCED EACH YEAR AFTER THE FULL ROLLOUT OF HI-RIS

THE CHALLENGE

The residential building sector accounts for 44% of Toronto's greenhouse gas emissions, and the city has more than 1 million housing units that were largely built before 1980, when no energy efficiency requirements were included in the building code. Through its low-cost loan initiative, the city enables homeowners to undertake more affordable and much-needed building retrofits.

CO-BENEFITS



Environmental

Results from the first year of the pilot indicate an estimated energy savings of 25% and 28% for HELP and Hi-RIS participants, respectively.



Social

With full rollout, Hi-RIS can improve the quality of housing for up to 549,000 residents, which represents 21% of Toronto's population.



Economic

For the vast majority of completed HELP and Hi-RIS projects, the future energy cost savings are greater than the upfront capital borrowed and financing costs.

→ Two new loan programs in Toronto offer homeowners an affordable option to retrofit their property to improve energy efficiency and water conservation.

In 2014, Toronto launched two innovative loan programs: Home Energy Loan Program (HELP) and High-Rise Retrofit Improvement Support Program (Hi-RIS). Offered with no upfront costs and at a low interest rate, the loans target energy efficiency and water conservation upgrades in single-family houses and rental apartment buildings. Crucially, the cost of improvements is repaid over time via fixed installments linked to the property tax bill, meaning the loan is tied to the land not the owner, in case of sale. The program also has equity considerations, as owners' eligibility is not dependent on traditional credit ratings but their rate of municipality repayment. So far, **\$5.4 million in low-interest loans have been committed to 111 energy projects.**

The programs' "one-window" service makes the process as easy and streamlined as possible for participants, allowing access to utility incentives, energy advisors, and customer support in addition to financing. Furthermore, **HELP and Hi-RIS are self-sustaining financially** and do not impact the city's taxpayers, as about 60% of the operating budget has been raised from third-party sources and the remainder is recovered directly from program participants through an administrative fee.



Specifically designed for multi-residential buildings, Toronto's Hi-RIS pilot program will target 1,000 homes and 10 apartment buildings.

Page 101 photo © James Schwartz



CITY: WASHINGTON, D.C.



Green Finance Advances Housing Affordability

↓ 114

METRIC TONS OF CO₂ REDUCED ANNUALLY BY THE RETROFIT OF THE WHEATLEY YMCA

THE CHALLENGE

Affordable housing properties and non-profits often have major deferred maintenance needs and struggle with the burden of high utility bills. Additionally, the upfront cost of efficiency improvements can put these technologies out of reach for many. By applying PACE financing to an affordable housing project, Washington, D.C. is bringing sustainability measures to an underserved market and proving that green retrofits and housing affordability can be mutually reinforcing.

CO-BENEFITS

Environmental

This project will reduce the property's energy use by 24% and its water use by 47%.

Social

The project is designed to ensure that current residents of Phyllis Wheatley YWCA, a non-discriminatory residence for women in precarious situations, can remain in their homes and not be displaced.

Economic

The Wheatley YWCA owners are expected to save about \$5,000 in utility and operations expenses each year, which reduces rents for women offered shelter in the facility.

Health

This project was supported by the Department of Behavioral Health, which provides ongoing supportive services, and mental health and substance abuse counseling to women in need.

→ Washington, D.C.'s application of PACE financing to an affordable housing project is saving the property money as it promotes climate and energy equity.

Washington, D.C. is using the Property Assessed Clean Energy (PACE) financing tool, along with public housing capital funds and private investment, to support the \$16.8 million rehabilitation of the Phyllis Wheatley YWCA, which hosts 82 units of affordable housing for homeless women in transition in a rapidly gentrifying neighborhood. PACE provided 100% of the upfront capital for the project, which includes high-efficiency HVAC equipment and controls, lighting, domestic water heating, and plumbing systems, as well as a 32.7-kW solar PV system, which together **will reduce energy consumption by 25%**.

While PACE financing is available in most of the USA, this project marks the first time it has been approved for a Department of Housing and Urban Development-assisted mixed finance public housing property. By making **it work in tandem with affordable housing subsidies**, the novel mechanism enables rents to remain low enough so the property can remain as public affordable housing for at least 40 years, while at the same time it decreases its ecological footprint.



CITY: OSLO



Green Procurement in the Construction Industry

↓40K

TONS OF CO₂ EXPECTED TO BE REDUCED CITY-WIDE THROUGH THE USE OF ZERO-EMISSION CONSTRUCTION VEHICLES AND MACHINERY IN 2020

THE CHALLENGE

Sixty-two percent of Oslo's greenhouse gas emissions come from transport, and more than 25% of that total is attributable to construction vehicles and machinery. By initiating the development of fossil fuel-free construction equipment, the city gets closer to its goal of reducing emissions by 50% by 2020 and accelerates the growth of a new market sub-sector.

CO-BENEFITS



Environmental

The pilot projects have the potential to cut direct emissions from construction by 400 tons of CO₂.



Economic

Companies involved in the pilot projects for zero-emission construction vehicles and machinery have already received new orders for their products.



Health

Decrease in noise pollution due to the use of the zero-emission construction machinery has been an important feedback from the rollout. This will benefit workers and neighboring communities.

→ Oslo is using public procurement to take the lead in the zero-emission construction vehicles and machinery market.

Oslo is now harnessing its purchasing power to **spur innovation in zero-emission construction vehicles and machinery**. While public procurement is commonly used by governments to encourage market development in certain sectors, this industry had received little attention in the past. To remedy this the city is running four pilot projects, run concurrently by public and private actors, to test the following solutions: fossil fuel-free demolition sites, fossil fuel-free construction sites, onsite locally produced renewable energy, and prototype electrical vehicles. The city acts as the initiator of product development and ensures solutions are deployable in larger markets. The results of the pilot projects will serve as guidelines for the public procurement of the vehicles and machinery, which will be initiated in 2018.

Though this sector is quite specific and relatively small, this targeted procurement can have a major impact, and as such, the need for action in the area of construction vehicles and machinery to meet Oslo's emissions reduction targets by 2020 is emphasized in the city's Climate and Energy Strategy. Indeed, the full deployment of the project is estimated to account for **15% of the emissions reductions** in the construction vehicles and machinery sub-sector.





CITY: **AUCKLAND**



Revolving Fund Yields Large Municipal Savings

↓5GWh

DECREASE IN ENERGY USE BY MUNICIPAL BUILDINGS WILL BE FINANCED BY THE REVOLVING FUND OVER THREE YEARS

THE CHALLENGE

Without intervention, Auckland's greenhouse gas emissions could increase by 46% by 2025 and energy use by 65% by 2040. Moreover, the city spends nearly 5% of its gross regional product on energy. Through the revolving fund mechanism, Auckland is curbing its energy use and demonstrating that significant savings and efficiencies can be gained while minimizing costs for taxpayers.

CO-BENEFITS



Environmental

The headquarters of Auckland's Council has achieved a 25% reduction in water use through installation of intelligent delivery systems included in its retrofit program.



Economic

A staff satisfaction survey in the retrofitted Council headquarters found that, within the first year of occupancy, personal productivity was up 8%.



Health

Thirty to 65% of night-time accidents can be attributed to the quality of white versus yellow light and their respective impacts on reaction time. The Council hopes to improve road safety with the adoption of LED streetlights, thanks to this fund.

→ A revolving fund enables Auckland to invest money flowing from municipal energy-saving projects into additional energy efficiency improvements.

Auckland is using a revolving fund to finance energy efficiency upgrades in city-owned or managed buildings. The fund was first granted \$700,000 in 2013 to invest in innovation and improvements of public-owned buildings; the savings achieved by the gains in efficiency have been reinvested in additional projects. To date, the retrofit of the Auckland Council Headquarters led to a **39% decrease in energy use and annual savings of \$377,000**. Additionally, the city's outfitting of 40,000 streetlights with LEDs, and the addition of a tele-management system, will result in a total net savings of \$30 million over 20 years.

As the Council has 1,816 buildings under its jurisdiction, Auckland has a wide scope to scale up improvements and achieve important savings via the revolving fund. In addition to addressing the climate-proofing needs of city-owned buildings, the project demonstrates the **viability of energy efficiency investments** and can act as a guide for building owners and the entire building industry across New Zealand.



The solar PV installations on community buildings are increasing the resilience of Auckland's municipal and community facilities.

CITY: **BOSTON**



Energy Performance Contracting Finances Resilient Infrastructure

↓ 80%

REDUCTION IN CO₂ BY 2050 TO BE REALIZED IN PART BY ACTIONS TAKEN UNDER THE PROGRAM

THE CHALLENGE

Like many cities, for Boston, financing essential municipal infrastructure upgrades via taxes is increasingly difficult in the face of other pressing social needs. Yet, as a coastal city vulnerable to severe weather and sea level rise, Boston still requires significant investments in resilience and energy efficiency upgrades. The RBT helps solve this challenge by using a tried-and-true model to fund improvements to critical-but-underserved projects.

CO-BENEFITS



Environmental

The resilience upgrades funded by RBT can make properties and communities less vulnerable to rising sea levels and increased storm activity.



Social

Given the negative impact of high operating costs on housing, expanding self-funded investment in property upgrades, without burdening the operating budget, aims to make affordable housing more widely available.



Economic

The expansion of projects under RBT will expand the green-collar workforce needed to carry out resilience and energy efficiency improvements.



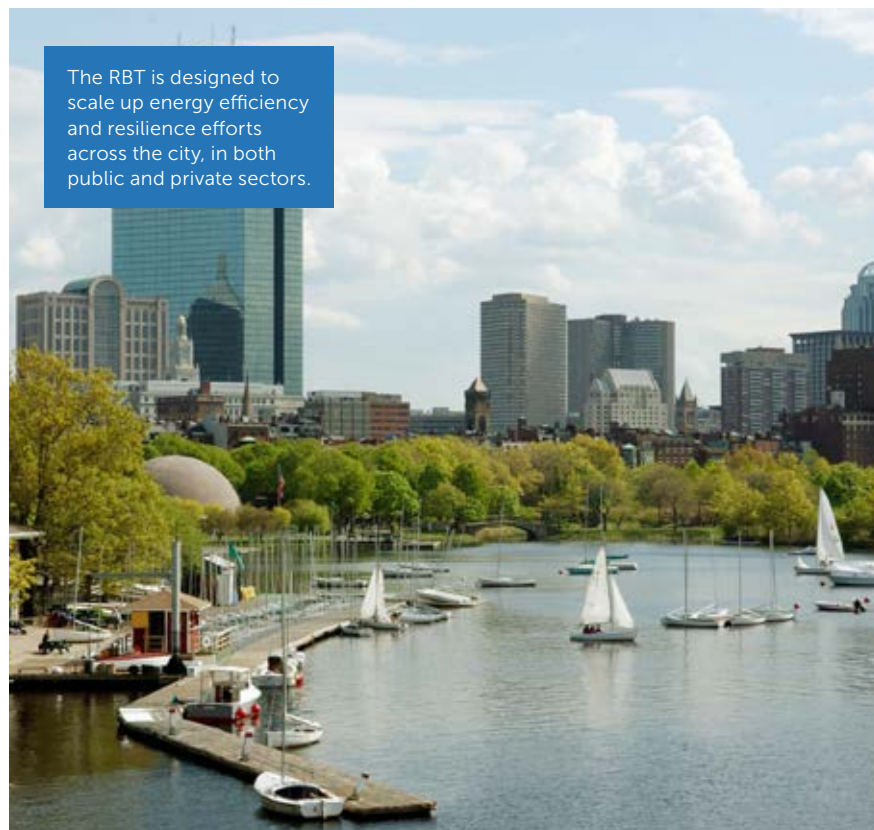
Health

The retrofit projects often result in improved indoor air quality that reduces respiratory health hazards.

→ Renew Boston Trust is using energy performance contracting to finance resilience measures with savings from energy efficiency upgrades in an effort to mitigate CO₂ emissions and boost adaptation capabilities.

Boston has launched the Renew Boston Trust (RBT) in an effort to improve energy efficiency and resilience upgrades in the city's building stock by using a self-funded financing model. The system builds upon the idea of energy performance contracting, in which energy savings are used to finance investments. With RBT, operating savings from energy efficiency and renewable energy measures pay not only for those investments, but **excess savings pay for resilience investments**, which traditionally do not produce operating savings by themselves.

While the current program primarily targets municipal properties, RBT is working to apply innovative financing models to the institutional and non-profit sector as well, via a tax-exempt lease program that would aggregate small projects, allowing non-profits to reduce upfront costs and improve financing through economies of scale. When implemented, the expanded RBT is expected to achieve a **10-fold increase in funding for energy efficiency and resilience projects** and accelerate achievement of the city's Climate Action Plan emissions reduction goals.



The RBT is designed to scale up energy efficiency and resilience efforts across the city, in both public and private sectors.

CITY: ADELAIDE



Financial Incentives Spur Green Home Improvements

↑ 25%

INCREASE IN SOLAR PV INSTALLATIONS IN ADELAIDE IN 2015 BECAUSE OF THE SCIS

THE CHALLENGE

Adelaide's solar PV uptake has been estimated at 6%, which is much lower than South Australia's uptake of, 27%. In order to boost homeowners' and tenants' investments in solar equipment, which is central to the city's goal of becoming carbon neutral by 2025, Adelaide now offers financial incentives to spur residents to reduce their carbon footprint.

CO-BENEFITS



Environmental

Based on solar conditions in Adelaide, it is estimated that solar PV installations will generate 1,460 MWh of zero-carbon electricity, and reduce carbon emissions by 978 tons per year.



Social

In addition to the pre-installation commitment, projects involving state benefit recipients are also eligible for higher SCIS rebates.



Economic

In its 2016-2017 Integrated Business Plan, Adelaide's city council committed a further \$112,000 to the scheme.

→ Adelaide is encouraging the installation of solar panels and other efficiency improvements with a scheme that reduces financial barriers for all property owners and residents.

