Wilson Center

INSIGHT OUT

Expert Voices on China's Energy and Environmental Challenges

Breaking Out of the Dome

Can Energy Efficiency Help Chinese Cities Conquer Air Pollution Choke Points?

3 January 2016

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Can Energy Efficiency Help Chinese Cities Conquer Air Pollution Choke Points?

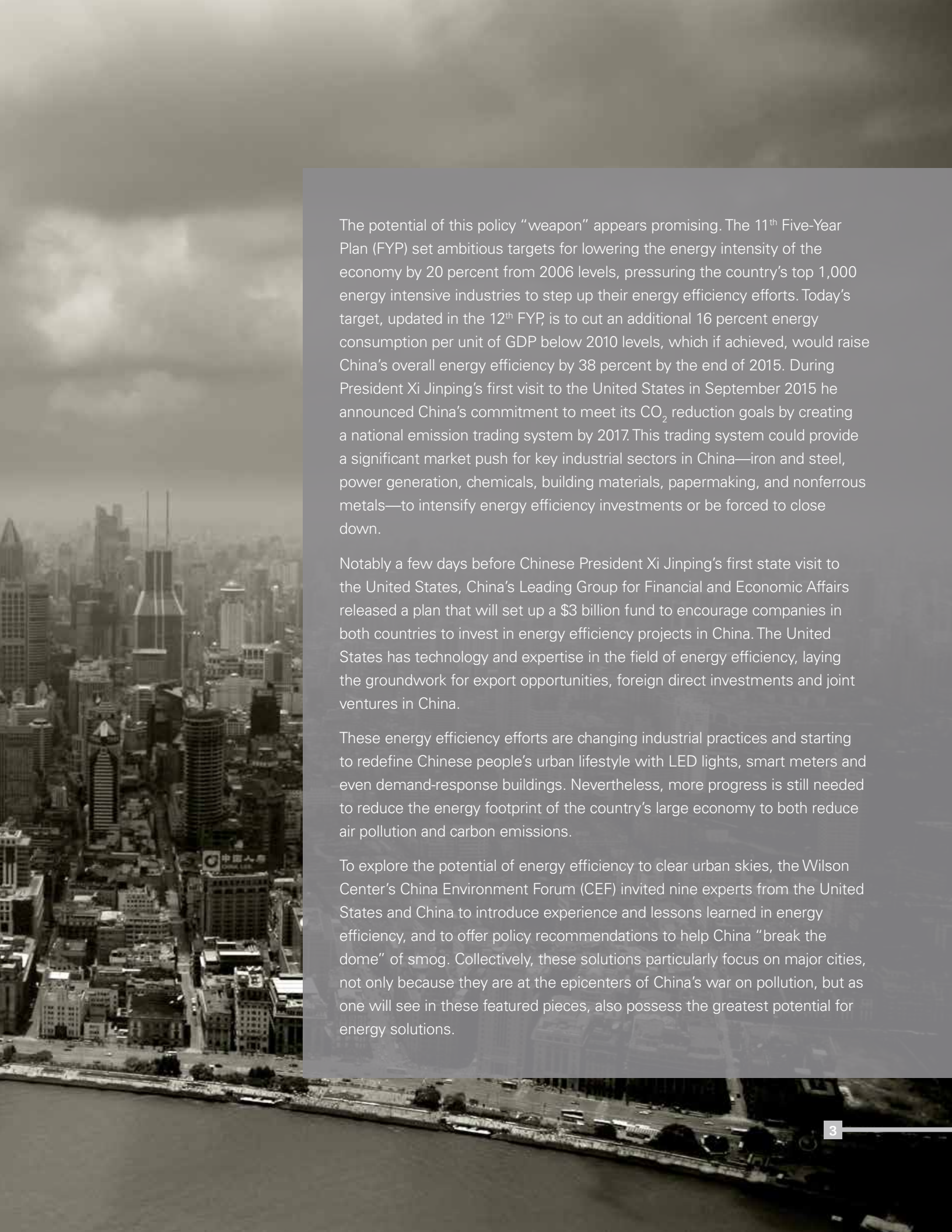
By Managing Editor, Qinnan (Sharon) Zhou

Cities, crowded with skyscrapers, vehicles and industrial parks, are at the heart of China's economic boom and also home to over 700 million people. However, many of these powerhouse cities are choked by air pollution so severe that even the mayor of Beijing recently called his city "unlivable." Chai Jing, a former China Central Television host whose February 2015 documentary on China's urban air pollution triggered a charged national conversation on coal, cars, and poor environmental enforcement aptly described the country as trapped "under the dome" of smog.

