



WORLD  
RESOURCES  
INSTITUTE

WRI ROSS CENTER FOR  
SUSTAINABLE  
CITIES



# Sustainable and Livable Cities Initiative Pioneering Impact

2011–2016





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## LETTER FROM THE GLOBAL DIRECTOR

Over the last 10 years, the Caterpillar Foundation's support has been vital in helping pioneer the transportation work of EMBARQ and its expansion into the WRI Ross Center for Sustainable Cities (the Center). Throughout this partnership, Caterpillar Foundation supported WRI to develop innovative approaches and solutions to address some of the world's most pressing challenges—congestion, sprawl and energy inefficiency. The results of our work have put cities on a path to lasting change.

The Sustainable and Livable Cities Initiative, made possible by an investment from the Caterpillar Foundation, is a series of projects of the Center that address climate, energy, transport and water issues in China, India and Brazil. The Initiative projects created better access to transit for the disabled in Brazil, made bus operators in India better-equipped to manage efficient and sustainable bus systems and introduced best practices on increasing water supply and improving air quality with decision-makers in China. Cities worldwide are also able to calculate their carbon dioxide emissions consistently.

This pioneering Initiative tackled challenges and opportunities in cities, disseminated solutions to policy-makers and showed that making cities more sustainable improves life for the people who live in them. Now more than ever, cities are central to sustainable development, climate change and economic growth, with city dwellers' needs and solutions taking center stage. At the same moment

that urban leaders and planners are moving to make the use of water, energy, climate and transport more sustainable, they are also working to create livable, healthy, dynamic cities that will draw and keep talented people. Recognizing the critical link between a city's quality of life and its economic competitiveness, city leaders also know that curbing climate change demands low-carbon mobility and cleaner energy. That's why cities are helping to drive this transformation.

Building on the success of the Initiative, the Center is exploring new areas of work, including gender, water risk management and new mobility, and developed tools to help cities reduce carbon emissions. Moving forward, the Center is looking to scale these solutions beyond China, India and Brazil to new geographies such as Africa.

This report details key outcomes from the Sustainable and Livable Cities Initiative in the last five years. We thank the Caterpillar Foundation, whose generous support made these important results possible.



A handwritten signature in black ink, reading "Ani Dasgupta". The signature is fluid and cursive, with the first name "Ani" and last name "Dasgupta" clearly distinguishable.

**Ani Dasgupta**

Global Director  
WRI Ross Center for  
Sustainable Cities

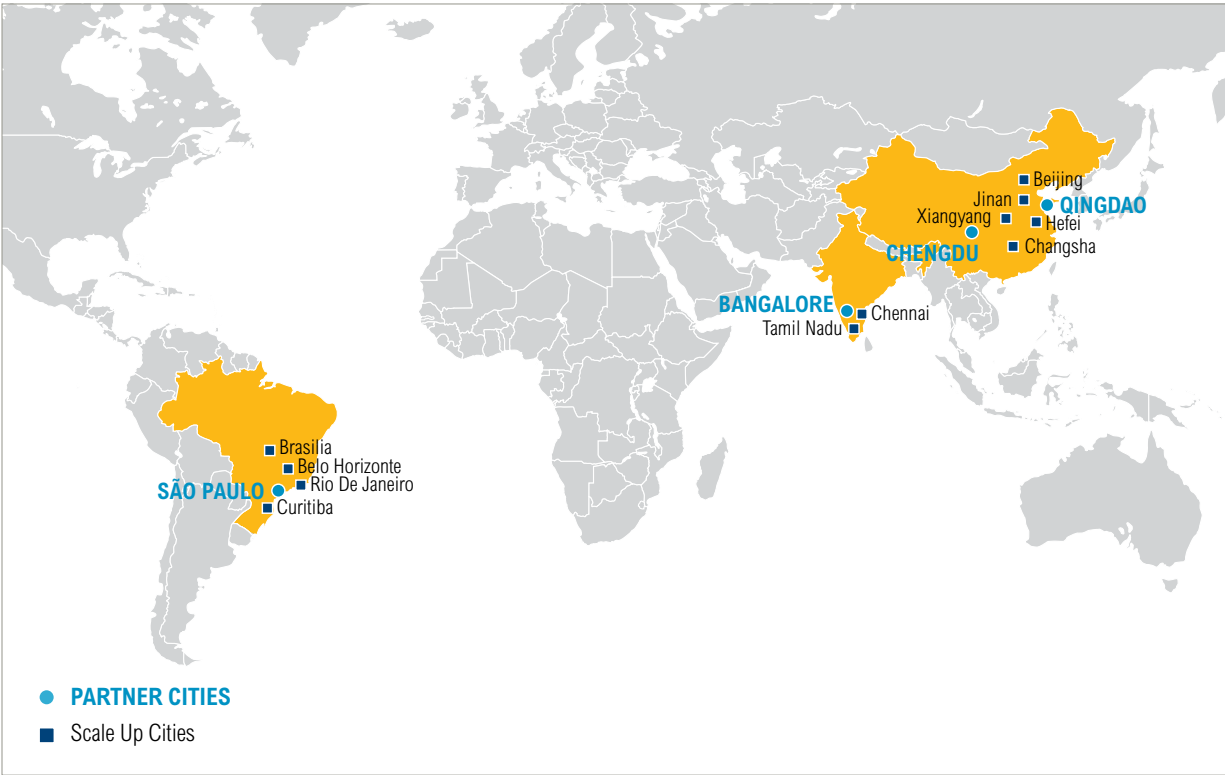
# ABOUT THE SUSTAINABLE AND LIVABLE CITIES INITIATIVE

The Sustainable and Livable Cities Initiative has enabled the WRI Ross Center for Sustainable Cities to support key leaders in China, India and Brazil to make informed decisions that improve urban quality of life and environmental sustainability. Through pilot projects, the development of new research and tools, and direct engagement with governments, this work, which was made possible by support from the Caterpillar Foundation, has achieved substantial on-the-ground impact.