Adelaide Sustainable City Incentives Scheme (SCIS) provides reimbursements to all property owners and tenants for the installation of an extensive range of green improvements, including solar photovoltaic systems, electric vehicle charging points, solar hot water systems, energy use monitoring devices, and rainwater tanks. Additionally, the SCIS also includes Australia's first solar energy storage incentive, which covers 50% of the installed cost of a storage system, up to \$3,750, in addition to \$3,750 towards the installation of solar PV. In 2015, the scheme led to the installment and commitment of more than **1 MW of solar PV and 90 kWh capacity of energy storage**.

To provide greater funding certainty for property owners and tenants, the SCIS also provides a Pre-installation Commitment, which **reserves funding for a period of three months** for projects that either require approval by a third party, offer community demonstration potential, engage multiple households, or involve the participation of state benefit recipients, including the elderly, students, or the unemployed.



Solar panel installations are some of the most common home upgrades under the SCIS.

CITY: **NEW YORK CITY**



Low-Cost Financing Enables Affordable Housing Retrofits

→ New York City's new program maintains housing affordability while mitigating greenhouse gas emissions by providing energy audits and low-cost financing to small property owners.

↑ **475**

UNITS WILL BE ASSISTED BY THE GHPP IN THE PROGRAM'S FIRST YEAR

THE CHALLENGE

Thirty-five percent of New York's emissions come from residential buildings; however, many small or medium property owners do not have the means to undertake retrofits as they also face mounting utility and operating costs. GHPP enables the city's affordable housing sector to undertake upgrades and reduce greenhouse gas emissions while maintaining housing affordability.

CO-BENEFITS



Environmental

GHPP decreases greenhouse gas emissions and increases the city's resilience to extreme weather events.



Social

Reductions in utility costs can help affordable buildings with restricted cash flow better prepare for financial and climate-related shocks and repair needs.



Economic

Energy efficiency improvements could yield an average annual savings of approximately \$1,500 per building for a 10-unit building and \$3,000 for a 20-unit building.

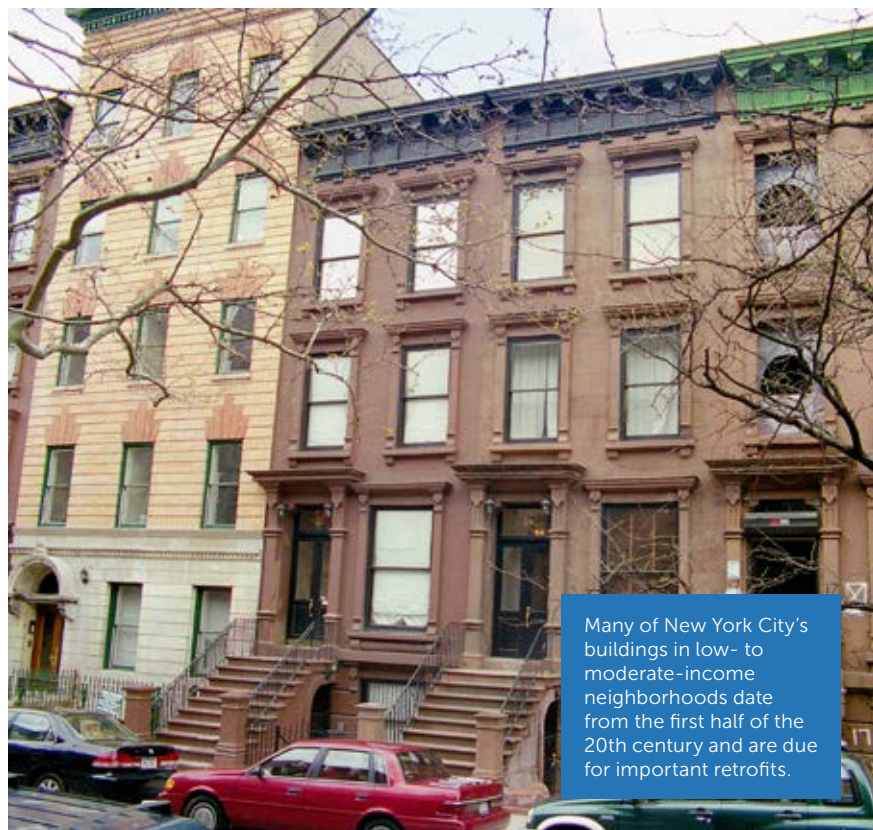


Health

Reducing greenhouse gas emissions reduces air pollutants, lowering risks for asthma, heart disease, and premature death.

New York City's Green Housing Preservation Program (GHPP) aims to reduce housing costs and greenhouse gas emissions in the city's affordable housing sector by easing barriers to undertake energy efficiency and water conservation improvements. Under the program, property owners, who often perceive housing improvements as out of reach, gain access to energy audit information and low- or no-cost financing for key retrofit measures. With improvements such as the installation of efficiency controls, it is anticipated that owners may see more than a **10% annual reduction in utility costs**, which account for roughly 25% of the average operating budget of a rent-stabilized building.

GHPP has the potential to impact a large number of owners and tenants in the city, as almost two-thirds of New York's rental apartment buildings are eligible for the program. In addition to securing the climate resilience of owners and tenants in low- to moderate-income neighborhoods, the initiative is an important aspect of the city's plan to **reduce greenhouse gas emissions from buildings by 30%** below 2005 levels by 2025.



Many of New York City's buildings in low- to moderate-income neighborhoods date from the first half of the 20th century and are due for important retrofits.





SOCIAL EQUITY & CLIMATE CHANGE



ATHENS

*Heatwave Action
Plan Protects Vulnerable
Residents*
P. 123



SEOUL

*Public-Private Partnership
Prevents Energy Poverty*
P. 115



TSHWANE

*Small-Scale Farming Reaps
Big Community Benefits*
P. 113



→ The Social Equity & Climate Change sector showcases solutions that alleviate social injustices relating to climate change and its impacts, including expanding transport access for low-income city residents, adapting disadvantaged neighborhoods to the physical effects of climate change, and promoting food and energy security for marginalized communities.





Sustainability Agenda Protects Public Housing

↓ 330K

METRIC TONS OF CO₂ ESTIMATED TO BE REDUCED BY 2025 VIA MEASURES DEPLOYED UNDER THE NYCHA SUSTAINABILITY AGENDA

THE CHALLENGE

The NYCHA serves 400,000 residents and provides amenities that contribute to the social cohesion of entire neighborhoods. However, many of these residents are particularly vulnerable to climate change, with 54,000 living in a 100-year flood plain. The NYCHA Sustainability Agenda contributes to the city's CO₂ reduction goals, but also ensures developments adapt to weather impacts, so residents are not displaced.

CO-BENEFITS

Environmental

By the end 2015, recycling infrastructure had been installed in 99 NYCHA developments housing more than 150,000 residents.

Social

NYCHA will recruit 100 young residents for sustainability training provided by local community organizations as part of the Sustainability Agenda.

Economic

The strategies laid out in the Sustainability Agenda will contribute about \$980 million toward decreasing NYCHA's capital needs and reduce energy- and water-related costs.

Health

Repairing roofs, fixing leaking plumbing, and modernizing ventilation improves the respiratory health of residents.

→ The New York City Housing Authority (NYCHA) has devised a plan to reduce CO₂ emissions and ensure that affordable housing residents have resilient homes that can endure the effects of climate change.

In 2016, the NextGeneration NYCHA Sustainability Agenda was developed as a 10-year roadmap for healthy and comfortable homes able to withstand the impacts of climate change, in addition to supporting the city's commitment to reduce its greenhouse gas emissions by 80% by 2050. The plan outlines **17 strategies to reduce NYCHA's carbon footprint by 30% by 2025**, foster resilience, and safeguard resident wellness, including improving heating and hot water efficiency, establishing standards for new buildings and improving existing buildings, adopting large-scale use of clean energy, and connecting residents to economic opportunity.

Flood risk and stormwater management are a priority of the agenda, with resilience plans in development for all housing vulnerable to coastal flooding, including risk assessments and retrofit guidelines based on lessons learned from Hurricane Sandy. Phase one of the stormwater infrastructure implementation projects has the **potential to capture approximately 72 million liters per year**. Additionally, NYCHA will provide back-up power for all Sandy-affected developments, develop microgrids at certain developments, and install 25 MW of solar power in an effort to protect public housing residents from the short- and long-term impacts of climate change.



Previously an asphalt playground, the Red Hook Community Farm is now an 11,000 m² garden and compost site that supplies produce to nearby residents.¹

¹ NYC: The Official Guide. Red Hook Community Farm. 2016.

CITY: TSHWANE



Small-Scale Farming Reaps Big Community Benefits

↑ 131

NEW JOBS CREATED BY THE TSHWANE FOOD AND ENERGY CENTRE

THE CHALLENGE

Economic and energy poverty and food insecurity are already national crises in rural South Africa, without taking into account extreme weather events, such as droughts and floods caused by climate change. As a flagship project, the Tshwane Food and Energy Centre is creating new opportunities for people from vulnerable communities to become small-scale entrepreneurial farmers, contributing to the food security of the region and establishing new sources of energy.

CO-BENEFITS



Environmental

The organic agriculture techniques implemented at the Food and Energy Centre enhance soil fertility, making it less susceptible to erosion.



Social

The project will improve capacity building of entrepreneurs in new ways of farming and business management.



Economic

The Centre is structured so that participating entrepreneurial farmers become independent and self-sustaining, enabling the potential expansion of the model.



Health

The Food and Energy Centre secures access to food, ensuring the community is getting the nourishment it needs.

→ By creating a cooperative of 25 small farms, Tshwane's Food and Energy Centre is securing its food and energy supply for generations to come.

The Tshwane Food and Energy Centre was established in 2015, providing small-scale **farming opportunities to underprivileged residents** under a cooperative model, incorporating synchronized production and centralized transactions. The Centre comprises 25 individual plots, where farmers tend to 60,000 chickens and manage 72,000 m² of vegetable plots. By vertically integrating assets, the Centre is able to finance a hatchery and slaughterhouse, as well as vegetable processing, seedling production, crop farming, and feed mill facilities. By creating a supply of nourishing produce that is locally, organically, and sustainably produced, the Centre ensures food sovereignty and security for the local community and the region at large.

In addition to food production, the Tshwane Food and Energy Centre produces **self-sustaining energy via a photovoltaic solar power plant** and by reusing livestock organic waste as feedstock for the production of biogas. This both reduces energy costs and serves as another source of income, while ensuring energy security for current and future entrepreneurial farmers.



Tshwane's Food and Energy Centre demonstrates the importance of collaborative farming to ensure food and energy security.



CITY: SEOUL



Public-Private Partnership Prevents Energy Poverty

↑1.3K

HOUSEHOLDS ACCESSED
FINANCING FOR RETROFITS IN 2015
VIA THE ENERGY WELFARE PUBLIC-
PRIVATE PARTNERSHIP PROGRAM

THE CHALLENGE

Seoul's already vulnerable low-income families will become even more at risk of energy poverty as climate change accelerates. Through the Energy Welfare Public-Private Partnership Program, the city ensures that at-risk communities receive needed home energy efficiency upgrades and relevant job training and employment, while also securing an innovative and sustainable financing method to ensure the program succeeds in the long term.

CO-BENEFITS



Environmental

Around 1,600 micro-PV panels have been installed at public apartments and low-income houses in disadvantaged communities under the program.



Social

Fifty former energy consultants and energy social workers are continuing work in the industry, having founded eight cooperatives and four non-profit organizations.



Economic

The virtual power plant registered under the project has resulted in annual profits of more than \$180,000 sent to the Seoul Energy Welfare Civic Fund.

→ Seoul launched its Energy Welfare Public-Private Partnership Program, a collaboration between local government and private actors, in order to reduce energy poverty and promote the saving and sharing of energy.

Launched in 2015, Seoul's Energy Welfare Public-Private Partnership Program is helping to alleviate energy poverty among the city's disadvantaged communities via a range of direct and indirect support. Direct support includes financing for **low-income households to have their homes retrofitted for greater energy efficiency**, and training and employing disadvantaged job seekers as energy consultants to assess energy performance of low-income households. Since 2015, the program has employed 180 of these consultants who offer energy-saving advice and tips, and carry out home energy retrofits. Many consultants build on this experience and continue their career in energy-welfare related fields.

Indirect support from the program includes the creation of an innovative virtual power plant through which 17 municipal buildings and 16 universities save electricity consumption during peak hours and **donate profits from saved power back to the program** to finance energy welfare programs. Registered to sell 5 MW of electricity, this plant is the first of its kind in South Korea, and aims to create a sustainably financed method for alleviating energy poverty throughout the city.



CITY: **BUENOS AIRES**



Environmental Education Targets Low-Income Youth

→ Buenos Aires is bringing environmental education and local food production skills to its underserved neighborhoods, promoting access to healthy eating and sustainability knowledge for all youth.

↑440

BUENOS AIRES SCHOOLS HAVE VEGETABLE GARDENS THANKS TO THE GREEN SCHOOLS PROGRAM

THE CHALLENGE

Buenos Aires faces a number of challenges associated with climate change and urbanization, notably air and water pollution particularly in underprivileged neighborhoods. The Green Schools Program aims to alleviate socioeconomic inequalities in the city and boost climate resilience by focusing on environmental education and equipping the city's low-income youth with waste management and urban gardening skills.

CO-BENEFITS



Environmental

Under the program, 35 schools have renewable energy installations and six boast green roofs.



Social

The Green Schools Program encourages all schools, students, and teachers to share their experiences in order to improve services and outcomes.



Economic

The program helps schools save money by reducing electricity, water, and energy use expenses.



Health

By learning the principles of gardening, hydroponics, and local food production, students are introduced to healthy eating and sustainability practices.

Buenos Aires' Green Schools Program seeks to provide the city's youth, particularly in low-income neighborhoods, with education about four key sustainability themes: integrated waste management, environmental health, energy efficiency and renewable energy, and climate change. The program offers both direct learning opportunities for students, as well as strategies to improve the teaching methods around these themes. The program is already achieving impressive results. In 2016, more than **2,500 schools and 588,000 students had already participated** in the Green Schools Program's integrated waste management initiative, and more than 16,000 supervisors, managers, teachers, and assistants were trained under Green Schools Program principles.