The growing frequency of "airpocolypse" events in Chinese cities prompted the State Council to issue an *Air Pollution Action Plan* in September 2013. The *Plan* included aggressive targets to reduce small particulate matter emissions ($PM_{2.5}$) through halting construction of new coal-fired power plants in several eastern Chinese cities, reducing cars on the road, cutting the number of energy-intensive iron and steelmaking, and scaling up renewable energy. The August 2015 amendments to the *Air Pollution Control Law* mandated higher penalties for polluters and more stringent requirements for emissions monitoring, both of which aim to create greater pressure on local officials to meet $PM_{2.5}$ reduction targets.

Despite these efforts, many cities are still shrouded in smog as it takes time for politically weak and underfunded Ministry of Environmental Protection and its local bureaus to bring these policies fully into force. Notably, Premier Li Keqiang—who in 2014 declared a "war on pollution"—stressed at the 2015 National People's Congress (NPC) that the government is committed to intensifying improvements in energy efficiency as another key strategy to help clear the air.

Insight Out is designed to tap on-the-ground expertise to understand the complex energy and environmental challenges facing China. As with much of our work, we cast an eye on opportunities for collaboration between American and Chinese researchers, business, NGOs, and governments.



The potential of this policy "weapon" appears promising. The 11th Five-Year Plan (FYP) set ambitious targets for lowering the energy intensity of the economy by 20 percent from 2006 levels, pressuring the country's top 1,000 energy intensive industries to step up their energy efficiency efforts. Today's target, updated in the 12th FYP, is to cut an additional 16 percent energy consumption per unit of GDP below 2010 levels, which if achieved, would raise China's overall energy efficiency by 38 percent by the end of 2015. During President Xi Jinping's first visit to the United States in September 2015 he announced China's commitment to meet its CO_2 reduction goals by creating a national emission trading system by 2017. This trading system could provide a significant market push for key industrial sectors in China—iron and steel, power generation, chemicals, building materials, papermaking, and nonferrous metals—to intensify energy efficiency investments or be forced to close down.

Notably a few days before Chinese President Xi Jinping's first state visit to the United States, China's Leading Group for Financial and Economic Affairs released a plan that will set up a $3 billion fund to encourage companies in both countries to invest in energy efficiency projects in China. The United States has technology and expertise in the field of energy efficiency, laying the groundwork for export opportunities, foreign direct investments and joint ventures in China.

These energy efficiency efforts are changing industrial practices and starting to redefine Chinese people's urban lifestyle with LED lights, smart meters and even demand-response buildings. Nevertheless, more progress is still needed to reduce the energy footprint of the country's large economy to both reduce air pollution and carbon emissions.

To explore the potential of energy efficiency to clear urban skies, the Wilson Center's China Environment Forum (CEF) invited nine experts from the United States and China to introduce experience and lessons learned in energy efficiency, and to offer policy recommendations to help China "break the dome" of smog. Collectively, these solutions particularly focus on major cities, not only because they are at the epicenters of China's war on pollution, but as one will see in these featured pieces, also possess the greatest potential for energy solutions.

Fran Schulberg, Winston Gilcrease, Sara Chun and **Julia Beabout** from the China-US Energy Efficiency Alliance begin with an introduction of China's air pollution-led urban health crises and illustrate the energy efficiency solutions adopted by U.S. companies and their Chinese partners to address it. **Hyoungmi Kim**, an energy efficiency and utility policy specialist at the Natural Resources Defense Council (NRDC) Beijing office, discusses the opportunities and challenges faced by China's first demand response pilot project launched in Shanghai two years ago that aims to reduce electricity load on the grid. Then, exploring more solutions, **Judy Li** and **Zhiming Zhang** from NRDC's green building team stress the importance of data transparency in order to improve city buildings' compliance with energy efficiency standards. Finally, the American Council for an Energy-Efficient Economy's **David Ribeiro** and **Michael Jarrett** detail a four-year-old City Energy Efficiency Scorecard system, which through friendly competition, ultimately resulted in two-thirds of surveyed cities committing to greater energy efficiency efforts. The momentum built by the scorecard system could be applicable to Chinese cities to promote energy efficiency.

This is the third issue of CEF's new *InsightOut* series, designed to tap on-the-ground expertise to understand the complex energy and environmental challenges faced by China. As with much of our work, we cast an eye on opportunities for the collaboration between American and Chinese researchers, business, NGOs, and governments.

As Managing Editor of this InsightOut issue I want to give special thanks to the assistant editors: Joyce Tang, Jennifer L. Turner, and Zhou Yang; copy editors: Susan Chan Shifflett and Ilaria Mazzocco; and our fabulous designers: Kathy Butterfield and Angelina Fox.

Energy Efficiency Leading the Charge toward Cleaner Chinese Cities

By Fran Schulberg, Julia Beabout, Sara Chun and Winston Gilcrease

The viral documentary "Under the Dome" that was released in early spring 2015 by a former CCTV broadcaster Chai Jing revealed a deep concern among the Chinese public over the pollution problems plaguing Chinese cities. While aptly identifying coal burning and tail gas as the chief sources of the small particulate ($PM_{2.5}$) pollution and exploring the governance gaps in China, the film did not delve deeply into solutions.