From its inception in 2011 through 2016, the Sustainable and Livable Cities Initiative has helped cities avoid 1.4 billion metric tons of greenhouse gas emissions and

saved 8.1 million metric tons of energy, directly improved 1.2 billion trips, saved 99 million hours of travel time and helped cities leverage \$3.03 billion of investment.

TABLE 1 | CITIES IMPACTED BY THE SUSTAINABLE AND LIVABLE CITIES INITIATIVE



The Initiative develops solutions in four key sectors: CLIMATE, ENERGY, TRANSPORT and WATER. The Center provided the policy analysis, evidence and tools to help cities make informed decisions and implement lasting impacts.

**ON CLIMATE**, the Center helped over 500 cities around the globe take stock of their greenhouse gas emissions. In fast-growing Chengdu, home to 14 million people, city leaders used tools developed through the Initiative in setting their goal to avoid 25 million tons of carbon dioxide emissions per year by 2020 and to achieve their peak emission targets by 2025.

**FOR ENERGY**, Indian corporations committed to sourcing 150 megawatts of renewable energy and the Bangalore International Airport will source 40 percent of its electricity from solar energy.

**TRANSPORT** outcomes have improved safety and quality of life in cities. In Bangalore, the BIG Bus Network reform will benefit 2.5 million daily passengers by 2020. Increased accessibility at one metro station in Bangalore benefits more than 100,000 daily passengers and improvements at 12 additional stations are being implemented. Additionally, \$2.6 million was leveraged to increase safety at six junctions and over \$150,000

was invested in 20 neighborhood improvement projects in Bangalore. In Chengdu, improvements made to mitigate transport emissions will help commuters save 10.8 million hours per year by 2020. Belo Horizonte enacted the first public policy on corporate mobility in Latin America and 30 corporations in five Brazilian cities are implementing measures to improve the sustainability of commutes for 80,000 employees. Additionally, Brazilian cities prioritized low speed zones to improve safety and accessibility.

**ON WATER**, six Chinese cities are creating energy from sludge, benefiting 51.2 million people, eliminating 2.6 million tons of carbon dioxide emissions per year and producing 70 million cubic meters of compressed natural gas. And Qingdao avoided potential health risks for 2 million residents by shifting its desalination plant from residential to industrial users.

For more detail on how we worked to achieve these results, read on.





# CLIMATE

Stabilizing the global climate is the greatest challenge of the 21st century.

Since urban areas are home to half the world's population and generate around 80 percent of global economic output and around 70 percent of greenhouse gas emissions, cities are an essential component in addressing this challenge. By 2030, cities could produce nearly 8 billion metric tons of carbon dioxide annually from buildings and personal vehicle use alone.

The Center aims to help cities reduce their greenhouse gas emissions and vulnerability to climate change impacts, and influence the national and international climate agenda.

The Center advocates for the adoption of global and local strategies that reconcile top-down and bottom-up approaches with specific pilot projects in targeted countries and cities.

By using analysis, innovation and partnerships to influence change, the Sustainable and Livable Cities Initiative helps cities measure, plan and track commitments to low-carbon development. The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) and Low-Carbon Blueprints aid in reaching this goal.



# Global Protocol for Community- Scale Greenhouse Gas Emission Inventories (GPC)

## THE CHALLENGE

Cities represent the single greatest opportunity for tackling climate change. To take effective action, cities need reliable data to measure and track their emissions.

OVER 500 CITIES PLEDGE



TO MEASURE AND MANAGE



**GREENHOUSE  
GAS EMISSIONS**

WITH COMMON STANDARD



## THE SOLUTION

WRI partnered with networks of cities C40 and ICLEI to develop the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) in December 2014. GPC builds on WRI's flagship Greenhouse Gas Protocol to provide a common standard that lets cities accurately and comprehensively measure their emissions, map reduction strategies and track their progress.

In 2012, WRI, C40 and ICLEI launched GPC as a pilot project in 35 cities. Within a year, 60 cities were using the GPC to measure and report city-wide greenhouse gas emissions. Since then, many organizations adopted the GPC standard, including the Compact of Mayors, the World Bank, UN-HABITAT, the Inter-American Development Bank, the British Standards Institution, CDP and others.

## THE IMPACT

More than 500 cities have committed to measure their emissions using the GPC, develop action plans to reduce emissions and publicly report on their progress. These cities are home to more than 400 million people and annually emit nearly 3 billion tons of greenhouse gas emissions—roughly the same as Brazil, France and Germany's total annual emissions combined. As more cities adopt the GPC, the potential impact for curbing climate change will increase.

GPC is the first widely endorsed international standard for cities to measure and report their emissions. The Protocol allows cities to assess what strategies are working and hold themselves accountable for results. Better data can also help to drive investment, providing cities improved access to local and international climate financing. The impact of this landmark tool will continue beyond 2016 as it is an integral part of the Center's body of work.

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“Building a greenhouse gas emissions inventory enables city leaders to manage their emissions reduction efforts, allocate resources and develop comprehensive climate action plans.”