One-fourth of the program's resources are dedicated specifically to Buenos Aires' poorer southern neighborhoods, **ensuring that socioeconomic disparities do not impact environmental education**. These targeted programs include the creation of hydroponics gardens at schools near the polluted Mantanza River, in order to avoid the area's heavily contaminated soil, and ensuring students not only have access to healthy, fresh, and safe food, but also learn about the importance of safe waste disposal and gardening practices.



The program focuses on developing environmental education skills and competencies for both students and teachers.

CITY: LOS ANGELES



Electric Car-Sharing in Low-Income Communities

↓ 2.2K

METRIC TONS OF ANNUAL CO₂ EMISSIONS EXPECTED TO BE REDUCED THROUGH THE PILOT PROJECT

THE CHALLENGE

Each year, Los Angeles experiences unhealthy levels of particle pollution for the equivalent of nearly a month, and unhealthy ozone pollution for the equivalent of more than two months, mainly impacting underprivileged communities of the city. By introducing electric car-sharing fleets in disadvantaged communities, the city hopes to reduce CO₂ emissions, while addressing pollution and transit injustice in historically underserved communities.

CO-BENEFITS

Environmental

The project will result in 5.3 million fewer annual vehicle miles traveled in Los Angeles and more than 900,000 fewer annual liters of gasoline used.

Social

The project will lift up historically disadvantaged communities by providing them with affordable access to resources around the city, such as jobs and schools.

Economic

The car-sharing program can help boost the economy by lowering transportation costs, allowing for greater purchasing power in the local and regional economies.

Health

The project will help decrease air pollution that can cause asthma attacks, heart problems, and other health issues.

→ Los Angeles is introducing an electric car-sharing fleet in disadvantaged communities lacking transport options, in a coordinated effort to improve environmental conditions and economic prospects in these districts.

In 2016, Los Angeles launched its plan to introduce electric car-sharing fleets into disadvantaged communities, benefiting those most impacted by air pollution and most in need of improved mobility options, in addition to reducing greenhouse gas emissions. As the first project of its kind in the world, the pilot will double car-sharing in the city, initially placing **100 shared-use EVs and 200 charging stations** in disadvantaged communities in and around Central Los Angeles. Within three years, the project aims to recruit 7,000 new users, who are expected to sell or avoid purchasing 1,000 private vehicles. By putting EVs and infrastructure in low-income neighborhoods and providing a subsidy to encourage their use, the city is helping increase access to economic opportunities while also promoting behavior change, eco-friendly mobility options, and improved air quality.

The project is part of Los Angeles' Sustainable City plan, which includes a goal of installing 1,000 public EV charging stations by 2017. Having already surpassed that goal, this program will **help the city achieve its aims of having 25% of all vehicles on the road be emissions free** by 2035 and reducing greenhouse gas emissions by 45% below 1990 baseline levels by 2025.



The EV-sharing fleet is unveiled in Los Angeles.

CITY: MEXICO CITY



New Park Boosts Resilience and Economic Potential

↑ 30K

PEOPLE ARE ABLE TO REACH THE PARK BY FOOT

THE CHALLENGE

The effects of climate change, such as cyclical floods, water shortages, and heatwaves are some of the most pressing urban vulnerabilities in Mexico City, and the most disadvantaged communities are most at risk. The Parque Lineal La Viga sets an example of how investment in public spaces that integrate resource management infrastructure is not a lifestyle amenity, but a strategic city action, mitigating urban climate vulnerabilities while opening up opportunities for economic development.

CO-BENEFITS



Environmental

In an attempt to raise the available green space per inhabitant from 5 m² to 10 m², as suggested by the World Health Organization, there will be 22% more green areas and up to 100 new trees in the park.



Social

The accessibility of the park will encourage interactions between people of all ages and genders, improving social cohesion in the area.



Economic

Based on the experience of the Parque Lineal La Viga, Mexico City's Authority for Public Space plans to invest in a new park twice its size, in one of the most densely populated and marginalized boroughs of the city, Iztapalapa.



Health

The park's design has allocated areas for sports and exercise, including a multi-use forum, which can be used for activities such as dance and yoga.

→ With the construction of Parque Lineal La Viga, Mexico City is preventing floods, reducing heatwaves, and increasing potable water, as well as providing new business opportunities for locals.

Spreading across almost 16,500 m², Parque Lineal La Viga was constructed in the eastern part of Mexico City in 2015, mitigating urban climate vulnerabilities such as floods, water shortages, and heatwaves, in addition to preventing unequal urban development in an underprivileged part of the city. Up to **60% of the park's area serves as a rain water catchment surface**, mitigating floods by relieving pressure from the drainage and sewage systems. The collected stormwater is then treated and can be used as potable water, diversifying the city's water sources.

Nearly 500 neighbors participated in the design of the park, aiming to create a major attraction to encourage social cohesion and economic development. **Reachable by up to 4.6 million people within 30 minutes on public transport**, the city anticipates that the presence of the park will result in increased revenues by local businesses, improve the livelihoods of nearby residents, and demonstrate the critical role of accessible public spaces in cities.



Stormwater is captured and stored beneath pedestrian areas.



CITY: WASHINGTON, D.C.



Low-Cost Bike-Share Memberships for Low-Income Earners

↓ 6

TONS OF CO₂ OFFSET THROUGH THE ENTIRE CAPITAL BIKESHARE PROGRAM PER MONTH

THE CHALLENGE

Washington, D.C., consistently ranks as one of the most congested metropolitan regions in the USA, with single-occupancy vehicle travel one of the largest sources of emissions. While the Capital Bikeshare program was designed to address CO₂ emissions from single-occupancy vehicles, the Community Partners Program was added to ensure equal access to the program via the distribution of low-cost memberships to low-income earners.

CO-BENEFITS

Environmental

The Capital Bikeshare program reduces air pollution and, in turn, creates cleaner streams and rivers.

Social

The low-cost Capital Bikeshare membership lowers transportation costs for participants, leaving more disposable income available for other needs such as rent and groceries.

Economic

The Community Partners Program leverages local and public resources in a cost-effective manner, delivering a net positive result to local communities.

Health

Participants now have access to a transportation option that also serves as a form of physical exercise, decreasing the risk of serious conditions like diabetes, obesity, and cardiovascular disease.

→ Washington, D.C., has introduced low-cost memberships as part of the city's bike-share program, helping ensure that healthy, green transport is available to everyone.

In 2016, the Washington, D.C., public bike-sharing program, Capital Bikeshare, launched its Community Partners Program, designed to put low-cost bike-share memberships into the hands of those most in need of affordable transportation options. The Community Partners Program membership is available to local non-profits, government agencies, and social services organizations, enabling them to offer a **steeply discounted annual membership** to clients receiving social benefits, allowing equal access to safe, healthy, and sustainable transport. While the Capital Bikeshare system already boasts 35,000 members and averages 250,000 trips per month, the city hopes this new program will further increase the use of bicycles in the city.

In addition to reducing membership costs, the program equips individuals in traditionally underserved communities with resources, including workshops to learn how to bike. As of June 2016, **five large social services organizations had signed on as partners** and are enrolling their clients to become Capital Bikeshare members, showcasing how a city's transportation department and social services can work together to address social needs and achieve positive environmental results.



Many people across different income levels are choosing to bike instead of drive, preventing emissions from being released to the environment.



Heatwave Action Plan Protects Vulnerable Residents

↑10K

TREES TO BE PLANTED BY 2020 UNDER THE PLAN, REDUCING THE IMMEDIATE SURROUNDING TEMPERATURE BY UP TO 10%

THE CHALLENGE

With the mean temperature rising .5°C per year since the 1990s, Athens is experiencing hotter and longer summers, with more frequent and intense heatwaves, which disproportionately affect vulnerable populations. As part of the Heatwave Action Plan, Athens is implementing heatwave warnings and constructing green areas with cooling spots, increasing resilience to heat and ensuring the well-being of the most at-risk residents.

CO-BENEFITS

Environmental

By cooling the city, smog and ozone concentrations above threshold limits are predicted to reduce during summer months.

Social

Athens hopes to reverse “urban flight” with the deployment of greening and cooling infrastructure, attracting locals, tourists, and immigrants back to the city center.

Economic

By applying measures for cooling included in the Heatwave Action Plan, Athens can reduce its energy demand in summer months by 15%.

Health

With successful awareness campaigns and proper preventive measures included in the Heatwave Action Plan, Athens aims to reduce the number of heat-related health incidents.

→ Athens is implementing a Heatwave Action Plan, ensuring the most vulnerable residents are less at risk from rising temperatures.

Athens’ Heatwave Action Plan was launched in 2016, aiming to protect the city’s most at-risk residents, including the elderly, those with cardiovascular or respiratory conditions, infants, people with obesity problems, and energy poverty stricken households from the adverse health threats of heatwaves. Through the coordination of municipal social services, the city is instituting projects such as increasing green areas, expanding the use of cool materials, increasing shade options, and promoting “cooling routes” in parts of the city where the urban heat island effect is more intense, ensuring that vulnerable residents are protected.

Under a strategic partnership between the city and the National Observatory of Athens, a digital heatwave warning mechanism is now available to residents via either personal computers or smartphones. The mechanism provides valuable information such as the current temperature in the user’s location, whether or not they are at risk depending on their age and medical condition, as well as how to reach a cooling spot in case they are indeed at risk.



Awareness campaigns like this one, advising residents to drink water, wear sunscreen, and not to leave pets or people in cars, are an important part of Athens’ Heatwave Action Plan.





Awareness Campaign Gets Residents to Think Outside the Car

↓424

METRIC TONS OF CO₂ EMISSIONS REDUCED UNDER GONEWHAVENGO SINCE LAUNCHING

THE CHALLENGE

Transport accounts for 40% of Connecticut's CO₂ emissions, and high rates of air pollution in New Haven directly impact residents' health. Meanwhile, New Haven experiences some of the most extreme income inequality in the USA. Prompted by the need for a solution that addresses environmental, health, and socioeconomic concerns, goNewHavenGo encourages the shift from driving to using public transportation, walking, and biking, helping to reduce class divisions and stimulate transit improvements through increased demand.

CO-BENEFITS



Environmental

At the current rates, the campaign will reduce CO₂ emissions by 2,099 metric tons annually by 2020.



Social

The initiative has launched a photo campaign to reduce the stigma associated with the use of alternative transportation.



Economic

With fewer cars on the roads because of goNewHavenGo, the city has avoided an estimated \$71,532 in road maintenance costs.



Health

Participants together burned more than 2 million extra calories from June 2015 to June 2016 as part of the initiative.

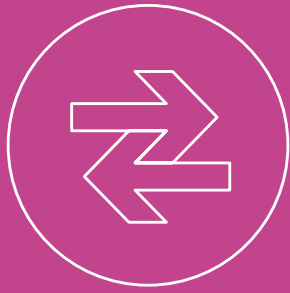
→ New Haven's campaign to promote alternative transportation as an easy choice for all residents is reducing CO₂ emissions by removing the stigma associated with public transportation.

In 2014, New Haven, Connecticut, launched an initiative to promote the use of public transit and active mobility in an effort to make alternative modes of transport available, accessible, and attractive for all residents and contribute to the city's goal of reducing greenhouse gas emissions. Projects under the GoNewHavenGo initiative include **pedestrian wayfinding**, **pop-up bicycle infrastructure**, and tabling at open streets and community events, reaching hundreds of New Haven residents each year. Furthermore, the campaign encourages businesses and their employees to use alternative transportation by running car-free commuting challenges and providing information on transit pre-tax benefits, custom trip planning, ride-sharing platforms, and free bike rack installation.

The campaign has an added focus of taking on the negative social stigma associated with public transport and creating a culture of widespread transit use among all city residents. In creating this culture, the campaign is improving air quality and **reducing transit-related emissions, high rates of asthma, and transportation inequity**. In just one year, 73,604 single-occupancy vehicle trips were avoided due to the initiative's efforts.



A young cyclist proudly shows off how he moves around the city, and volunteers create a pop-up bike lane.



TRANSPORTATION



PARIS

*Transport Policy Curbs
Air Pollution*
P. 138



GOTHENBURG

*Collaborative Approach to
Public Transit Innovation*
P. 131



TAIYUAN

*World's Fastest Electric Taxi
Fleet Overhaul*
P. 130



TALLINN

*Universal Fare-Free
Public Transport*
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COPENHAGEN

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BARCELONA

*Redefining City Blocks to Tackle
Traffic-Related Emissions*
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ADDIS ABABA

*Sub-Saharan Africa's First
Light-Rail Train*
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WUHAN

*Carbon Credit Scheme Bolsters
Massive Bike-Share Program*
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TORRES VEDRAS

*Holistic Approach to
Active Mobility*
P. 137

→ The solutions in the Transportation sector showcase the importance of improving public transport systems to reach last-mile connectivity, promoting the use of clean fuelled-vehicles, and fully integrating mobility into urban planning and development in order to reduce CO₂ emissions and create more livable cities.





CITY: **WUHAN**

Carbon Credit Scheme Bolsters Massive Bike-Share Program

↓ **170K**

TONS OF CARBON WILL BE REDUCED ANNUALLY BY 2018 WITH THE BIKE-SHARE PROGRAM

THE CHALLENGE

Faced with problems of air pollution and traffic congestion, Wuhan, one of the most populous cities in Central China, launched an ambitious bike-sharing project that helps curb growing motor vehicle dependence and related emissions, while also solving last-mile transportation and boosting citizen engagement through the carbon credit system.

CO-BENEFITS

Environmental

The bike-share's annual CO₂ emissions reduction has reached 25,000 tons.

Social

The project helps address the city's traffic congestion problems and lack of space for parking.

Economic

As the first hour of bike use is free, and most bike trips last less than one hour, users are able to save money on transport.

Health

The bike-sharing program addresses health problems related to vehicle emissions and encourages the population to participate in a daily fitness activity.

→ Wuhan has unveiled one of the world's largest bike-sharing programs in an effort to solve last-mile transportation while engaging citizens through a fun and interactive carbon credit system.

Wuhan has rolled out one of the world's largest bike-sharing projects, installing 20,000 bikes at 856 stations since 2015. Plans call for **80,000 bicycles and 3,160 stations to be installed city-wide by 2018**. The new system is integrated with other modes of public transport in the city to increase connectivity. As a bonus feature, the stations offer charging facilities for electric vehicles, to further promote green transportation. Daily rides have risen from more than 1,000 during the trial period to about 80,000 in May 2016, amounting to 15 million total rides since launching.