Our prescription is embedded in our name—the China-US Energy Efficiency Alliance. Our years of engaging with businesses and policymakers in China and the United States have demonstrated the great potential that improving energy efficiency could have in reducing China's air pollution.

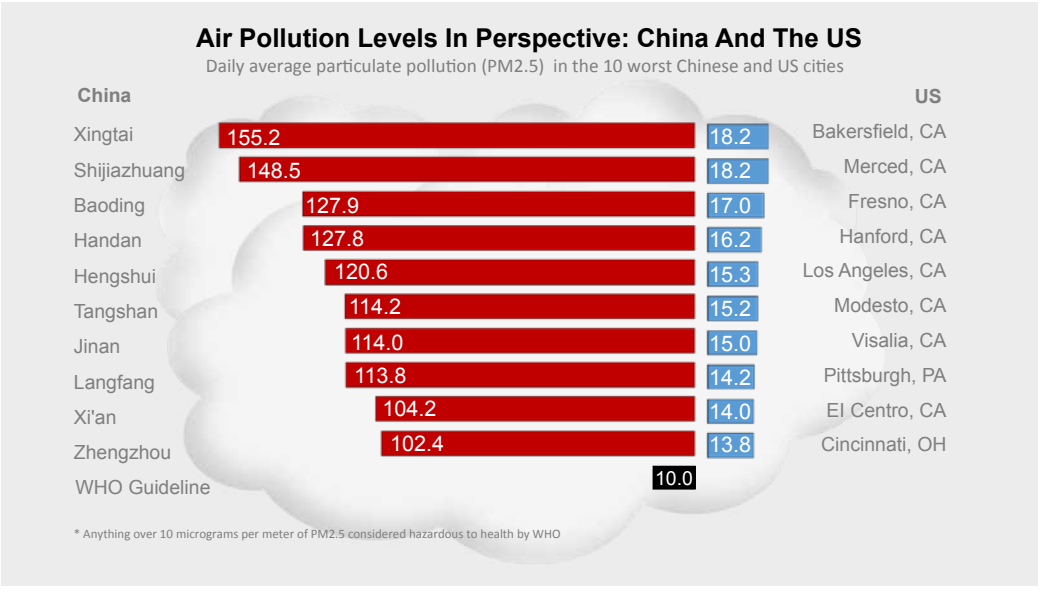
Energy consumption in China, predominantly fueled by coal, increased fivefold over the past three decades. In 2011, China surpassed the United States to become the world's largest energy consumer and emitter of CO_2. Although its per capita energy use is below that of the developed world, China's energy consumption per unit of GDP is well above international standards. This inefficient energy consumption is exacerbating its serious air pollution problems and leading to a severe public health crisis.

Inefficient use of energy in China is exacerbating the country's already serious air pollution from coal-fired power and increasing respiratory and other health problems domestically.

TonyV3112 / Shutterstock.com

THE URBAN HEALTH CRISIS IN CHINESE CITIES

The World Health Organization reports pollution levels over 10 micrograms per cubic meter of $PM_{2.5}$ can be dangerous, causing asthma, cardiovascular disease and cancer. Lung cancer rates attributed to air pollution in China, for example, have risen 50 percent over the past decade and even children are being diagnosed with serious air-borne related illnesses and cancer. Air pollution is directly blamed for a drop in life spans in cities from Shanghai to north of Beijing.



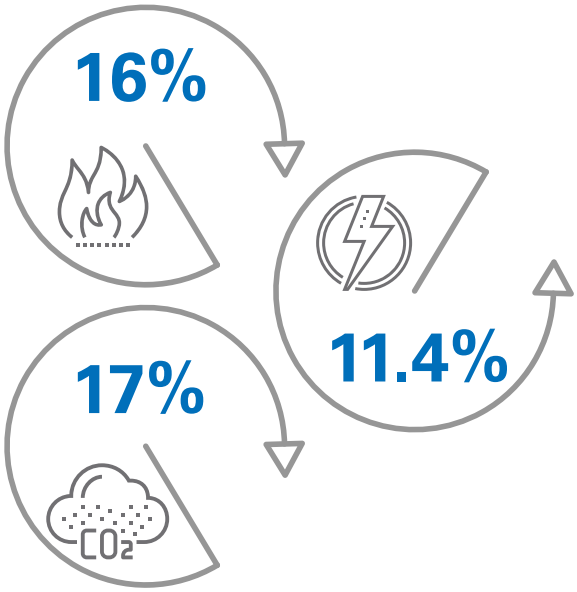
Sources: *Data modified from Forbes infographic (2015)." Air Pollution: Chinese And American Cities In Comparison." http://www.forbes.com/sites/niallmccarthy/2015/01/23/air-pollution-chinese-and-american-cities-in-comparison-infographic/.*