—Eduardo Paes, Mayor of Rio de Janeiro, Chair of C40

# Low-Carbon Blueprint for Chinese Cities

CHENGDU, CITY OF 14 MILLION,



SETS **TARGET TO AVOID**  
**25 MILLION** TONS OF



**GREENHOUSE GAS EMISSIONS**



**PER YEAR BY 2020 AND**  
TO PEAK EMISSIONS **BY 2025**



## THE CHALLENGE

China leads the world in carbon dioxide emissions from fossil fuels and aims to reduce carbon intensity of GDP (from the 2005 level) by 40–45 percent by 2020 and 60–65 percent by 2030. Because cities are the main consumers of energy and sources of greenhouse gas emissions, they are key actors in implementing China's national strategies and policies on climate change and energy. While some cities have developed local frameworks for low-carbon development, many challenges remain in the areas of low carbon planning and implementation.



## THE SOLUTION

The Center developed Low Carbon Development Blueprints for Chengdu and Qingdao, examining their energy consumption and emissions, and analyzing development pathways and scenarios focusing on travel demand management, transit-oriented urban development, and improving energy efficiency for wastewater treatment. The team identified key influential factors of carbon emissions, formulating mid- and long-term low-carbon strategies and short-term plans. The Center used the blueprints to provide recommendations to the National Development and Reform Commission (NDRC) on national guidelines.

## THE IMPACT

Influenced by WRI's Low Carbon Development Blueprints, Chengdu set targets to reach 50 percent mode share of public transit, build 1200 hectares of green space and reduce coal based energy consumption to 19 percent. By 2020, Chengdu will avoid nearly 25 million tons greenhouse gas emissions per year. The city also committed to peak emissions by 2025. Additionally, the NDRC adopted WRI's innovative guidelines in their national regulations, which will exponentially reduce greenhouse gas emissions when implemented.

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“Since 2012, Chengdu Development and Reform Commission has cooperated with WRI on ‘Sustainable and Livable Cities Initiative’ which is supported by Caterpillar Foundation, lifting the curtain on Chengdu’s international cooperation to tackle climate change. We have made great achievements in low-carbon development blueprint and low-carbon community construction and look forward to achieve more fruitful results in follow-up cooperation.”

—Zhu Xiaowen, Deputy Inspector of Chengdu Development and Reform Commission





# ENERGY

Rising world demand for energy makes the need for affordable, sustainable energy increasingly urgent.

The coal, oil and natural gas that fuel most electricity generation produce more than one-third of global greenhouse gas emissions. Generous subsidies continue to support fossil fuel investment, despite growing evidence that clean energy can be lower-risk and often cost less. Energy consumption in cities around the world will grow 73 percent by 2030, causing a 76 percent increase in carbon dioxide emissions.

At the same time, the opportunity to shift global energy systems onto a more sustainable path has never been greater. Citizens are demanding cleaner, more reliable electricity. Governments are searching for low-carbon development options. Renewables like wind and solar are becoming increasingly cost-competitive. Transitioning to a low-carbon electricity system could increase the capacity of the global financial system by as much as \$1.8 trillion between 2015 and 2035.

The Center analyzes the costs, benefits and risks associated with various energy and policy options. It develops innovative approaches to buying, selling and regulating clean electricity. It provides policy recommendations to advance renewable energy, particularly in major emerging economies. And it fosters collaboration among a diverse group of energy stakeholders, including regulators, utilities, businesses, governments and civil society.

The Sustainable and Livable Cities Initiative researches and helps implement best practices of solar photovoltaics (PV) in India and China. The increase in solar PV makes these countries' energy sources cleaner and more diverse and helps fulfill national sustainable energy commitments to combat climate change.

# Solar Solutions in India



CORPORATIONS COMMIT  
TO **150 MEGAWATTS**



OF **RENEWABLE ENERGY**



**BANGALORE AIRPORT**  
TO **GENERATE SOLAR** TO MEET  
**40%** OF ITS ELECTRICITY NEED

SETTING A RECORD FOR THE COUNTRY

## THE CHALLENGE

Bangalore, in the state of Karnataka, suffers from daily brownouts that threaten economic development and undercut quality of life for millions of residents. With the city's population expected to double by 2050, Karnataka's government is expanding and diversifying its electricity supply so it can provide 3 percent of electricity from solar by 2021, and avoid approximately 2.8 million tons of greenhouse gas emissions, a move that has the potential to create more than 18,000 jobs.



## THE SOLUTION

The Center partnered with the Confederation of Indian Industries to launch the Green Power Market Development Group (GPMDG) in Bangalore, a corporate renewable energy “buyers group” dedicated to building corporate demand and markets for renewable power. With WRI’s leadership, GPMDG’s demand for rooftop solar attracted major suppliers in a competitive bid and cultivated political support for distributed solar. A dozen major companies—including Infosys, Coca Cola, ACC, Cognizant, IBM and WIPRO—joined the initiative and committed to explore options to increase their renewable energy use.

GPMDG also provided expert opinion in Karnataka regulatory hearings to support off-site solar procurement. As a result, state regulators exempted solar power producers from grid usage charges for 10 years to encourage solar development and created incentives to support more projects. These changes provided much needed long-term clarity for solar project developers and consumers.