A unique component of the system is the **integration of a carbon credit scheme**, through which bike-sharing users' individual CO₂ reduction is calculated based on average riding speed and other factors, and converted into a carbon credit, registered to individual users. The credit can be used to purchase small personal commodities and services, such as movie tickets, or used to offset other carbon emissions.



CITY: ADDIS ABABA



Sub-Saharan Africa's First Light-Rail Train

↓ 1.8M

TONS OF CO₂ EXPECTED TO BE REDUCED BY 2030 THROUGH THE LRT

THE CHALLENGE

Transportation accounts for 47% of the CO₂ emissions in Addis Ababa. The renewable energy-powered LRT reduces greenhouse gas emissions while bringing clean and efficient transportation to city dwellers.

CO-BENEFITS



Environmental

The LRT is less land-intensive than conventional roads, which will decrease the burden on ecosystems.



Social

The city's average transport speed is improved from 10 km/hour by road traffic to 22 km/hour with LRT, which significantly reduces the commuting time of workers in the city.



Economic

More than 1,100 jobs were created to operate the LRT after its opening. The Ethiopian government also expects to spend less money on purchasing foreign oil.



Health

The city expects a decrease in particulate emission that will reduce the incidence of heart and respiratory diseases.

→ With Sub-Saharan Africa's first renewable energy-powered light-rail train network, Addis Ababa is leading a modal shift for urban public transport on the continent.

In September 2015, Addis Ababa inaugurated Sub-Saharan Africa's first light-rail train (LRT). The LRT, an inner-city tram, can carry up to 60,000 people per hour, and after 10 months of operation, **ridership has reached 15,000 passengers per hour** in each direction. The train is powered by Ethiopia's power grid, which is fueled almost exclusively by hydropower, geothermal, and wind power. Emissions reductions from the project are estimated to grow from 55,000 tons of CO₂ per year in 2015 to 170,000 tons CO₂ per year by 2030. The more efficient mode of transportation is expected to stimulate the local economy and attract new investments and will become a blueprint for local expansion and regional replication.

The project is the fruit of an **international multi-stakeholder collaboration** that involved different levels of the Ethiopian government, foreign banks, and the Chinese government. It is also an important tenet of the Addis Ababa Climate Resilient Growth Economy plan to drive the transition to a green economy.



Addis Ababa residents celebrated the Ethiopian New Year with the launch of the city's first LRT, covering 34 km of tracks.



PLANTANDO
EL MAÑO
LA PUNTERA
DEBEMOS SER
RESPONSABLES

PLANTANDO
EL MAÑO
LA PUNTERA
DEBEMOS SER
RESPONSABLES

CITY: BARCELONA



Redefining City Blocks to Tackle Traffic-Related Emissions

↑49K

M² OF SURFACE EXPECTED TO BE TRANSFORMED TO PUBLIC SPACE AS PART OF THE PILOT SANT MARTÍ SUPERBLOCK

THE CHALLENGE

Barcelona is a densely built city dealing with a lack of urban green space and chronic air and noise pollution problems. The Superblocks approach to spatial organization will increase green spaces and decrease emissions in a city where transportation accounts for 27.8% of CO₂ emissions.

CO-BENEFITS



Environmental

The project increases the amount of green spaces, reduces the heat island effect, and improves air quality.



Social

The new car-free public spaces encourage use by children and the elderly, and create opportunities for social interaction, sports, and cultural activities.



Economic

The Superblocks program improves the quality of life in the city which makes Barcelona a more attractive destination for businesses and their employees.



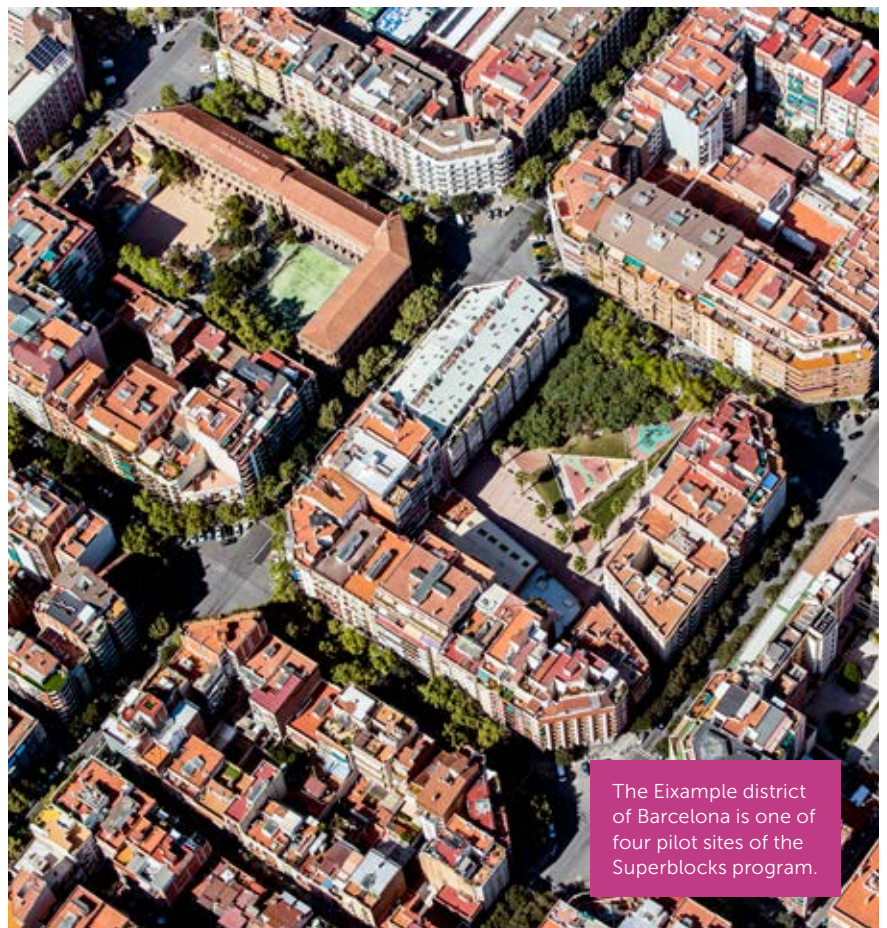
Health

The project simultaneously reduces the city's noise pollution levels while increasing the amount of green space by 1m² per capita.

→ Barcelona is redefining the city's streets to promote green spaces for citizens and reduce traffic-related emissions.

Through the Superblocks program, Barcelona is redesigning the city's streets to limit traffic and increase the amount of green and recreational spaces available to citizens. The new program changes traditional city blocks into clusters of "superblocks," where perimeter streets allow through traffic, but inner streets are reserved for pedestrians and cyclists. So far, the city has created Superblocks in four pilot neighborhoods, and by 2019, it expects the program will achieve CO₂ emissions reductions of between 20% and 75%.

The Superblocks program does not involve major physical changes, which allows for experimentation and reversibility. The project is part of a larger Urban Mobility Plan, a strategic measure of Barcelona's Climate Commitment, expected to decrease traffic by 21% while extending car-free spaces by more than 23 hectares and adding 300 km of bike lanes. This measure will reduce CO₂ emissions by 159,100 metric tons per year.



The Example district of Barcelona is one of four pilot sites of the Superblocks program.

CITY: **TAIYUAN**



World's Fastest Electric Taxi Fleet Overhaul

↓ **222K**

TONS OF CO₂ WILL BE REDUCED PER YEAR DUE TO THE TAXI REPLACEMENT SCHEME

THE CHALLENGE

Taiyuan is an industrial city where poor air quality adversely affects the daily lives of its citizens. Vehicle emissions are a big contributor to the poor air quality, accounting for about 16% of PM_{2.5} and 14% of PM₁₀ in the city. Taiyuan's new electric taxi fleet has reduced tailpipe and CO₂ emission levels and helped increase investments in the EV industry.

CO-BENEFITS



Environmental

In the eight service years of the vehicles' lifetime, 1.78 million tons of CO₂ emissions will be saved.



Social

The new electric vehicle fleet has received a significant amount of public support, and citizens have helped promote the program.



Economic

Since the start of the project, taxi operators, in total, have been able to save about \$7.95 million in operating costs.



Health

Reductions in CO, HC, and NO_x, thanks to the full fleet overhaul, will improve air quality and help reduce the incidence of respiratory diseases.

→ Taiyuan, the largest city in Northern China's Shanxi province, is one of the first cities in the world to replace its entire taxi fleet with electric vehicles.

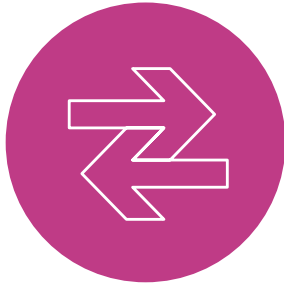
Since January 2016, Taiyuan has undertaken one of the world's most extensive electric vehicle overhaul projects. In just eight months, **the city replaced all of its 8,292 taxis with electric vehicles**, making it the fastest city to have replaced its entire taxi fleet with electric vehicles. The taxis currently rely on more than 2,000 units of 40-kW high-power charging outlets, and the city will also install 18 towers capable of providing power to 7,200 taxis simultaneously. By June 2016, 8,000 tons of CO₂ emissions were saved thanks to the fleet.

According to national regulations, the city's conventional taxis have to be replaced with new vehicles in the years 2015 and 2016. Taiyuan took advantage of the deadline to usher in the new electric vehicle fleet. By replacing the internal combustion taxis for their electric counterparts, the city will significantly improve air quality; the municipality estimates **reductions of 21,176 tons of CO**, 2,451 tons of HC, and 3,478 tons of NO_x per year.



Taiyuan has become the fastest city to replace its entire conventional taxi fleet to electric vehicles.

CITY: **GOTHENBURG**



Collaborative Approach to Public Transit Innovation

↓ **100%**

REDUCTION OF CO₂ AND NO_x WITH THE FULL ELECTRIC BUSES

THE CHALLENGE

ElectriCity is a unique response to the dual challenge of reducing CO₂ and NO_x emissions from transit and bridging the knowledge-sharing gap between academia and public and private actors. The collaborative project creates a platform on which multiple actors can share results with one another and test innovative transit system elements that will reduce CO₂ and NO_x emissions and lower city noise levels.

CO-BENEFITS



Environmental

The electrified buses reduce CO₂ emissions by 80% and produce no NO_x emissions.



Social

User satisfaction along the route is extremely high, with 80% of passengers happy with the free Wi-Fi and 9 of 10 riders appreciative of indoor boarding.



Economic

Improved liveability and reduced noise and air pollution generate public health savings and boost property values.



Health

The reduced noise and emissions translates into better health outcomes for the community.

→ An innovative pilot program in Gothenburg is introducing renewable energy buses in the city, reducing emissions and generating key data for further green public transport expansion.

ElectriCity, a cooperative venture in Gothenburg, brings together 14 partners — including the city, vehicle manufacturers, transit operators, business authorities, and universities — in the development and testing of new solutions for next-generation sustainable public transport. In 2015, it launched a pilot public transport project in which 10 electric buses were unveiled along the 8 km route 55. The buses are quiet, exhaust-free, energy efficient, and **100% powered by renewable energy**. Currently, 100,000 passengers per month take the new route and test the new products and services, including Wi-Fi, touch-screens, and a unique indoor bus stop system that increases accessibility to transport as stations can be placed inside hospitals or supermarkets.

By operating the ElectriCity project, the City of Gothenburg will learn how to use and deploy a full-scale electrified bus system and work towards the city's goal to lower emissions by 80% by 2035. The partners also **share the data in a cloud solution** to inspire novel business models. The open data has already been used in innovation challenges and school projects.



100,000 passengers per month take route 55 which tests new products and services, including indoor bus stops.



CITY: MEXICO CITY



Transportation Overhaul Guides Urban Development

↓30%

REDUCTION IN CITY-WIDE CO₂ EMISSIONS BY 2020 SUPPORTED BY THE COMPREHENSIVE MOBILITY PROGRAM¹

THE CHALLENGE

Covering nearly 1,500 km², Mexico City's sprawling footprint has led to inequitable access to key city resources and high CO₂ emissions. By overhauling the city's transportation network to focus on mobility and access via active and public transit, Mexico City is taking the major necessary steps to redefine its landscape, reduce car dependence, and cultivate a connected and coordinated city.

CO-BENEFITS

Environmental

As the transport sector is the main contributor to Mexico City's CO₂ emissions, prioritizing active mobility and public transit will substantially reduce energy use.

Social

A focus on transit-oriented development will help more city residents to access crucial economic opportunities and city services via affordable public transport.

Economic

Economic activity along Calle Madero, a historic street that received mobility improvements, has increased by 80% in the form of sales, employment, and business investment.

Health

Replacing tens of thousands of polluting minibuses and taxis, and adding CNG buses to the city's fleet, will reduce outdoor air pollution.

→ Mexico City is transforming its transportation network to prioritize active mobility and transit-oriented development in an effort to create a more connected, coordinated, and accessible urban landscape.

Launched in 2014, Mexico City's Comprehensive Mobility Program represents a paradigm shift in the city's approach to urban planning, prioritizing pedestrians, cyclists, and users of the public transportation system over private automobiles in an effort to catalyze economic development and social inclusion and reduce CO₂ emissions. The Comprehensive Mobility Program is structured under a number of strategic areas, with a clear focus on creating **complete streets that prioritize active and public transit** and fostering transit-oriented development (TOD).

To support these goals, Mexico City has already added 65 CNG buses on two lines, transporting 23,000 users a day; extended its bus rapid transit system to cover six lines; and expanded its bike-sharing system, Ecobici, to **6,000 bicycles and 444 stations**. In the coming years, the program, which is closely linked to Mexico City's General Development Program 2013–2018, will further transform the city, improving access to social and economic opportunities by adding 110 km of cycling infrastructure and cleaning the city's air by replacing 20,000 old polluting minibuses and taxis with new cleaner vehicles.



Mexico City is overhauling its transportation network, improving transit access and connectivity.

¹ Compact of Mayors. Mexico City. 2015.