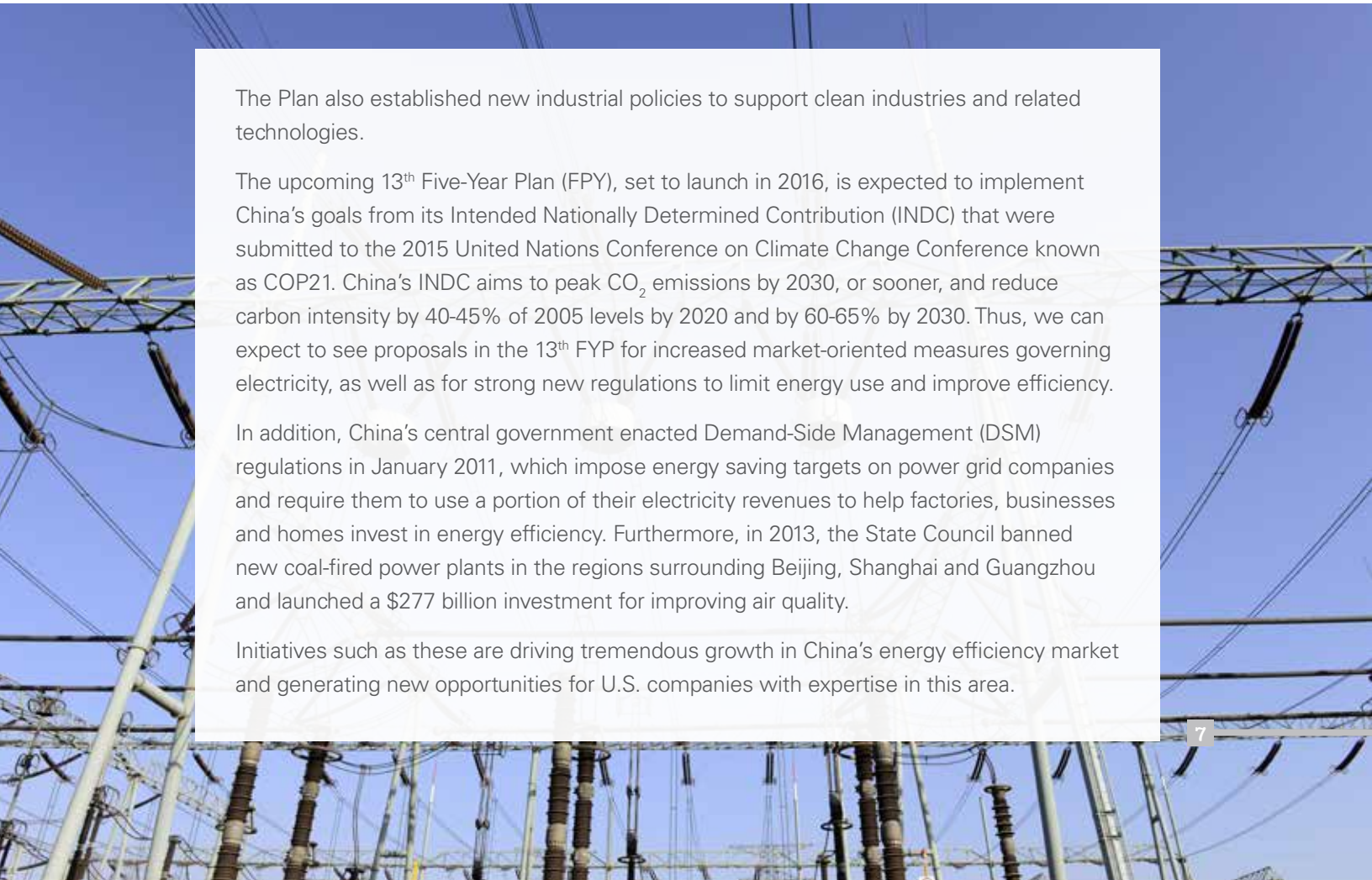
However, with 54 percent of China's total population living in cities, and urbanization continuing to rise, there is huge potential to reduce electricity demand in cities, and thus pollution and emissions, by improving the efficiency of residential and commercial buildings.

AN ENERGY REVOLUTION IN CHINA—EMBRACING ENERGY EFFICIENCY

Over the past few years, China's leadership has re-embraced energy efficiency as an official strategy. For example, the 12th Five-Year Plan (2011 – 2015) aimed to reduce fossil energy consumption, promote low-carbon energy sources, and restructure China's economy. Specifically, the key targets included:

- A **16 percent** reduction in energy intensity by 2015 (energy consumption per unit of GDP).
- An increase of non-fossil energy to **11.4 percent** of total energy use.
- A **17 percent** reduction in carbon intensity (carbon emissions per unit of GDP).