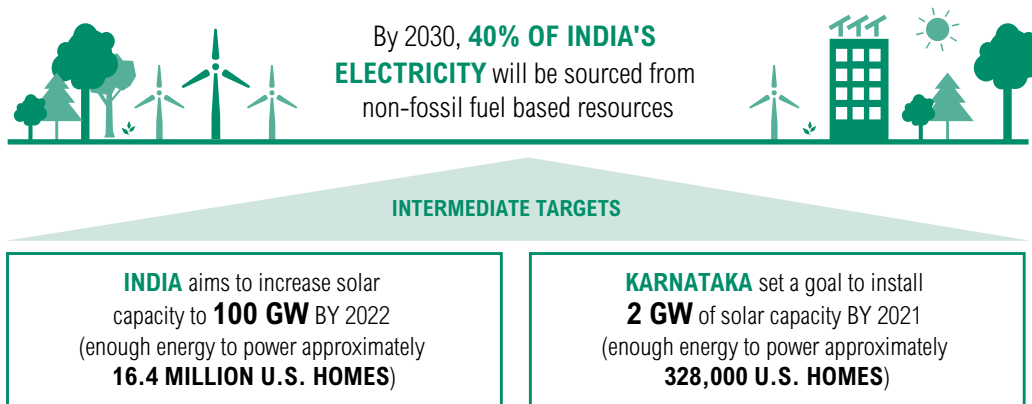
## THE IMPACT

GPMDG members initiated over 150 megawatts of renewable energy procurement. The same model was used in Chennai and could expand to other cities in India, where 400 million residents lack reliable electricity.

As a direct result of Karnataka’s tax breaks for solar development, the Bangalore International Airport will source 40 percent of its electricity from solar energy and generate 14.6 megawatts of solar power, offsetting approximately 17,000 tons of greenhouse gas emissions. This is the largest solar procurement for an airport in India and it serves as a pioneering example for airports worldwide.

The Center and the GPMDG have leveraged additional funding to begin discussions on solar opportunities in Mumbai and Pune.

### SOLAR ENERGY CONTRIBUTES TO INDIA'S NATIONAL AND STATE CLIMATE COMMITMENTS







# TRANSPORT

Transport is at the intersection of many of the world's most pressing issues, from climate change to public health.

Urban populations are soaring, especially in China, India and Brazil, where city populations are expected to expand by 632 million people by 2030. Urban transport constitutes 40 percent of total transport energy consumption and is poised to double by 2050, despite ongoing vehicle technology and fuel-economy improvements. Cities in developing countries are where most of the increase in personal fossil-fueled vehicles is occurring. This increases air pollution, greenhouse gas emissions, traffic injuries and deaths, as well as societal changes including a decrease in residents' levels of healthy physical activity and unequal access to urban opportunities.

Despite these trends, there have been many advances in sustainable mobility worldwide in the areas of public transit and non-motorized facilities, travel demand strategies, cleaner technologies and new forms of mobility, like shared ride services and autonomous vehicles. Well-planned, compact, connected urban environments promote economic growth, improve energy efficiency, curb greenhouse gas

emissions, increase accessibility and enhance public health and safety for urban dwellers.

The Center helps urban leaders go beyond improving the efficiency of existing mobility projects and technologies, to shift motorized trips to more sustainable transport modes and to design and implement high quality transport systems to expand sustainable mobility. It focuses on projects that provide better, safer, cleaner transport for urban populations while also influencing transport demand. The Center's expertise in sustainable mobility provides a foundation for valuable research and practical design that results in the best possible solutions for cities. Effective solutions include safe, high-quality walking, bicycling, and public transit; smart land use that encourages sustainable mobility; cleaner fuels and vehicles; and supportive international and national policies that deliver finance and ensure a balanced transport system.

The Sustainable and Livable Cities Initiative helps implement best practices for transport in India, China, and Brazil.



# Bangalore's BIG Bus Network

 **INDIA'S LARGEST**  
**BUS SERVICE REFORM**

WILL IMPROVE MOBILITY FOR  
**2.5 MILLION PASSENGERS**

— DAILY BY 2020 —



## THE CHALLENGE

As India's third-largest city, Bangalore is home to approximately 8.75 million people. While often cited as a positive example of modern development, the city has been struggling with some of the consequences of fast growth: rapid motorization has increased traffic congestion, made commutes longer and contributed to poor air quality.

The Bangalore Metropolitan Transport Corporation (BMTC) is the city's sole provider of public bus-based transport services. As one of the largest public transport operators in India, BMTC's fleet of 6,700 buses carries around 5.2 million passenger trips daily, accounting for 42 percent of all motorized trips in the city.



## THE SOLUTION

The Center helped the BMTC conceptualize, plan and implement the Bangalore Intra-city Grid (BIG) Bus Network, a city-wide, high-frequency integrated transport system organized around arterial corridors that is providing significant improvements in quality and capacity. The reform also created suburban feeder routes, which connect peripheral destinations to the BIG Bus Network. Additionally, the team drafted a financial proposal to the state government to fund the purchase of new buses, leveraging a total of \$100 million for fleet renewal.

## THE IMPACT

Bangalore implemented four of the twelve planned arterial corridors of their city-wide bus network, and two additional corridors will be in operation by the end of 2016. The implemented corridors serve 490,000 passengers daily and 147 million passengers annually, and save them 24.5 million commuting hours each year. When fully implemented across the city, the BIG Bus Network will benefit 2.5 million passengers daily by 2020.

Other Indian cities are taking note of this enterprising project and its important impacts. Chennai's Metropolitan Transport Commission has implemented the Center's recommendations for efficient route planning on a major arterial corridor, which improved service and resulted in a 6 percent rise in ridership, along with an 11.7 percent jump in revenue collection. Ahmedabad, Chennai, Delhi and Mumbai are planning improvements to the efficiency and quality of public transport services along major roads.

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“This has affected my productivity and general well-being in a positive way. People around my home are very positive about the BIG Bus Network and my relatives often talk about it. When someone gets a service extended to where they live, they get a sense of pride and happiness. It really feels good to have an effective and reliable bus service.”