CITY: **TALLINN**



Universal Fare-Free Public Transport

↓742

TONS OF CO₂ EMISSIONS REDUCED
ANNUALLY FROM THE INITIATIVE

THE CHALLENGE

Tallinn was increasingly challenged with the growth of private car use and its negative impacts on the citizens' quality of life. The city decided to address the problem by providing free transport to all city residents, reducing the need for private vehicles.

CO-BENEFITS



Environmental

The decrease in congestion reduces car engine idling, resulting in lower greenhouse gas emissions and air pollution.



Social

Universal free public transport guarantees mobility for unemployed and low-income residents.



Economic

Forty-three percent of respondents to a city-wide survey say fare-free public transport has improved the possibility of finding a job.

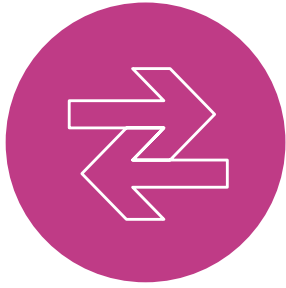
→ Fare-Free Public Transport (FFPT) is now available to all residents of Tallinn, improving traffic circulation in the city and receiving wide citizen support.

Estonia's capital recently launched Europe's largest initiative for FFPT to date. Since January 2013, Tallinn has provided free public transport in buses, trams, and trolleybuses to all city residents and all students in Estonia. This is an extension of a successful measure that allowed preschoolers, the elderly, and public servants to travel fare-free. The project curbs private car use, a growing trend in the country, and has contributed to a **7.5% annual decrease in congestion** in the city center between 2011 and 2015. City residents now enjoy cleaner air, safer streets, and savings on transport costs.

The initiative is publicly funded, and the city received strong support from their constituency. A public poll on FFPT, conducted in March 2012, showed massive **75.5% support for the initiative**. Furthermore, there has been a significant increase in the number of registered and tax-paying Tallinners since the implementation of free public transport, which the city believes is a result of the initiative.



The savings on bus fare from the FFPT initiative improve people's livelihoods.



CITY: COPENHAGEN

Smart Traffic Signals Boost Cycling

↓ 25K

TONS OF CO₂ WILL BE REDUCED BY 2025 COMPARED TO 2011 LEVELS

THE CHALLENGE

Copenhagen has an ambitious goal of becoming CO₂ neutral by 2025, but also has to manage a population growth of 1,000 citizens per month, which puts a strain on the space allocated for traffic. By modernizing the city's infrastructure, Copenhagen wants to encourage more people to take up cycling on a daily basis and further limit traffic.

CO-BENEFITS



Environmental

The smart traffic lights help prevent congestion and decrease emissions from idle cars and trucks.



Social

By making mobility and public transportation accessible and attractive to all citizens, Copenhagen is working to improve quality of life throughout the entire city.



Economic

With the upgrade of the traffic lights, the city saves money on repairs of the outdated models which experienced frequent blackouts.



Health

By prioritizing cycling, Copenhagen counteracts some of the health risks associated with a sedentary lifestyle.

→ Copenhagen is making its transportation system more intelligent and modernizing its traffic signals to be controlled in real time in order to further promote cycling and public transport.

Copenhagen is investing in Intelligent Transport Systems (ITS) by installing new controllers in traffic signals at the city's 380 intersections. The new technology not only enables the city to control traffic and optimize signals in real time, resulting in more efficient flow of bikes and buses, but also decreases the energy use of traffic signals by one-third. Overall, the **travel time of cyclists will be reduced by 10%** and travel time for buses is expected to decrease by up to 20%. The city hopes the improvements will entice even more people to partake in cycling in particular, which already accounts for 45% of commutes.

Copenhagen is also using the smart traffic signals to reduce the number of stops for cyclists by 10%, which will reduce the incidence of accidents. ITS will help Copenhagen achieve its vision to have **75% of all trips in the city be by bike, by public transport, or on foot** by 2025.



Smart traffic signals allow the city to provide more "green waves" to cyclists and buses.

CITY: SANTA MONICA



Landfill-Captured Biomethane Powers Bus Fleet

↓ 64%

DECREASE IN THE BUS FLEET'S CO₂ EMISSIONS SINCE 2014

THE CHALLENGE

Santa Monica's municipal operations account for nearly 10% of the city's total emissions. The city government addresses this by using landfill-captured biomethane as fuel for its bus fleet — simultaneously targeting emissions from the city's landfill and from transportation.

CO-BENEFITS

Environmental

The project has reduced emissions equivalent to removing 1,296 automobiles from its streets.

Economic

Santa Monica's transition to a cleaner transportation fuel was cost neutral, as the municipality saves on the fuel purchase of the biomethane, which is collected directly from the city's own landfills.

Health

Santa Monica experiences a decrease in noise pollution as the biomethane-fueled buses operate more quietly than diesel-fueled buses.

→ Santa Monica's Big Blue Bus fleet reduced its carbon footprint by replacing conventional diesel with biomethane from a local landfill.

In 2014, Santa Monica began using biomethane, harvested from organic waste in landfills, as fuel for the 200 vehicles in its Big Blue Bus fleet. The new fuel, created by Clean Energy Fuel Corp., produces **90% less CO₂ emissions than conventional diesel**. The project not only reduces the Big Blue Bus fleet's footprint — responsible for 50% of municipal operations emissions — but also recycles the methane emissions of the landfill. The initiative helped the city surpass a goal stated in its 15x15 Climate Action Plan, as it reduced city CO₂ emissions by 13,480 metric tons in 2015 compared to the projected 8,000 metric tons.

The transformation of the bus fleet is popular with residents and visitors; from 2014 to 2015, nearly **19 million passengers rode the Big Blue Bus**. The project has established Big Blue Bus as one of the USA's first municipal transit authorities to convert its entire fleet to a liquefied renewable natural gas fuel.



CITY: TORRES VEDRAS



Holistic Approach to Active Mobility

↓50

TONS OF CO₂ EMISSIONS WERE AVOIDED IN TWO YEARS AS A RESULT OF INCREASED BIKE USE

THE CHALLENGE

Torres Vedras will experience an increase in hot days, according to climate projections, and is vulnerable to the heat island effect. By suppressing car traffic, the city is taking a proactive stance towards the forecasted increase in temperature while encouraging active mobility.

CO-BENEFITS



Environmental

Torres Vedras anticipates that mitigating the heat island effect will create better conditions for urban flora and fauna to thrive.



Social

The bike-sharing system is free to use, ensuring the service is accessible to the entire population.



Economic

Through the initiative, the city reduced traffic in the historic city center, which improved accessibility for tourists and residents and stimulated economic activity.



Health

The bike-sharing system facilitates active lifestyles and the traffic reduction minimizes the impact of heat waves and their related negative health consequences.

→ Torres Vedras' approach to active transportation proves small cities can deliver best practices in bike-sharing and electric vehicle promotion.

Torres Vedras, Portugal, population 20,000, is implementing a holistic mobility strategy with a focus on active mobility and electric vehicle promotion. The strategy involves expanding the city's free bike-sharing system with 14 new bike-sharing parks that each include 30 electric bicycles and charging points available directly on the docking stations. Furthermore, **more than 15% of public spaces have been remodeled** to allow increased access to pedestrians and bicycles. The municipality also introduced taxed parking in the city center to lessen traffic in the historic area. These measures will contribute to Torres Vedras Sustainable Energy Action Plan, which aims to reduce CO₂ emissions by 29%, compared to 2009 levels, by 2020.

The changes have been popular so far in the small but environmentally conscious city. The new bike-sharing system has recorded a high number of memberships, with more than **1,400 users and 25,000 rides** after two years of operation. The city also has an ambitious vision to repurpose 50% of public spaces away from car use in the next four years.



Torres Vedras is promoting the use of its electric bike sharing system.



CITY: **PARIS**

Transport Policy Curbs Air Pollution

↑48.6

MILLION KM WERE TRAVELED USING AUTOLIB'S SILENT, ZERO-EMISSION CARS IN 2015

THE CHALLENGE

Paris has struggled with poor air quality connected to motorized vehicle transportation, especially from diesel-fueled vehicles, which are responsible for 40% of fine particle emissions. To remedy this situation, the city launched a series of rigorous measures to advance a shift away from diesel vehicles and promote low-carbon mobility.

CO-BENEFITS

Environmental

Measures taken by the city aim to decrease traffic, which is responsible for two-thirds of NO2 emissions in Paris.

Economic

The promotion of Autolib' and Velib' contributes to the development of the sharing economy and allow users to avoid high-cost vehicle ownership.

Health

With these concrete actions, Paris aims to improve its air quality and the respiratory health of its residents.

→ Paris is instituting a suite of initiatives to combat air pollution and promote mobility, with a focus on eliminating diesel vehicles and promoting bike- and car-sharing services.

Paris' ambitious mix of public policy initiatives and investment in alternative modes of mobility is tackling the city's air quality problems. Specific measures include improving the pedestrian network, promoting the use of electric vehicles, and banning the use of polluting diesel vehicles by 2020. By gradually implementing these policies over the coming years, Paris hopes to achieve its ultimate goal of **reducing transportation emissions by 60% by 2020**.

Other key measures of Paris' plan to combat traffic-related air pollution are improvements to the city's flagship self-service bike- and electric car-sharing programs, Velib' and Autolib'. To support these services, Paris added 1,279 bicycle parking spots in 2014 and **will install 1,400 km of cycle lanes by 2020**, with the goal of increasing the share of trips made by bikes to 15% by that year. In addition, citizens who give up their car can receive financial help to subscribe to Velib' or Autolib' or to Navigo, the city-wide public transport pass.



By increasing the amount of cycle-friendly spaces throughout the city, Paris aims to spur the uptake of the activity.



CITY: SEATTLE



Getting Ready for Mass Electrification of Transport

↓50%

REDUCTION IN THE MUNICIPAL FLEET'S GREENHOUSE GAS EMISSIONS BY 2025

THE CHALLENGE

Sixty-five percent of Seattle's greenhouse gas emissions come from the transportation sector. The city confronts this issue head-on with its Drive Clean Initiative and other ambitious measures that will drive mass electrification and reform its transport system for the future.

CO-BENEFITS



Environmental

The shift to electric vehicles will help abate the 60% annual pollutant load attributable to vehicle emission runoff into Puget Sound, the nation's second-largest estuary.



Economic

The city's expenditure on energy will decrease with the transition to electricity-powered transport, as it will reduce fuel expenses and turn resources towards in-state electricity providers.



Health

The elimination of tailpipe emissions from fossil fuel-burning engines provides significant health benefits to local communities.

→ Seattle has a vision to transform how its transportation systems are fueled and is preparing to overhaul all city-owned transport fleets with electric vehicles.

In order to help reach its ambitious goal of eliminating greenhouse gas emissions attributable to transport by 2050, Seattle is spurring the mass electrification of many modes of transport, including passenger cars, trucks, transit, off-road vehicles, and maritime transportation through its Drive Clean Initiative. The measure includes a plan to reduce greenhouse gas emissions from the city's municipal fleet through significant investment in energy-efficient vehicles and cleaner fuels and deployment of **15,000 electric vehicles by 2025**.

The initiative includes not only the municipal fleet electrification strategy but also infrastructure investment by Seattle City Light, opportunities for public-private partnerships, and use of regulations to accelerate the process. The city's **commitment to low-carbon transportation modes** has already attracted investments, as BMW relocated the North American headquarters of its car-sharing service – ReachNow – to Seattle.



Through this initiative, Seattle will encourage the use of electric shared vehicles and public transport, and decrease congestion and air pollution in the city.

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CITY: **BELO HORIZONTE**



Mobility Plan Improves Transit Travel Time

↓ **9M**

TONS OF CO₂ EMISSION SAVINGS ARE EXPECTED FROM 2008-2030 AS A RESULT OF THE MOBILITY PLAN

THE CHALLENGE

Road transport is responsible for 53% of greenhouse gas emissions in Belo Horizonte and could be responsible for 6 million tons of CO₂ emission by 2030. Belo Horizonte has responded to the needs of a growing population and the increase in greenhouse gas emissions by implementing measures to improve urban mobility and reduce public transport travel times.

CO-BENEFITS

Environmental

Particulate matter concentrations – PM₁₂, PM_{0.2}, NO_x, and MHC – will be reduced as car use declines.

Social

With 30% of BRT users saying they could be using a car instead of the bus, the program is initiating a shift in transport modes for Belo Horizonte's residents.

Economic

By 2030, the city estimates that the cumulative reduction in travel time will save the equivalent of \$1.3 billion in workers' productivity.

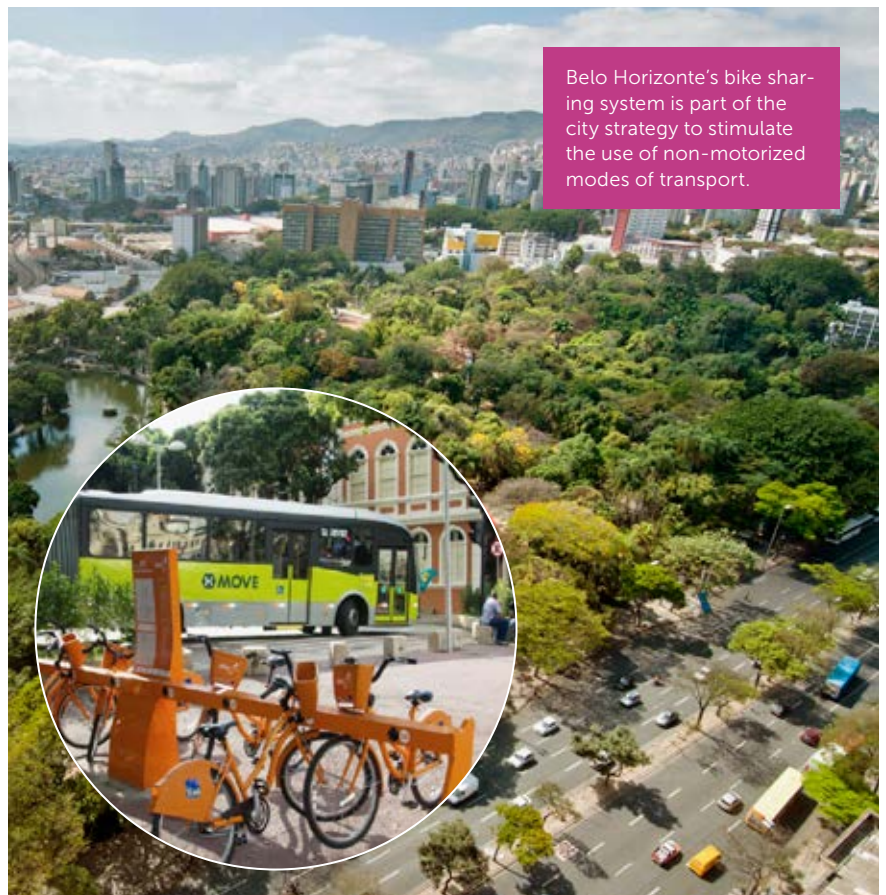
Health

PlanMob-BH is expected to significantly reduce the number of traffic-related accidents and deaths.