The Plan also established new industrial policies to support clean industries and related technologies.

The upcoming 13th Five-Year Plan (FPY), set to launch in 2016, is expected to implement China's goals from its Intended Nationally Determined Contribution (INDC) that were submitted to the 2015 United Nations Conference on Climate Change Conference known as COP21. China's INDC aims to peak CO_2 emissions by 2030, or sooner, and reduce carbon intensity by 40-45% of 2005 levels by 2020 and by 60-65% by 2030. Thus, we can expect to see proposals in the 13th FYP for increased market-oriented measures governing electricity, as well as for strong new regulations to limit energy use and improve efficiency.

In addition, China's central government enacted Demand-Side Management (DSM) regulations in January 2011, which impose energy saving targets on power grid companies and require them to use a portion of their electricity revenues to help factories, businesses and homes invest in energy efficiency. Furthermore, in 2013, the State Council banned new coal-fired power plants in the regions surrounding Beijing, Shanghai and Guangzhou and launched a $277 billion investment for improving air quality.

Initiatives such as these are driving tremendous growth in China's energy efficiency market and generating new opportunities for U.S. companies with expertise in this area.

U.S.-CHINA ENERGY AND CLIMATE COOPERATION: A PATH TO CLEARER SKIES

As the leading energy consumers and greenhouse gas emitters, China and the United States can mutually benefit from cooperating on issues related to clean energy and energy efficiency. Such initiatives have the double benefit of addressing both climate change and air pollution.

Collaboration between the U.S. and China related to clean energy and climate has accelerated over the past few years at national, as well as at subnational, levels. These collaborative efforts are opening up opportunities for private sector and NGO involvement in furthering energy efficiency. Some relevant national and subnational agreements include:

National Agreements

- On September 25, 2015 during Chinese President Xi Jinping's State Visit to the United States, a **U.S.-China Joint Presidential Statement on Climate Change** was issued. The statement reaffirmed commitments the two presidents made in November 2014 at the Asia Pacific Economic Cooperation (APEC) summit (see below). In addition, China announced its plans to start a national emission trading system to cover heavy polluting industries including iron, steel, power generation, paper, aluminum and chemicals.
- In November 2014 at the APEC summit, both countries committed to cut their CO_2 emissions[1] in the **U.S. and China Clean Energy and Climate Agreement**, which created incentives for accelerated action on energy efficiency. China pledged to reach peak carbon emissions by 2030, if not sooner, and integrate clean energy sources to account for 20 percent of its total energy production by 2030. The U.S. pledged to emit 26% to 28% less carbon in 2025 than it did in 2005.
- April 2013 marked the launch of the **U.S.-China Climate Change Working Group** to identify large-scale, bilateral cooperation opportunities. Energy efficiency in buildings and industry was notably one of the five initiatives the working group agreed to for

collaboration.[2] In September 2015, top level officials from this working group met at the **U.S.-China Climate Leaders Summit in Los Angeles** for the first time to discuss areas of additional cooperation, particularly at city and state levels.

- **The U.S.-China Ten-Year Framework for Cooperation on Energy and Environment,** established in June 2008, aims to foster innovative solutions in seven major areas: air, water, wetlands, nature reserves and protected areas, transportation, electricity, and energy efficiency.

Subnational Agreements

- In September 2015, Sichuan Province signed the **Subnational Global Climate Leadership MOU (Under 2 MOU)** with five U.S. Governors. The Under 2 MOU is an agreement among subnational jurisdictions around the world to limit the increase in global average temperature to below 2 degrees Celsius - the warming threshold at which scientists say there will likely be catastrophic climate disruptions.
- In 2013**,** an **MOU was signed by China and the State of California** which aims to promote low carbon development, improve public health and protect natural resources with strengthened efforts to combat climate change and boost clean and efficient energy.
- In 2012, a first of its kind **MOU was signed by China and the city of San Francisco** which addresses energy efficiency cooperation and, among other things, is intended to help Chinese cities meet their energy conservation goals by leveraging San Francisco's low-carbon urban status.

These and other U.S-China climate and clean energy collaborative activities are not only helping the two countries share best practices on energy efficiency, but also creating opportunities for U.S. businesses.

OPPORTUNITIES FOR U.S. BUSINESSES

While the Chinese government has set very ambitious targets for energy efficiency and clean energy, there is a need for external, technical support. This opens up prospects for U.S. companies to provide services and products to help China achieve their energy efficiency goals and, at the same time, provide significant benefits in terms of greenhouse gas reductions and air pollution mitigation.