—Akshay Sharma, BIG Bus Network passenger; Tutor of Hindi, math, and science

# Metro Station Accessibility in Bangalore



IMPROVED ACCESSIBILITY AT  
1 STATION BENEFITS MORE THAN  
100,000 DAILY PASSENGERS

IMPROVEMENTS AT **13 STATIONS**



TO BE IMPLEMENTED BY 2020

## THE CHALLENGE

The Namma Metro system in Bangalore provides public transport in an area of the city that anticipates increased density and rapid urban transformation. However, the city needs to improve accessibility and safety around metro stations.



## THE SOLUTION

The Center worked with the government of Karnataka to develop methodologies for designing and implementing public spaces, sidewalks and crosswalks around the Namma Metro stations in Bangalore. Pedestrian surveys revealed that at least 50 percent of the trips originated or terminated at Indiranagar Metro Station and over 75 percent of those surveyed said that either there were no sidewalks or that existing sidewalks were obstructed or in poor condition. The Center's pilot plan was implemented to improve pedestrian accessibility at Indiranagar Metro Station by restricting motor vehicle access along feeder roads, providing safe pedestrian walkways and cycle paths and creating an integrated hub with multiple transport modes. These improvements benefit more than 100,000 passengers daily.

## THE IMPACT

Based on the success of Indiranagar Station, Karnataka's government secured \$15 million for accessibility plans and their implementation. At the transport authority's request, the Center developed accessibility plans for 12 additional stations, which will be implemented by 2020 and further scaled up across all 40 metro stations. The team is also working with Bangalore to create regulations that integrate land use and transport and incorporate safe access methodologies into the Master Plan.

This project prompted the Center to launch the Safe Access Manual, which recommends strategies to develop safe access to mass transit stations. The manual has triggered a series of discussions, activities and interactive workshops in Bangalore, Delhi and Kochi on collaborative planning and decision-making. The station accessibility project has the potential to be adopted in Chennai and Hyderabad.

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“In the face of rapid urbanization, cities like Bangalore are recognizing the need to invest in high quality mass transit systems to meet the increasing transport demand. While this is good, it is important for us to think comprehensively about mass transit station areas, and ensure connectivity so that commuter experience can be made safer and more convenient.”

—V. Manjula, Commissioner, Directorate of Urban and Land Transport, Urban Development Department, Government of Karnataka



# Improving Neighborhoods through Community Partnerships

**\$ 2.6 MILLION INVESTED**

TO IMPROVE SAFETY AT **SIX JUNCTIONS**



AND OVER  
**\$150,000** LEVERAGED

FOR **20 BANGALORE**  
NEIGHBORHOODS

## THE CHALLENGE

Over the last 30 years, Bangalore has built wider roads and highway overpasses to accommodate increased motor vehicle traffic that moves at higher speeds. This approach has been unsafe for pedestrians and the city now has the sixth-worst traffic jams in the world.



## THE SOLUTION

The Center is working with Bangalore's municipal corporation on the Hosur Sarjapur Road (HSR) Neighborhood Improvement Plan to help design infrastructure enhancements and mobility solutions. The HSR neighborhood is a rapidly developing, 5 square kilometer area in Bangalore with a high-speed, trafficked corridor that connects to one of India's largest electronic industrial parks. Six key junctions were identified for redesign to help prevent accidents and improve safety for pedestrians and cyclists.

Based on the success of the HSR Plan, the Center helped launch the collaborative Neighborhood Improvement Partnership (NIP) Challenge, which called for local resident welfare associations and citizen groups throughout Bangalore to submit ideas to transform their neighborhoods. Eleven winning projects were selected to improve 20 city neighborhoods and the team provided technical support to improve the quality of the winning plans.

## THE IMPACT

The government of Karnataka invested \$2.6 million to improve safety at six junctions in the HSR neighborhood. Additionally, the city introduced a feeder bus system with daily ridership of 20,000 and developed 14 km of bicycle paths with daily ridership of 2,000. The city's investment will make urban life safer and more sustainable for 75,000 people.

In addition to implementation grants awarded to the 11 winning projects, the Center leveraged an additional \$153,000 from United Technologies Corporations to engage citizens and implement neighborhood strategies to make Bangalore communities more sustainable. With WRI's help, community members are learning how to identify neighborhood problems, understand best practices for solutions, work with local municipal corporations and leverage finance to implement projects.

My vision is to make HSR ward one of the best places to live in Bangalore. To achieve this, I would like to introduce the “Namma HSR, Namma Neighbourhood” (Our HSR, Our neighbourhood) program, which will essentially be a neighbourhood improvement plan (NIP) for the HSR layout. This project has been under development for some time and once completed, will stand as an exercise and a program that probably will be the first of its kind in this city.

I am sure the efforts [of the team of partners] will prove to be exemplary in neighbourhood practices in sustainability, and result in an improved quality of life for everyone.”