→ Belo Horizonte tackled long transit times with improvements to public transport and the promotion of active mobility.

Under PlanMob-BH, Belo Horizonte has introduced new strategies to improve mobility in the city. The plan includes the addition of **60 km of bus rapid transit (BRT)** and metro lines as well as a bike-sharing system, among other schemes, to stimulate active mobility and reduce travel times. PlanMob-BH is the result of a public-private partnership between the government, international agencies, and bus companies that helped finance new buses. The new projects contribute to the city's Reduction of Greenhouse Gases Plan and will account for 28% of the city's 2030 goal of reducing 1.45 million tons of CO₂ emissions per year.

The new initiatives have also been positively received by commuters. In a city survey, **52% of respondents said they spend less time on public transport** after the extension of the BRT. Belo Horizonte is one of the first cities in Brazil to prepare an urban mobility plan in accordance with the country's overall strategy.





SUSTAINABLE COMMUNITIES



STOCKHOLM

*Walkable City Drives
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WUHAN

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CAPE TOWN

*Transformative Land Use
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AUCKLAND

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Development*
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→ The solutions in the Sustainable Communities sector illustrate how cities integrate resilience and mitigation strategies in neighborhood regeneration projects, engage citizens in planning and executing climate initiatives, and transform the urban landscape to promote healthy and low-carbon development.



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Neighborhood Renewal Boosts Climate Resilience
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CITY: **TORONTO**



Neighborhood Renewal Boosts Climate Resilience

↓ **2.2K**

TONS OF CO₂ CAN BE REDUCED
ANNUALLY WHEN SNAP
IS UNDERTAKEN IN ALL 1,750
ELIGIBLE HOMES

THE CHALLENGE

Retrofit and climate mitigation measures can often be difficult to implement in Toronto's older buildings and communities where the aging infrastructure requires the most improvements. SNAP programs succeed in promoting change and increasing community resilience while fully engaging residents in the process.

CO-BENEFITS



Environmental

SNAP assists in achieving targets established by the City of Toronto by reducing electricity use in the neighborhood by 10% and reducing natural gas use by 17% below 2007 levels by 2020.



Social

1,500 neighbors have connected with one another through the Black Creek SNAP program.



Economic

SNAP aims to satisfy 20% of a community's vegetable needs with onsite gardens, helping residents save money on grocery bills.



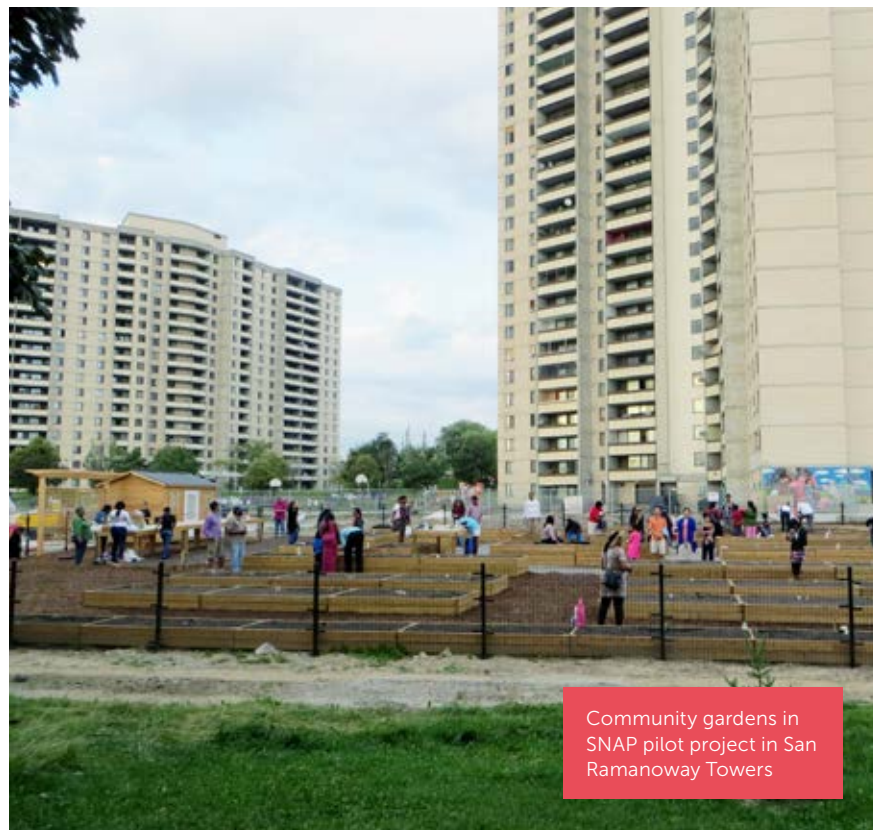
Health

SNAP's expansion of urban forest cover and promotion of gardening increases the community's contact with nature, which has positive impacts on mental health.

→ Toronto's Sustainable Neighbourhood Retrofit Action Plan is bringing adaptation and mitigation measures to apartment buildings and single-family homes.

Toronto's Sustainable Neighbourhood Retrofit Action Plan (SNAP) is a locally tailored home retrofit program **reaching both homeowners and renters with building upgrades** and community enhancement initiatives. Assisting residents from planning to implementation of projects, SNAP simultaneously targets energy conservation, urban forest enhancement, water conservation, and stormwater management, as well as local food production in order to create more resilient neighborhoods.

In the Black Creek neighborhood, a community of 25,000 people which was home to one of SNAP's six pilot projects, positive results have already been observed; **88% of participants have undertaken at least one retrofit action** since the program launched in 2012. One SNAP program underway in Black Creek, Harvest the Rain, has distributed 217 rain barrels to residents in an effort to protect against basement flooding while using the collected water to support vegetable gardens and tree planting. City-wide, SNAP measures are expected to reduce stormwater runoff and pollutants from private lots by 30%, expand urban forest cover by 8%, and reduce electricity use by 10%.



Community gardens in SNAP pilot project in San Ramanoway Towers

CITY: CAPE TOWN



Transformative Land Use Plan Supports Transit

↓ 1.6M

TONS OF CO₂ WILL BE REDUCED
FROM 2012 LEVELS BY 2032 UNDER
THE TODSF

THE CHALLENGE

Due to sprawl, historical emphasis on road-based transport, and inequitable access to transit, Cape Town consumes a great deal of diesel, and transport, as a whole, is responsible for 34% of the city's CO₂ emissions. By directing its long-term strategic vision to address these systemic issues, Cape Town will not only reduce its greenhouse gas emissions, it will enable residents to navigate the city more efficiently.

CO-BENEFITS

Environmental

The TODSF aims to have 20% fewer cars circulating in the city by 2032, which will improve the air quality of Cape Town.

Economic

By prioritizing transit-oriented development, the TODSF will decrease kilometers traveled and transportation costs, particularly for low-income groups who currently spend 43% of their income on transport.

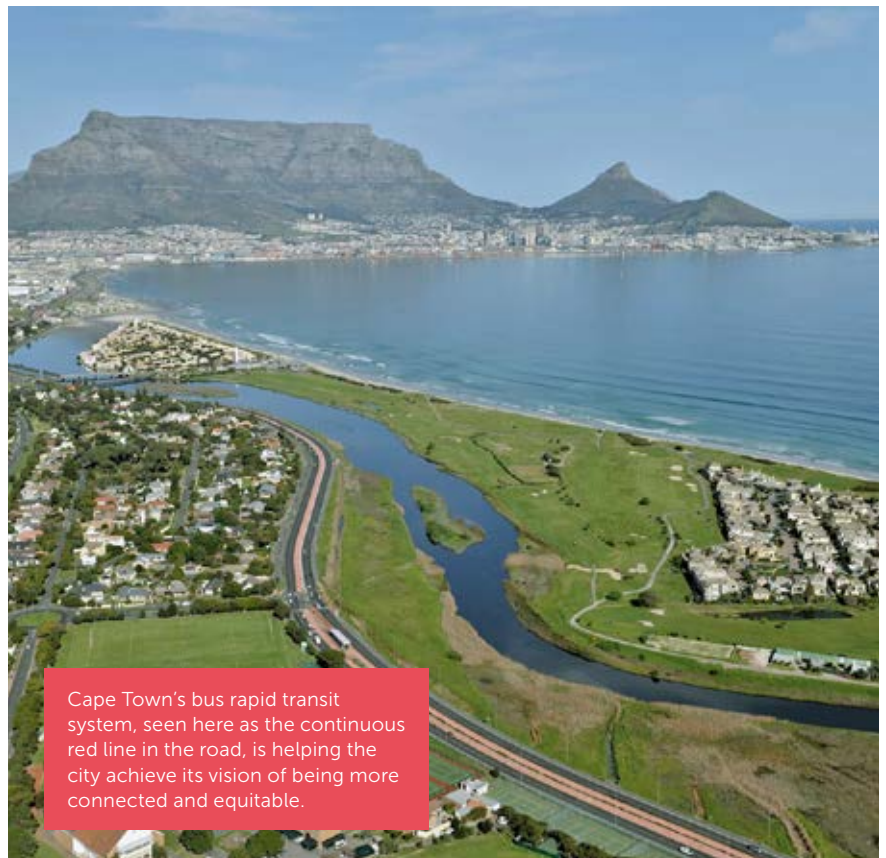
Health

By reshaping the city to allow for greater use of non-motorized transport such as walking and cycling, the TODSF will help residents lead healthier lifestyles.

→ By integrating transport into its long-term development strategy, Cape Town will ensure that land use is best organized to suit residents' needs and reduce greenhouse emissions.

With its Transit Oriented Development Strategic Framework (TODSF), Cape Town is using transport as the foundation of its long-term land use management and growth development, marking a paradigm shift for the city, which wants to become more compact and connected. The TODSF's priorities include a modal shift towards public transport, the reduction of travel distances and costs, and the alleviation of urban sprawl through the optimization of land use. Concrete measures include a **12% improvement in access to transit** and a 23% reduction in passenger kilometers traveled by 2032.

To embark on this new vision, Cape Town developed an optimized transport scenario that will direct the organization of different land uses, including transport zones, public utilities, and businesses, and identify the actors necessary to deliver the new developments. To facilitate the uptake of the new directives, this **focus on transit-oriented development** will be embedded within all strategic and built environment plans of the city and will be used as a sustainable growth management tool.



Cape Town's bus rapid transit system, seen here as the continuous red line in the road, is helping the city achieve its vision of being more connected and equitable.





CITY: **AUCKLAND**

Smart Green Waterfront Development

↓ **45 %**

REDUCTION IN CO₂ EMISSIONS BY 2030 COMPARED TO BUSINESS AS USUAL IN WYNYARD QUARTER

THE CHALLENGE

New Zealand is experiencing growth in many urban areas, but development often happens in a haphazard way without consideration for environmental impacts and climate adaptation measures, especially flooding risks. Utilizing neighborhood data and smart infrastructure, Wynyard Quarter is demonstrating replicable practices to both mitigate and adapt to climate change at a district scale.

CO-BENEFITS



Environmental

Wynyard Quarter is an old industrial area that was severely contaminated in the past. By improving water quality and remediating the land, the project will help restore the biodiversity and ecology of the area.



Social

As transparency is one of the stated goals of the redevelopment project, citizens can view the environmental impact of the development in real time on a city website.



Economic

By 2040, the waterfront redevelopment will contribute \$4.29 billion to Auckland's economy and support 20,000 new full-time jobs in the city.



Health

Wynyard Quarter aims to have 70% of trips made by walking, cycling, or public transport, fostering a healthier lifestyle for residents.

→ By using smart sensors and development contracts tied to environmental standards, Auckland is ensuring the climate resilience and energy efficiency of its largest waterfront redevelopment project.

Data capture and reporting through neighborhood-scale smart infrastructure is central to Auckland's largest urban regeneration project to date: Wynyard Quarter, an 18-hectare former brownfield waterfront site. From the plan's inception in 2011, the city has enforced strict environmental performance targets and is **using state-of-the-art sensors to gather detailed data** on the project's goals, including energy efficiency, sustainable transport, and climate adaptation. The data collected will enable the city to monitor the environmental performance of Wynyard Quarter over time.

Environmental standards were integrated in the development's construction contracts to ensure that the city's goals are met. With these measures, the city wants to reach a respective **48% and 79% reduction in greenhouse gas emissions from energy and transport** compared to business as usual in Wynyard Quarter. Special attention was also given to the climate resilience of the waterfront project, with the incorporation of sustainable design features like stormwater infrastructure, rainwater harvesting, and waterproof basement pumping stations.



CITY: **HONG KONG**



From Brownfield to Low-Carbon Business District

↓ **59.5K**

TONS OF CO₂ EMISSION PER YEAR WILL BE REDUCED DUE TO KOWLOON EAST'S DISTRICT COOLING SYSTEM

THE CHALLENGE

Hong Kong had the double challenge to render Kowloon East economically attractive while ensuring the area's CO₂ mitigating abilities and resilience to climate change in the face of increasing water levels. The city integrated green development directives and policy into the neighborhood's redevelopment plan to ensure that climate impacts were mitigated.

CO-BENEFITS



Environmental

Compared with the 2011 base value, NO₂, PM₁₀, and PM_{2.5} concentrations in the Kwun Tong section of Kowloon East had decreased by 12.7%, 10.2%, and 12.9%, respectively, in 2015.