As a strategic partner of the U.S. Department of Commerce, the Alliance has facilitated American companies' efforts to enter or expand into the energy efficiency market in China. For example, in December 2014, the Alliance led the organization of the first Commerce Department certified trade mission to China focusing exclusively on companies in the energy efficiency sector.

> President Xi called for an energy revolution, and put energy conservation as the first priority to contain the energy growth in China.
>
> —Deputy Director-General Feng Liang, NDRC's Environment Protection & Resource Conservation Department.

The one-week trade mission was co-organized with ChinaSF and the US-China Clean Tech Center. It focused exclusively on energy efficiency with the aim of helping U.S. companies find and take advantage of business opportunities in order to provide their services, equipment or technology. The companies also had opportunities to meet with central government and local officials, as well as have one-on-one meetings with potential partners and customers.

CHINA-U.S. ENERGY EFFICIENCY ALLIANCE

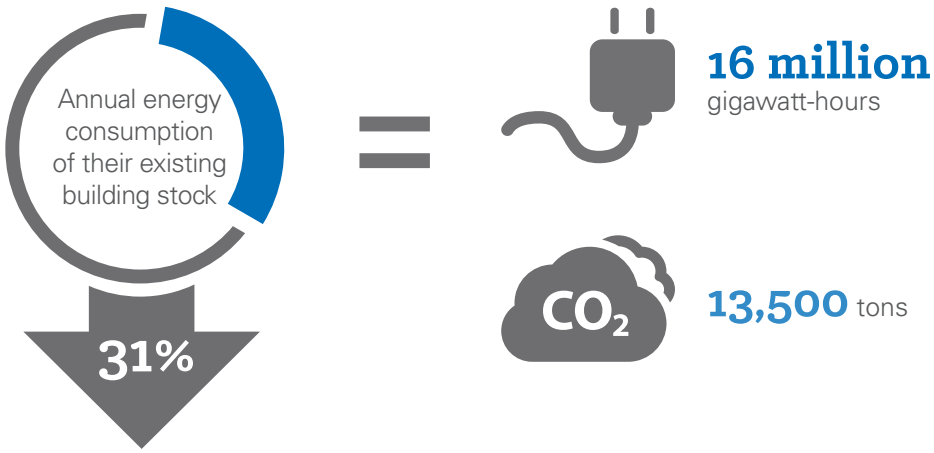
The China-U.S. Energy Efficiency Alliance was established in 2005 as a public-private partnership to support China in developing and implementing policies and programs to improve energy efficiency. Based in San Francisco, the Alliance is well-placed to facilitate technical and policy exchanges between experts from China and California (a leader in energy efficiency) as well as other U.S. states. As an official Strategic Partner of the U.S. Department of Commerce, the Alliance works to increase access to Chinese markets for American businesses that focus on energy efficiency solutions. The Alliance also helps educate the public in the United States about the importance of working with China to address climate change, low carbon development and air pollution. www.chinauseealliance.org

SUSTAINABLE ENERGY BUSINESS DISTRICTS (SEBIZ)

The Sustainable Energy Business District (SEBIZ) project opened up a new door for the trade mission. Prior to the trade mission, the SEBIZ project worked with local Chinese governments and commercial enterprises to identify opportunities for international and domestic businesses to provide efficiency and renewable energy solutions to improve energy efficiency in their existing and future commercial buildings. Optony Inc, a global research and consulting services firm, developed and implemented the SEBIZ model with funding from the U.S. Department of Energy (DOE).

The trade delegation visited two SEBIZ districts. The first was Green Dragon Lake (GDL) located in the southwest corner of Beijing. The GDL developers plan to incorporate innovative energy saving technologies globally to realize the project's net-zero emissions goal. The other district was Wujin Industrial Zone in Changzhou, Jiangsu Province. The SEBIZ team identified retrofit opportunities that could reduce the annual energy consumption of their existing building stock by 31%. This potential electricity reduction is equivalent to 16 million gigawatt-hours and 13,500 tons of CO_2 each year.

The U.S. trade delegation was given the opportunity to introduce their energy efficiency products and services to these potential customers. As a pilot program of the U.S. DOE, the project successfully demonstrated the value and effectiveness of public-private partnerships. The SEBIZ project provided a mechanism for U.S. businesses to identify opportunities in China's energy efficiency and renewable energy market, while helping China address its energy and environmental challenges. With the end of the pilot phase, the Alliance is exploring how the SEBIZ project can continue and expand into other business districts in China.



Endnotes

1 The Obama Administration committed to cut U.S. emissions by 26 to 28 percent from 2005 levels by the year 2025, while China committed to peaking its CO2 emissions around 2030 or earlier, and generating 20% of its total energy supply from non-fossil fuel sources by 2030.

2 The other four included: (1) emission reductions from heavy-duty and other vehicles, (2) smart grids, (3) carbon capture, utilization and storage, and (4) collecting and managing greenhouse gas emission data.