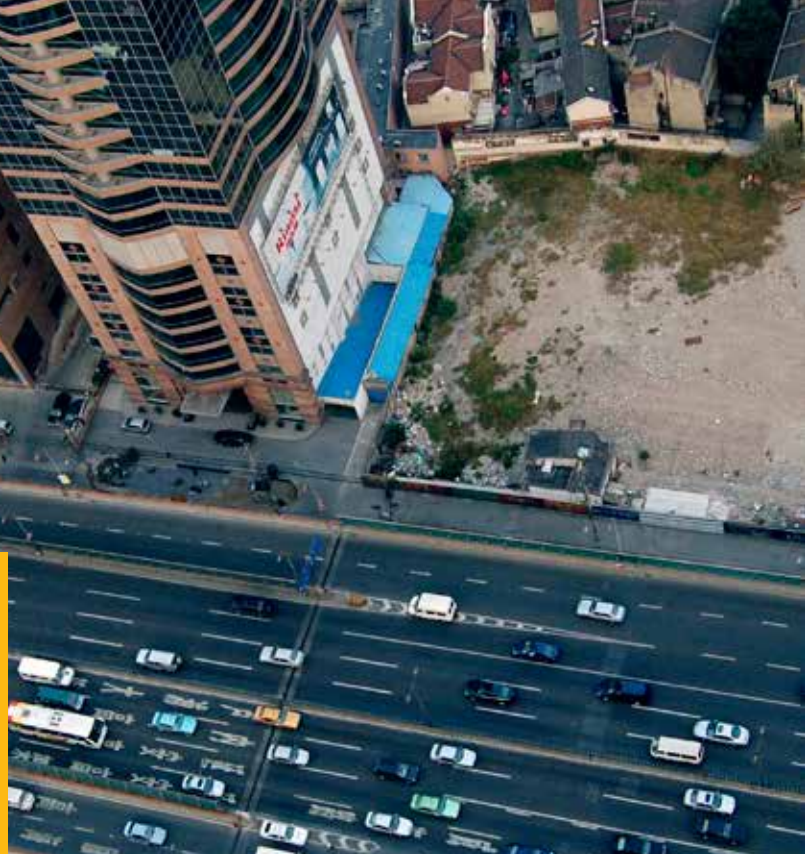
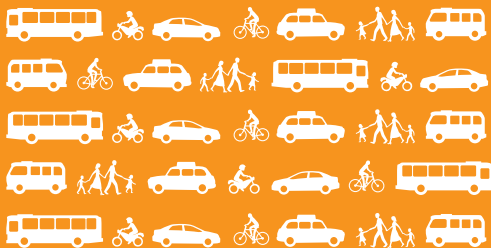
—Latha Narasimhamurthy, Corporator, HSR ward

# Transport Emissions in Chengdu



COMMUTERS WILL SAVE  
**10.8 MILLION HOURS**

PER YEAR **BY 2020**



## THE CHALLENGE

Due to rapid urbanization and motorization in Chinese cities, transport is becoming a major source of air pollution and climate-warming emissions. In the largest Chinese cities, transport is estimated to contribute about 15 to 35 percent of local fine particulate matter in urban areas, in addition to carbon dioxide and other pollutants. Air pollution had a \$1.4 trillion impact on human health in 2010; more than \$200 billion of that was from the transport sector, and the numbers have climbed since then. The solution is to introduce policies that cut transport emissions, but before doing that, it's important to measure current emissions and assess impact costs. However, many developing countries lack the capacity to conduct this analysis.



## THE SOLUTION

The Center developed the Transport Emissions & Social Cost Assessment methodology and database tool to estimate transport emissions and evaluate associated social impact costs. The guide and tool are designed for developing cities that lack statistical systems and have poor data availability and quality. With this methodology, the range of social costs for each type of emission can be roughly estimated and decision-makers can create cost-efficient policies and data-driven action plans. The first version of the tool was successfully tested in Chengdu and a case study details the lessons learned from its implementation.

## THE IMPACT

Based on WRI's recommendation, Chengdu is prioritizing emission and congestion reductions and is implementing low-emission zones, parking management policies and traffic restrictions, and developing subway networks to move citizens toward cleaner modes of transport. As a result, Chengdu commuters are expected to save 10.8 million hours per year by 2020.

The Ministry of Transport and China Academy of Transportation Sciences recognized the tool as a best practice, paving the way for further cooperation with WRI to scale its applicability. The Center continues to improve the guide while working with more cities—Qingdao, Suzhou and Harbin—to develop strategies to cut transport emissions.

# Transport Demand Management for Corporate Mobility

 **CORPORATE MOBILITY**  
MEASURES DIRECTLY IMPACT



**80,000**  
EMPLOYEES



**IN 30**  
COMPANIES



**OF FIVE**  
BRAZILIAN  
CITIES

ENABLING **THE FIRST** CORPORATE MOBILITY  
PUBLIC POLICY IN LATIN AMERICA



## THE CHALLENGE

In large Brazilian cities, commuting to work represents up to 60 percent of daily trips. The time spent commuting constitutes 10-15 full days per year per person. The concentration of jobs in certain zones of cities aggravates local congestion and decreases private sector productivity and people's quality of life. Combined with intense use of single occupancy vehicles, this pattern has made Brazilian cities more congested, polluted and with high rates of traffic crashes.



## THE SOLUTION

The Center developed methodological guidelines to diagnose travel patterns of companies' employees and to help them create corporate mobility plans to incentivize workers to change the way they commute. Providing incentives to employees to bike, walk, carpool or take public transit to work can cut business costs and improve workers quality of life.

Transport demand management solutions source from creating public policies, working directly with companies and raising awareness. While working with the private sector can be effective in making commutes more sustainable, implementing corporate mobility strategies is a paradigm change for Brazilian companies. It requires a fundamental shift not only in corporate culture and priorities, but also in government and city policies.

## THE IMPACT

The Center's work on corporate mobility has the potential to influence about 80,000 employees in 30 companies in Brazil. For instance, the state government of Minas Gerais implemented a set of measures to reduce car dependency of its 17,000 employees at the state's main administrative office 20 km from downtown Belo Horizonte.

Additionally, the Belo Horizonte municipality used the Center's guideline to create the first corporate mobility public policy in Latin America. The policy encourages large companies to implement corporate mobility plans as a counter measure for the transportation demand they generate. This pioneering policy is an example for other Brazilian cities.