Social

The remediated waterfronts have become popular destinations for art and cultural events in the district.



Economic

The district cooling system saves up to 10% of the private capital required to build conventional cooling plants and enables more flexible building design.



Health

Various pedestrian-centric improvements promote active mobility, which will result in positive health outcomes for the community.

→ In redeveloping the industrial Kowloon East brownfield into a thriving business district, Hong Kong is using innovative infrastructure to reduce energy consumption, improve mobility, and conserve resources.

The Energizing Kowloon East redevelopment project aims not only to transform Kowloon East into an additional central business district of Hong Kong but also a resilient, low-carbon community. To achieve this, the city has installed a large-scale district cooling system, serving about 1.73 million m² of floor space. Furthermore, both new and existing buildings in the district will have to adopt green certifications and provide electric vehicle charging facilities. So far, the 30 green building **projects in Kowloon East have reduced CO₂ emissions by 56,100 metric tons** annually.

In addition to reductions in energy use, the city is promoting active mobility in Kowloon East by improving walkability and well-integrated pedestrian networks. The district is also conscious of its adaptation measures, working to improve drainage and water quality while ramping up flood protection capacity. Boosting this effort, **one-third of Kowloon East will be public space**, and 60% of that land will consist of green areas.



The Kwun Tong Promenade offers Kowloon East residents a beautiful and resilient recreational public space.

CITY: ATLANTA



Increased Connectivity Curbs Urban Sprawl

↓ 625K

METRIC TONS OF VMT-CAUSED EMISSIONS WILL BE REDUCED FROM THE 2009 BASELINE WHEN THE PROJECT IS FULLY IMPLEMENTED IN 2030

THE CHALLENGE

Vehicle miles traveled (VMT) is the second-largest emitter of greenhouse gases in Atlanta, responsible for 2.5 million metric tons of CO₂ emissions. Yet, despite the city's sprawling size, the average car trip is less than 9 km. When complete, Atlanta's BeltLine is expected to reduce VMT emissions by up to 25% and reverse the pattern of regional sprawl, while creating vibrant, walkable, and livable communities.

CO-BENEFITS



Environmental

The Atlanta BeltLine Arboretum is planting thousands of new trees across 526 hectares and removing invasive species in the ABL.



Social

The project is expected to add 28,000 units of housing, with 5,600 of these units classified as affordable housing.



Economic

By 2015, the ABL had created 6,100 permanent jobs, 22,490 construction jobs, and \$3.1 billion in economic development.



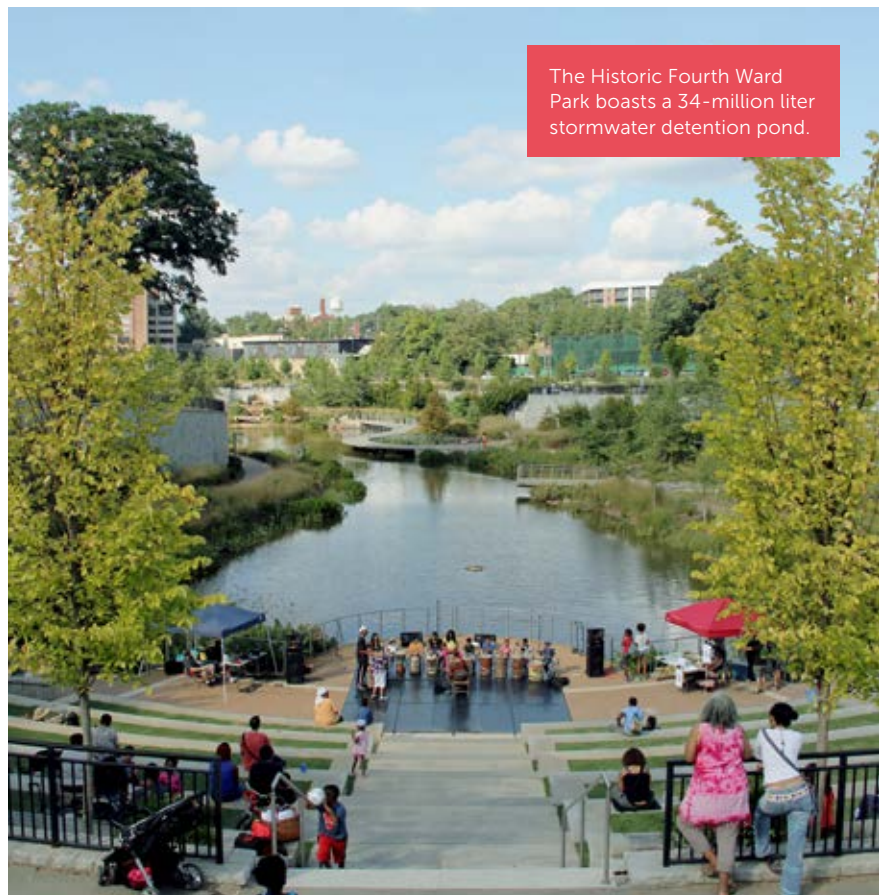
Health

The Eastside Trail promotes active modes of travel and daily physical activity that could help prevent or reduce the occurrence of cardiovascular diseases.

→ Atlanta's BeltLine is a large-scale urban mobility project that connects residents with trails and public transit while remediating land and decreasing the risk of flooding.

Atlanta's BeltLine (ABL) is a 35.4 km transit corridor that improves mobility and addresses urban sprawl by connecting 45 inner-city neighborhoods and creating links to suburban transit systems. One of the largest and most comprehensive urban development projects in the country, the BeltLine will **join 53.1 km of multi-use trail to 80.5 km of modern streetcar transportation.**

The Eastside Trail, a key stretch of the ABL, is designed to cater to commuters who rely on their cars for short trips in the city center. When constructing the Eastside Trail, the city included improvements to further benefit the community and boost resilience. For instance, it transformed a barren, contaminated site that was prone to flooding into the 6.9-hectare Historic Fourth Ward Park. The environmental remediation **removed 1,700 tons of contaminated soil.** The park also sports a built-in flood protection and stormwater management system. When the Eastside Trail is complete in 2030, it is expected to reduce CO₂ emissions by 123,000 metric tons from the 2014 baseline.



The Historic Fourth Ward Park boasts a 34-million liter stormwater detention pond.



CITY: **CAMBRIDGE**

Inclusive Development Plan for City Resilience

↓ 70 %

REDUCTION IN CO₂ EMISSIONS FROM BUILDING ENERGY USE BY 2040 AS PART OF ENVISION CAMBRIDGE

THE CHALLENGE

While Cambridge has taken a proactive stance on climate resilience for years, it must work to balance long-term planning with the short-term needs of the community and its most vulnerable members. With Envision Cambridge, the city is making sure it listens to the needs of its entire community and incorporates their input into the long-term actions required to ensure the resilience of the city.

CO-BENEFITS

Environmental

Cambridge aims to reduce vehicle ownership by 15% below 1990 levels by 2020 in order to decrease transportation emissions and improve air quality.

Social

Envision Cambridge focuses on engaging the communities that will be most affected by climate change, according to the city's vulnerability assessment.

Economic

By integrating climate preparedness planning into Envision Cambridge, the city will be able to mitigate the effects of environmental disasters, which could otherwise cost the city an estimated \$43 million daily.

Health

The city plans to increase the number of trips made by bike to 30% by 2030. The increase in active mobility will have positive health outcomes for the community.

→ With a concerted effort to bring many voices to the discussion table, Cambridge is creating a city-wide development plan that lets climate change mitigation and resilience take center stage.

Cambridge has embraced a resilience and low-carbon focus in creating its overall urban development strategy, Envision Cambridge. The new roadmap will develop and design policy recommendations on a broad range of topics such as housing and affordability, mobility, economic opportunity, and urban form, with a particular focus on climate and the environment. As citizen involvement is key to the plan's success, the city is employing a number of **creative engagement strategies to reduce barriers to participation** in consultation sessions, ensuring diverse communities have a voice in the process. Strategies include providing translators and childcare during consultation sessions and bringing the process directly to communities through mobile meetings.

As Cambridge aims to reduce greenhouse gas emissions by 80% by 2050, Envision Cambridge established a number of complementary targets, including decreasing transportation emissions by **reducing vehicle ownership 15% below 1990 levels by 2020** and increasing solar photovoltaic generation capacity to 160 MW by 2040.



A mobile engagement station for Envision Cambridge.

CITY: STOCKHOLM



Walkable City Drives Long-Term Growth

↓ 20 %

DECREASE IN TRAFFIC AROUND THE INNER CITY SINCE INITIATING THE CONGESTION TAX AS PART OF WALKABLE CITY

THE CHALLENGE

Stockholm is one of Europe's fastest-growing cities. The sustainability of its future growth and development depends on planning policies enacted today. In this context, the city is embracing a holistic development plan with a focus on connectivity, active mobility, and public transport to ensure equitable growth and climate resilience.

CO-BENEFITS



Environmental

The Walkable City plan will drive Stockholm's goal of becoming carbon neutral by 2030.



Social

As part of Walkable City, Stockholm has created a special commission to investigate how the city can reduce unequal living conditions in order to increase the well-being of all inhabitants.



Economic

Increased connectivity to areas outside the city center will make these districts more attractive for investment.



Health

The city is investing \$122 million through 2018 to promote the use of bicycles, which will boost active mobility and reduce the incidence of illnesses related to sedentary lifestyles.

→ To ensure Stockholm's sustainable growth for years to come, the city has underpinned its development strategy on active mobility, public transport and efficient use of space.

Stockholm believes that making the city denser and more connected is indispensable to creating a thriving city that can grow equitably and sustainably in the face of challenges from globalization and climate change. With its new city-wide plan, Walkable City, Stockholm is promoting walking, cycling, and public transport as well as efficient use of space over driving. To deliver on this vision, the city has **extended its bicycle network by 7,000 m in 2015** and utilized measures like a congestion tax, which fines car use in the city center, to invest in walking, cycling, and public transport infrastructure. The mobility plan is crucial in helping Stockholm reach its goal of eliminating CO₂ emissions attributable to transport by 2030.

Ensuring that sustainable growth occurs not only in the city center but also in peripheral communities, Walkable City Stockholm is investing in key strategic transit nodes to connect the entire city. In doing so, the city will not only boost its climate resilience and lower CO₂ emissions but also **reduce social disparities between neighborhoods** by improving access to the city's services and unlocking economic opportunities for all residents.



As part of its long-term vision of improving active mobility, Stockholm wants to promote cycling as a means to get to and from work.



CITY: CURITIBA



Urban Voids Become Community Gardens

→ Curitiba is turning unused urban land into community gardens in order to improve food security and build social cohesion, while raising awareness about the environmental impacts of commercial food production.

↑ 67M

M² OF LAND HAS BEEN REPURPOSED FOR CULTIVATION UNDER THE PROGRAM

THE CHALLENGE

In Curitiba, swathes of land have long been treated as garbage disposal sites. By repurposing this land for community urban agriculture, the city is boosting resilience to climate change by simultaneously targeting food security and urban vegetation cover.

CO-BENEFITS

Environmental

The use of urban voids for agriculture helps mitigate the risk of flooding by reducing soil sealing and allowing water infiltration.

Economic

By saving on the purchase of vegetables or selling surpluses, each participating family earns or saves an average of \$50 per month.

Health

Gardening serves as physical activity for seniors and others.

The Urban Agriculture program in Curitiba is a community project that rehabilitates degraded land, and makes use of vacant space in private and public locations, including schools, backyards, and balconies, to produce food. Through local organic food production, the city hopes to mitigate the greenhouse gas emissions caused by the transport of food as well as enable more carbon sequestration from increased vegetation. In addition, the urban agriculture project increases food security and can serve as an income-generating activity for participants. Since its launch in 2011, the initiative has **generated more than 750 tons of food** and has benefitted more than 83,000 people.

The program also fosters social inclusion by providing a therapeutic group activity for a diverse group of participants, including children and the elderly and those afflicted by drug addiction and mental health issues. Environmental awareness and education is also a key element of the project, which **offers training activities, including home composting**, alternative methods of cultivation, pest control, and soil conservation.



The Urban Agriculture program will eventually reduce its larger community gardens to develop smaller and individual gardens.

CITY: **WUHAN**



Dense District Seeks Energy-Efficient Future

↓ **500K**

TONS OF GREENHOUSE GAS
EMISSIONS WILL BE REDUCED
ANNUALLY IN 2020 IN BAIBUTING
DUE TO ITS GEOTHERMAL HEAT
PUMP AND SOLAR ENERGY SYSTEM

THE CHALLENGE

Residents of Baibuting live in a very dense area in one of China's most populous cities. While the area's space constraints promote mobility, the district needed to improve its energy efficiency as well. Therefore, Wuhan initiated a holistic low-carbon approach to the neighborhood's development that engages residents and incentivizes the uptake of green technologies.

CO-BENEFITS



Environmental

The geothermal and solar energy systems have already reduced CO₂ emissions by 300,000 tons annually.



Social

There are now more than 170 cultural and sports groups in Baibuting, keeping the community active and engaged.



Economic

By reducing energy consumption and promoting energy conservation in buildings, Baibuting's low-carbon focus is also saving residents money on energy bills.