Are Green Buildings All that Green?

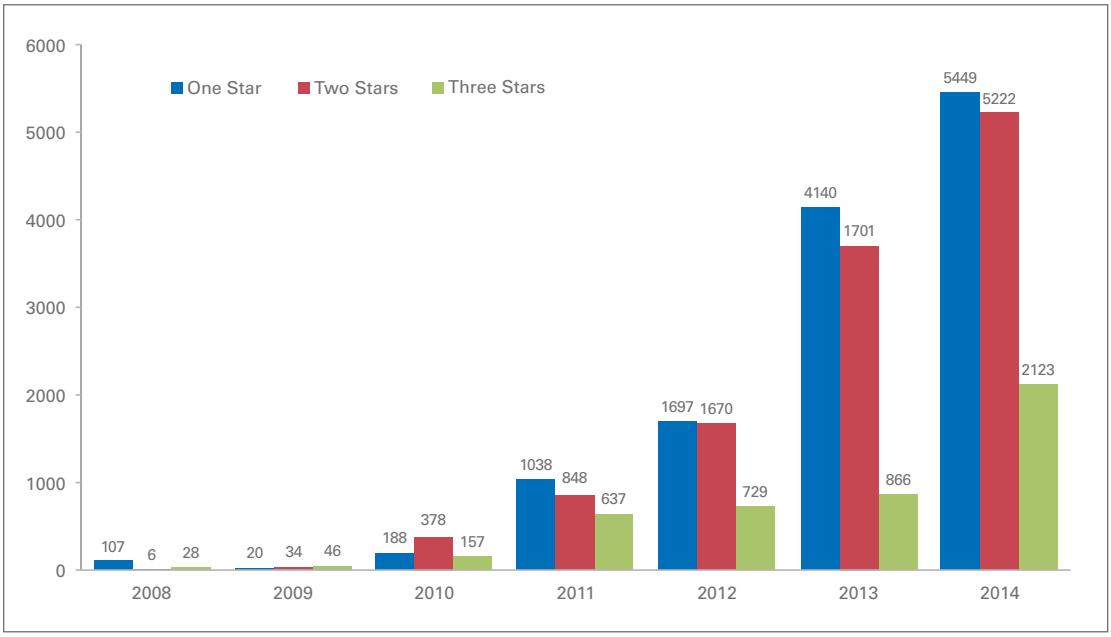
By Judy Li and Pan Zhiming

In China, construction cranes flock from one site to the next at baffling speed and buildings seem to pop up overnight as cities expand upwards and outwards. A jaw-dropping two billion square meters, representing half of the world's new construction, are built in the country each year.

As its rapid urbanization continues, China is projected to construct another 15 billion square meters of new buildings—equivalent to the size of 19 New York Cities combined—over the next 15 years. China's building stock consumes 750 million tons coal equivalent annually, representing more than 20 percent of the country's total energy consumption. In an attempt to curb this huge energy gulp, the central government has begun to accelerate energy efficiency through the country's new green building certification system, offering separate prerequisites for design and management of green buildings.

Central to the success of this new certification system will be the ability for regulators and building managers to reliably measure the energy savings. Thus, transparency of building energy data and clear benchmarking are vital components in this green building certification system. Without clear information on a building's actual performance, Chinese cities will not be able to improve energy efficiency in the rapidly growing building stock.

Figure 1. The Area of Certified Green Buildings Each Year (10,000 m^2) in China



Source: Boxing Qiu, March 2015, New Normal New Green Building, Chinese Society for Urban Studies (http://www.igreen.org/2015/0326/5795.html).

THE MYSTERY OF BEING "GREEN"

The Chinese green building sector is young but growing quickly. While green buildings currently make up only one percent of the Chinese building stock, great potential exists to accelerate their growth.

The vast majority of green buildings in China are certified for green design only, which does not ensure that they will be energy efficient in their day-to-day operations and management practices. Tellingly, only five percent of Chinese buildings certified for green design become certified for green operation. Since the lifetime energy use of a building depends on how it is operated and maintained, the lack of emphasis in this area begs the question of whether the "green buildings" on China's market will remain green in the long-run. Worse still, among policymakers, building managers, and tenants, there is a lack of awareness for both improving energy efficiency in building management and certification for green operations.