The Center also developed projects in São Paulo, Rio de Janeiro, Curitiba, Porto Alegre and Joinville, and continues efforts to make commutes more sustainable.

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“Our goal is to improve our employee's quality of life through the reduction of car use, to encourage carpooling, the use of bicycles and public transport. The orientations that we received from WRI were fundamental and we want to go even deeper with this project.”

—Beatriz de Souza Santa Rita, Manager of the More Mobility Program, Paraná Federation of Industries

# Safer, more accessible cities in Brazil



**LOW SPEED ZONES**

BECOME **TOP PRIORITY**



FOR **BRAZILIAN CITIES**



## THE CHALLENGE

Brazil's urban development pattern has prioritized the use of private vehicles for decades, leading to cities that are car-oriented and lack proper infrastructure for pedestrians, cyclists and public transport. As a result, citizens face problems including congestion, health complications associated with poor air quality, a lack of physical activity and traffic fatalities.



## THE SOLUTION

To create an accessible, sustainable and inclusive city, the municipal governments of São Paulo, Belo Horizonte and other cities are committed to implementing low speed zones and stimulating the use of non-motorized transport. Low speed zones foster best practices in urban design, including improved sidewalks, pedestrian crossings, infrastructure for bicycles and traffic calming measures.

The Center organized a design contest to engage civil society in improving accessibility at transit hubs in São Paulo. Based on the success of this pilot effort, the contest was scaled to Belo Horizonte and launched for a second year in São Paulo. The team conducted an accessibility diagnosis of the low-speed areas in São Paulo and Belo Horizonte, and developed design strategies that were used as reference by the competitors in proposing their concepts. The winners were rewarded with a study trip to learn about the implementation of accessibility solutions in Mexico City.

## THE IMPACT

São Paulo and Belo Horizonte are improving accessibility and implementing low speed areas. Design measures from the winning proposals will be applied to redesign ten additional low speed zones in the cities. The public contests were recognized as a good policy to engage local architects, engineers and civil society in developing mobility solutions within city neighborhoods.

The Center's accessibility work in São Paulo and Belo Horizonte has caught the attention of Brazil's National Front of Mayors, an organization of 395 mayors that represent 60 percent of Brazil's population and 75 percent of the national GDP. Through a partnership with the mayors group, the Center will help mayors advance sustainable and climate-oriented city agendas.

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“The participation of people with physical disability in discussions on urban planning must be stimulated. Being part of the Accessibility for All Contest was an opportunity to promote the universal design practice among new projects and to stimulate conversations about that between architects, engineers and civil society. Universal accessibility must be in project's essence, not in later adaptations.”

—Marcelo Pinto Guimarães, Architect, PhD in  
Design, Professor at Federal University of Minas Gerais





# WATER

Water scarcity challenges industries around the world.

Water scarcity challenges industries around the world. Global population growth and economic development suggest a future of increased demand, competition and cost for limited water supplies. This creates new challenges for energy supply because coal, oil, gas and electricity production are all extremely thirsty processes. At the same time, many countries will need more power for energy-intensive water treatment options, such as desalination, to meet their growing water demand. And that could increase greenhouse gas emissions.

The Center believes equitable, sustainable water management is key to global well-being. Every city dweller on earth depends on clean freshwater for food, energy,

commerce and daily survival. Access to better information to understand water challenges is the first step toward addressing this urgent challenge. Because cities consume 28 percent of all water and 70 percent of all energy used globally every year, cities must be part of the solution to the problem of water scarcity.

Based on economic analyses on water stress tradeoffs among key sectors, the Center advises decision-makers on the latest solutions to water-related issues. Through the Sustainable and Livable Cities Initiative, the Center uses data-driven analysis to help cities find new ways to derive energy from wastewater and to improve the safety of desalination practices.



WATER

# Making Energy from Sludge for Chinese Cities

## NEW SYSTEMS IN **SIX CITIES** WILL BENEFIT



**51.2 MILLION** PEOPLE



HELP ELIMINATE **2.6 MILLION**  
**TONS OF GREENHOUSE GAS**  
EMISSIONS PER YEAR AND



PRODUCE AN ADDED **70**  
**MILLION** CUBIC METERS OF  
COMPRESSED NATURAL GAS

## THE CHALLENGE

Pervasive air pollution and other problems related to polluting emissions prompted China's commitment to increase the share of energy from non-fossil fuels to 20 percent of the national energy supply by 2030.



## THE SOLUTION

The Center piloted its new Environment-Energy-Economic evaluation framework in Xiangyang, China and found that turning sludge into energy can reduce solid waste, greenhouse gases and water pollution while saving money. Wastewater treatment facilities that turn sludge into energy benefit from an immediate source of clean natural gas and new revenue opportunities, such as selling fertilizer, biochar and extra energy back to the grid.

The Center's technical recommendations gave China's government science-based confidence to promote sludge-to-energy systems in other cities. The team worked closely with authorities to present the benefits of sludge-to-energy systems at local, national and international events, and hosted Chinese city government officials on a U.S. study tour. City managers are beginning to view sludge as a resource that can be part of low-carbon development plans, rather than solely a waste product. As a result, six large cities in China—Beijing, Changsha, Chengdu, Hefei, Jingmen and Shenzhen—are planning or installing sludge-to-energy systems, which will benefit 51.2 million people. Chengdu alone included five plants in its latest Five-Year Plan.