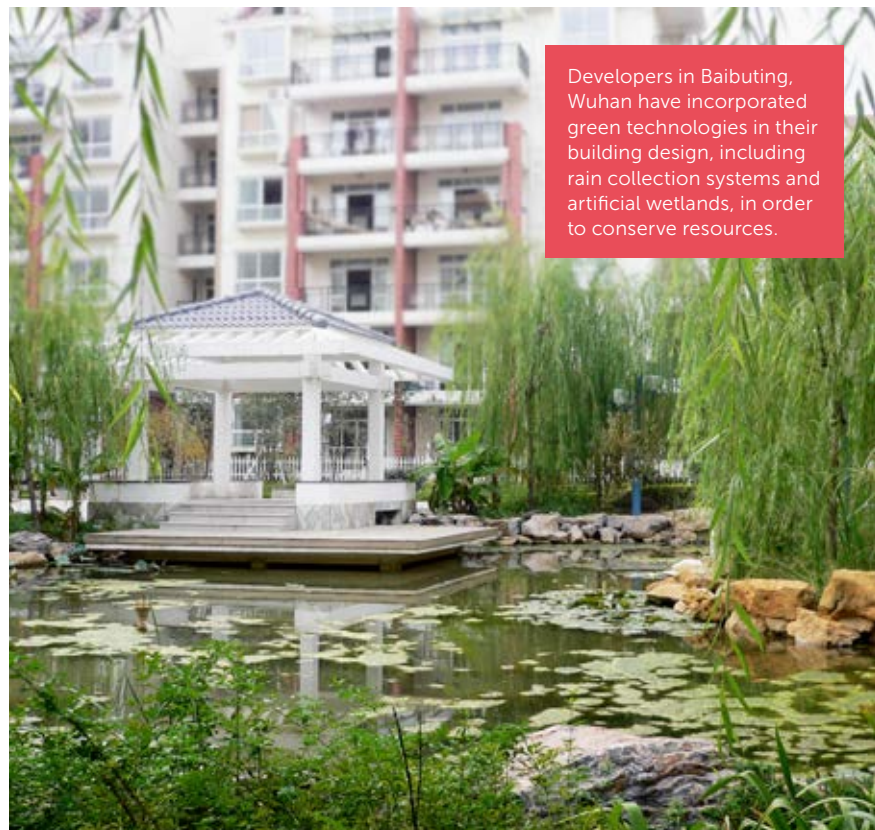
Health

Baibuting's low-carbon transportation projects encourage walking, cycling, and the use of public transit, which will improve residents' health outcomes.

→ By focusing on infrastructure development and community engagement, Baibuting, a densely built community in Wuhan, is successfully integrating a low-carbon philosophy into its strategic development.

As part of Wuhan's Low-Carbon City Pilot Program, Baibuting, a community of 150,000 people living on 5.5 km², is infusing a low-carbon philosophy into its strategic development goals. Launched in 2011, some of the main directives guiding Baibuting's development are affordable, energy efficient housing, convenient transport, and access to green space and essential services. According to the area's development strategy, housing construction is encouraged to incorporate **low-carbon and climate-resilient technologies**. So far, developers' investment in renewable energy has yielded a geothermal heat pump heating and cooling system and solar-powered water heaters for the community's benefit.

Baibuting's strategy focuses not only on physical improvements but also on the importance of instilling a low-carbon culture and environmentally responsible habits among residents. With the help of **40,000 volunteers**, almost a third of the population, the Baibuting council helps residents adopt a green lifestyle by, among other initiatives, bringing awareness to power and water savings and clarifying waste separation guidelines.



Developers in Baibuting, Wuhan have incorporated green technologies in their building design, including rain collection systems and artificial wetlands, in order to conserve resources.



CITY: **BARCELONA**

Citizen Initiatives Drive Climate Action

↓40%

REDUCTION IN PER CAPITA CO₂ EMISSIONS BY 2030, IN PART THROUGH CITIZEN-LED PROJECTS

THE CHALLENGE

Home to a large population located on the Mediterranean basin, Barcelona faces a number of deep-rooted problems related to climate change including high energy consumption and vulnerability to rising sea levels. To combat these challenges, the city is employing the power of collective local action to enact necessary changes to reduce emissions and improve resilience.

CO-BENEFITS



Environmental

The Green Point 2.0 project, which provides spaces for collection, reuse, and sharing of items that would otherwise be tossed, and the door-to-door waste collection and separation project, both initiated by residents, support the city's goal of cutting waste generation by 10% by 2020.



Economic

The implementation of Barcelona's plan could create up to 9,500 jobs in Barcelona and the surrounding area.



Health

The project's Safe School Routes initiative aims to reduce the number of children going to school by car by 10% over two years, thereby improving kids' health by increasing active mobility like walking and cycling.

→ By collaborating with various civil society actors, Barcelona is engaging residents in developing citizen-led actions that address climate resilience.

In 2015, Barcelona adopted a bottom-up approach to mitigating climate change through its citizen-led initiative Commitment to Climate Change. The city invited more than 800 organizations including schools, businesses, and NGOs to participate in the process, resulting in the creation of nine citizen-centric projects. It is the city's goal that these actions, along with city-led initiatives, will help Barcelona substantially reduce CO₂ emissions and **increase the total urban green area by 1.6 km² by 2030**.

The nine citizen-centric plans include a bike-sharing program to encourage people to cycle to work and a mobile application that connects residents who want to swap goods and offer repairs. Another project will employ and train residents to renovate housing with passive and low-cost systems to reduce energy consumption. All these projects **work in synergy with Barcelona's strategic measures** to address climate change with the hope that the citizen-driven process will ensure the city's long-term commitment to climate action.



Barcelona's citizen-led projects seek to improve public health through the promotion of walking and cycling.

Methodology

→ Arriving at the Top 100

Creating Cities100 was a long, multi-step process. The transparency of our application and evaluation procedures is of the utmost importance to the integrity of Cities100. By presenting our methodology we enable readers to understand how we selected these 100 city solutions.

Finding the solutions

Throughout May and June of 2016, Sustainia and C40 conducted a public campaign to encourage as many cities as possible to submit applications for exciting climate change projects to be featured in Cities100. This campaign included direct contact with city officials, desk research, and social media outreach and communication. In all, these efforts yielded 160 applications from 75 cities across every region of the world.

Who was eligible?

In order to ensure that applications came from the most viable, innovative, and replicable solutions, all applications had to meet the following eligibility requirements:

- ✓ Applications had to be submitted by a municipality, or by a third-party organization with the support of the cooperating municipality
- ✓ Solutions must be operating, and had to be initiated within the past four years
- ✓ Solutions must have secured funding

Only C40 cities, or cities that have committed to the Compact of Mayors, were eligible to submit to the following sectors: Adaptation Plans & Assessments, Building Energy Efficiency, Climate Action Plans & Inventories, and Clean Energy. The other six sectors were open to all cities.

In order to feature new solutions each year, projects featured in the 2015 edition of Cities100 were not eligible for consideration in this year's edition.

CITIES SUBMITTED PROJECTS WITHIN 10 SECTORS:

-  CLEAN ENERGY
-  SOLID WASTE
-  ADAPTATION PLANS & ASSESSMENTS
-  ADAPTATION IN ACTION
-  CLIMATE ACTION PLANS & INVENTORIES
-  BUILDING ENERGY EFFICIENCY
-  FINANCE & ECONOMIC DEVELOPMENT
-  SOCIAL EQUITY & CLIMATE CHANGE
-  TRANSPORTATION
-  SUSTAINABLE COMMUNITIES

How did we score them?

Scoring and ranking such a wide range of innovative projects was no easy task. In order to be as rigorous and objective as possible, we created a detailed, multi-step scoring system.

→ **STEP 1:** First, the Sustainia team of experts analyzed all 160 applications and scored them on the following five criteria:

1

CLIMATE ACTION

→ CO₂ reductions or climate change risk mitigation goals and results. Preference was given to results or goals that are measured and assessed quantitatively and to documented results over goals.

2

CO-BENEFITS

→ Co-benefits (economic, environmental, health, and social) goals and results. Preference was given to results or goals that are measured and assessed quantitatively and to documented results over goals.

3

INNOVATION

→ The geographic scale of innovation – this comprises innovation at an international level (e.g. the first in the world to apply this technology, approach, scale, etc.), and innovation at a city or regional level (either across the continent or within that country).

→ The evidence provided to support the claim of the project's innovativeness.

→ Description of the innovative elements of the project.

4

GOVERNANCE

→ Whether the project is referenced within the city's overall strategy or climate plans.

→ How the project collaborates with other entities in the city (i.e. other city departments, government agencies, NGOs, private companies, etc.).

→ How the project has undertaken citizen engagement activities and whether those activities have been quantified.

→ How citizen engagement has influenced the development and implementation of the project.

5

SHARING & SCALING

→ The extent to which the application demonstrates that the project experience has been shared openly or is planned to be shared openly with other cities.

→ Demonstration of plans to scale the project within the city, or a suitable explanation as to why scaling is not possible.

Within each of the five evaluation criteria, solutions were scored on sub-criteria (bullet points listed below each of the aforementioned evaluation criterion). For each sub-criterion, a solution could score 1 (low), 2 (medium), or 3 (high). A solution's overall score is the sum of their five evaluation criteria scores.

→ **STEP 2:** Once solutions received their initial overall score, a team of C40 sector-specific experts analyzed all projects within their given sector and provided detailed input for all evaluation criteria of every solution based on years of hands-on knowledge and experience. Solutions' initial scores were adjusted according to this input, yielding a final score for every solution. The highest scoring solutions in each sector were selected to be featured in Cities100.

Writing Notes

Monetary amounts provided by cities have been converted to United States dollars. Distance and volume measurements have been converted to metric system units. In regards to mass, we have used the unit provided by the city in their applications (either tons or metric tons). "Tonnes" have been written as "metric tons."

Explore Sustainia

→ We Make Sustainability Your Business

Sustainia is an international sustainability think tank and consultancy working to accelerate action towards a sustainable future. In order to realize this, we partner with companies, cities, and organizations to map their position, navigate the changing landscape, and communicate with impact. Sustainia has been unearthing sustainable solutions for more than five years, so we know it's possible to build the world of tomorrow with the solutions of today.

→ How we deliver sustainable **innovation**:



1) Insight

MAPPING & ANALYZING

The world is changing fast and all organizations are struggling to stay ahead. Our research gives us insights into emerging sustainability markets and new business models, policies, and partnerships. We can help you:

- Map and identify sustainable solutions
- Prepare for the future with trend analysis

Over the past five years, we have tracked more than 4,500 solutions from all over the world through our flagship Sustainia100 publication.

In 2017, we will launch a new online solutions platform, in partnership with UN Global Compact, to make it even easier to find inspiring solutions for a cleaner, greener, and fairer future.



2) Involvement

NAVIGATING & COLLABORATING

Beyond every risk sits a new opportunity. We apply this mindset to explore new markets through our networks with hundreds of experts, thought leaders and business pioneers. We work with you to develop a new approach – your navigation tool – to tackle your most pressing challenges and find your way in an increasingly complex landscape. We can help you:

- Turn your risks into business opportunities
- Co-create and innovate through our Opportunity Services



3) Impact

COMMUNICATING & INFLUENCING

Powerful storytelling and captivating visuals drive influence and impact. We're shifting the narrative on sustainability by making it inclusive, positive, and compelling. We can help you:

- Bring your sustainability agenda to life
- Create events with impact
- Inspire your audiences through multi-channel campaigns

Based on the latest research and knowledge, combined with specific examples from available technologies, solutions, and products, Sustainia specializes in creating sector-specific studies and analyses, trend reports, visual conceptualization and strategic communication, such as Eat in Sustainia and The State of Healthcare.



Explore C40

→ Local Action, Global Impact

The C40 Cities Climate Leadership Group connects more than 85 of the world's greatest cities, representing 650+ million people and one quarter of the global economy. Focused on tackling climate change, C40 provides a forum for cities to share strategies for reducing greenhouse gas emissions and climate risks, while increasing the health, wellbeing and economic opportunities of urban citizens.



Connecting & Learning

C40 networks connect hundreds of city officials around the world, helping them to implement climate action, access partnership resources and overcome technical and financial barriers. Currently working across six initiative areas, C40 delivers over 100 workshops and webinars each year, alongside a dynamic online knowledge exchange platform. Sharing is working. The power of our network is that when one city demonstrates the success of a great idea, other cities can quickly implement it.

- ✓ Nearly 75% of C40 cities have been able to take, new, better or faster climate actions as a result of participating in C40 networks; for example, investment in bus rapid transit (BRT) grew from 21 to 42 cities in 2 years.
- ✓ C40 cities focus on what works: 50% of all reported actions have gone from pilots to city-wide, up from 15% in 2011.
- ✓ Cities' ambition is still growing with nearly 80% of all actions planned for future expansion.





Empowering Cities with Data

C40 leverages our unprecedented database of city actions, extensive network of partnerships, and unique organizational insight to demonstrate the power of cities to address climate change.

Our research analyzes key trends, identifies opportunities for further action across the global C40 network, and helps to prioritize initiative areas with the greatest potential impact.

C40's research agenda is committed to creating actionable data, supporting decision-making and driving investments. Our cutting-edge tools, standards and frameworks help cities to implement the most impactful mitigation and adaptation strategies, and measure and manage their effectiveness.

100%

of cities reporting data to C40.

98%

of cities report that climate change poses a significant risk to their city.



A Global Platform of Mayoral Commitments

By engaging mayors in the international debate on climate and sustainable urban development, C40 highlights the crucial role of cities and the decisive leadership of mayors to place the world on a climate safe pathway, and help secure resources for ambitious local climate action.

In June 2016, cities around the world made another great and historic stride: bringing together the Compact of Mayors, which C40 helped to activate and deliver, and the EU Covenant of Mayors to form a new Global Covenant of Mayors for Climate & Energy. This new initiative will provide a global platform for mayors to transparently record their climate change commitments, building on the pledges already made by 7,100 cities and towns from 119 countries and six continents, representing more than 600 million residents.

C40 has long been committed to the principle that working together helps cities go farther, faster. The Global Covenant of Mayors for Climate & Energy helps us to engage new partners and a broader coalition of city leaders taking concrete, measureable and transparent action on climate change.



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It has become obvious that cities **play a critical role in adapting to climate change** and delivering on the ambition of the Paris Agreement. Urban areas account for most of the world's carbon emissions, and their share will continue to increase as two-thirds of the world will call cities home by 2050. Such booming populations bring with them challenges, but also myriad opportunities to adapt and grow sustainably. **As Cities100 showcases, cities around the world are already capitalizing on these opportunities** and employing local solutions that not only reduce CO₂ emissions and boost resilience, but also promote health, bolster economic vitality, and alleviate social inequities.

The solutions in Cities100 were selected after a review of **160 submissions from 75 cities spread across the globe**. By identifying 100 readily available city solutions, the partners behind Cities100 – C40, Realdania, and Sustainia – wish to highlight the potential for a sustainable urban future and **inspire other change makers** throughout the world.

→ **100 solutions for climate action in cities**

www.sustainia.me

#Cities100

www.c40.org