## THE IMPACT

The Center estimates that these new plants collectively can help reduce 2.6 million tons of carbon dioxide emissions per year, which is more than the emissions produced each day by all the cars on U.S. roads. Wastewater treatment in China produced more than 30 million tons of sludge in 2015. Turning 10 percent of that sludge into energy could reduce carbon dioxide emissions by 380 million tons annually. Additionally, the plants are expected to produce nearly 70 million cubic meters of compressed natural gas for taxis and city buses—enough to fill the tanks of 3.5 million cars—while also powering the sludge disposal systems themselves.

In addition to sludge-to-energy systems, China created a national pilot program for 100 cities to convert kitchen waste to energy. The Center is influencing 83 of the cities, which generate 16,000 tons of kitchen waste daily. All 83 cities aim to have waste-to-energy plants in operation by 2020, which will reduce 5.6 million tons of carbon dioxide emissions per year and produce 150 million cubic meters of compressed natural gas annually.

The Center is working with the World Bank and the U.S. Environmental Protection Agency to promote waste-to-energy systems globally, presenting an opportunity for hundreds of cities and serving as a pioneering, world-class example of technological innovation, environmental sustainability and sound economics.

# Desalination Development in Qingdao, China



**QINGDAO AVOIDED  
POTENTIAL HEALTH RISKS**

**FOR 2 MILLION RESIDENTS**  
BY SHIFTING ITS  
**DESALINATION PLANT FROM**



RESIDENTIAL



INDUSTRIAL  
USE



## THE CHALLENGE

In fast-urbanizing China, nearly 90 percent of coastal cities face some degree of water scarcity and roughly 300 million rural residents lack access to clean water. To provide water, the Chinese government has turned to desalination, aiming to quadruple its daily production of desalinated water by 2020, from 0.77 million to 3 million cubic meters. But the desalination process requires major capital expenditures, high operational cost and is highly energy intensive.



## THE SOLUTION

To address water scarcity in Qingdao, where per capita water availability is only 12 percent of the national average, a desalination plant with a daily capacity of 400,000 cubic meters was built to provide drinking water to residents.

During the early operations of the plant, the Center analyzed the energy requirements, operating costs, and risks of producing drinking water from various sources in Qingdao, including desalination. The analysis found that the city's antiquated water pipes lacked anti-corrosive properties, posing a potential risk to residents' health.

The Center's water-energy nexus analysis helped Qingdao better understand the high energy requirement, costs and emissions of desalination, as well as the associated risks and alternative solutions.

## THE IMPACT

Qingdao changed the end users of the desalinated water from residents to industries. The change avoided potential health risks for approximately 2 million people. This was critical to protect the safety of the municipal water supply as well as planning sustainable water resource allocation. The Center continues to engage with provincial and local governments to influence their water resource planning and desalination policies.

## MEASURING IMPACT AND EFFECTIVENESS

### Key Performance Indicators (KPIs)

The Center uses Key Performance Indicators (KPIs) to accurately track the collective impact of our projects. KPIs enable us to measure how our work has improved human wellbeing and encourage a streamlined and effective approach to project planning that has resulted in the successful growth of our organization and

impact. The Sustainable and Livable Cities Initiative established goals to be achieved between 2011-2020. This table indicates the Center's progress toward these goals during the 5-year Initiative (2011-2016) and projected cumulative impact (2011-2020).

TABLE 2 | KEY PERFORMANCE INDICATORS

KEY PERFORMANCE INDICATORS	2011–2020 GOALS	2011–2016 ACTUALS	2011-2020 PROJECTED TOTALS
<b>CO<sub>2</sub>e Avoided (tonnes)</b>	705,000	1.4 billion	3.64 billion
<b>Energy Consumption Saved (tce)</b>	26.1 million	8.1 million	55 million
<b>Trips Served</b>	3.89 billion	1.2 billion	7.43 billion
<b>Travel Time Savings (hours)</b>	1.61 billion	99 million	1.04 billion
<b>Investment Leveraged (USD)</b>	\$352 million	\$3.036 billion	\$3.36 billion
<b>Water Consumption<sup>1</sup></b>	-10%	-6%	-10%
<b>Energy Reduction<sup>2</sup></b>	-10%	-6%	-10%
<b>Renewable Energy (MWh)</b>	30 million	1.2 million	14 million

Notes

<sup>1</sup> Per 10,000 yuan of GDP from 2010 levels

<sup>2</sup> Per cubic meter of water produced/wastewater treated 2010 levels

## ABOUT WRI ROSS CENTER FOR SUSTAINABLE CITIES

By 2019, the WRI Ross Center for Sustainable Cities will influence 200+ cities to implement solutions that address congestion, sprawl and inefficiencies in energy systems—three urban challenges that have the greatest potential to lock in unsustainable pathways. In collaboration with public decision-makers, investors and private solution providers, the Center aims to mainstream the concept of compact, connected, and coordinated urbanization—showing this model can ensure more competitive cities and provide a better quality of life for all.

The Center takes an integrated and strategic planning approach to sustainable urbanization in Brazil, China, India, Mexico and Turkey. The team draws on a set of solutions for buildings efficiency, urban planning, energy, water, governance, transport and road safety, helping cities to develop holistic approaches.

To learn more, **visit [www.wrirosscities.org](http://www.wrirosscities.org)**.

## ABOUT CATERPILLAR FOUNDATION

Founded in 1952, Caterpillar's philanthropic organization, the Caterpillar Foundation has contributed more than \$650 million to help make sustainable progress possible around the world by providing program support in the areas of environmental sustainability, access to education and basic human needs.

To learn more about the global impact of the Caterpillar Foundation, please **visit [togetherstronger.com](http://togetherstronger.com)**.

To learn more about the Sustainable and Livable Cities Initiative, **visit: [www.wrirosscities.org/pioneer](http://www.wrirosscities.org/pioneer)**.

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