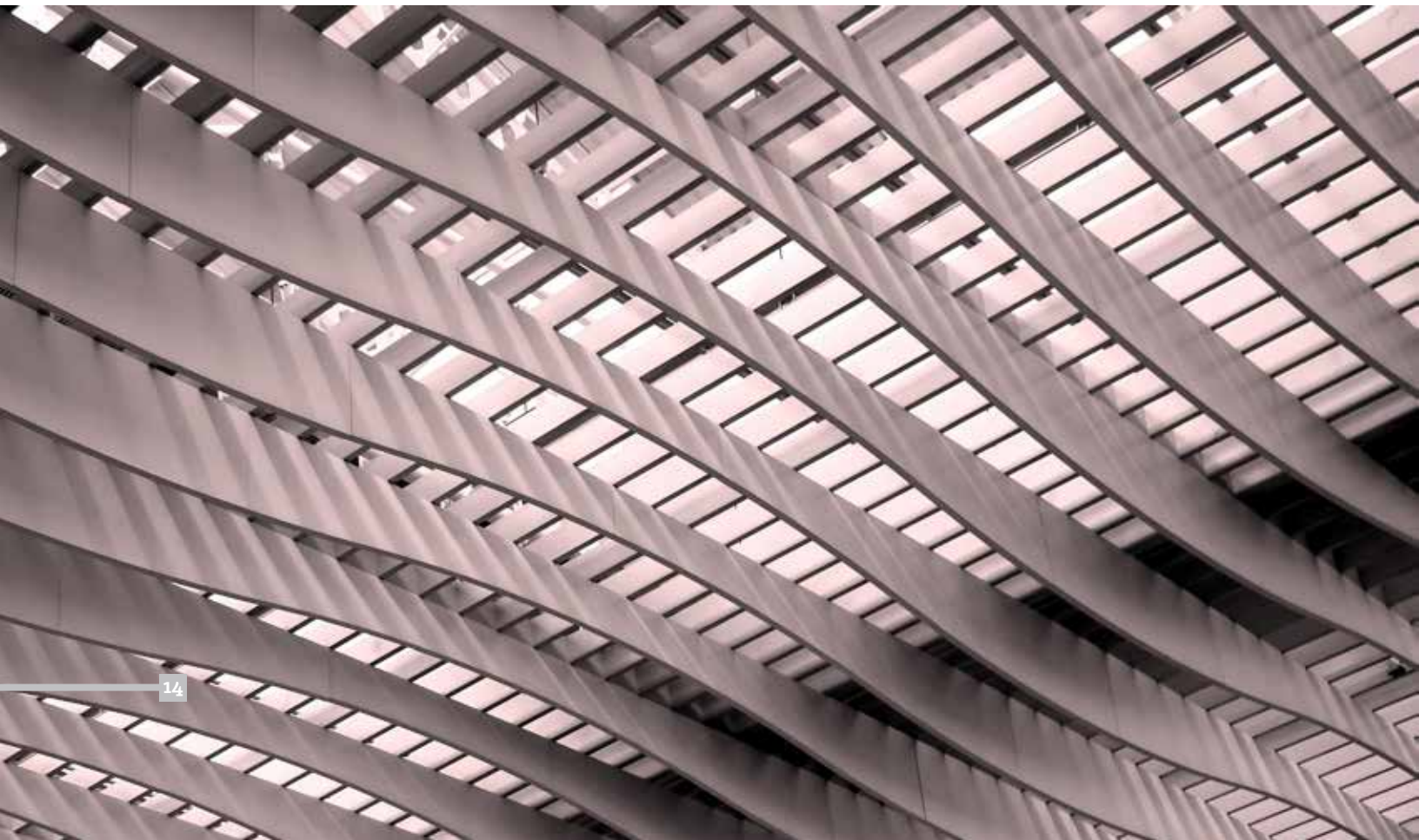
CONVENIENT MISINFORMATION

Green design certification in China expires two years after the Ministry of Housing and Urban-Rural Development or its affiliated institutions awards it. Unfortunately, tenants and building

owners often do not understand that even if a building is certified for green design at the time of purchase, it does not necessarily equate to being energy-efficient in the long term. Green design elements such as efficient air conditioners, smart thermostats, and lighting have the potential to make buildings more energy efficient over the life of a building if, and only if, they are operated and managed efficiently.

Tenants and building managers do not often know that only green design-certified buildings that have been operating for at least one year are qualified to apply for green operation certification. Developers sometimes benefit from this knowledge gap as they charge a premium even for expired green building design credentials. Since the public and real estate markets are not clear on the criteria and details of the two green certifications, consumer demand for energy efficient operation in green buildings is generally absent.

Additionally, many building owners cannot justify the cost of using energy efficiency technologies because they have never seen how cost-effective they can be. Owners often favor using fancy new active technologies such as high-power air conditioning and ventilation facilities in green certified buildings, rather than passive systems. Passive systems—natural lighting, shading, and natural ventilation—have been integral to the concept of green buildings in the United States and Europe, but are unfortunately often overlooked in China.



SO CHINA, HOW MUCH CAN YOU BENCHMARK?

Top Chinese building energy experts such as Professor Zhang Yi from Tsinghua University have questioned if green buildings in China are actually more energy efficient than non-green certified buildings. It is hard to know the answer without a strong building energy benchmarking program that can compare the operational energy use of similar buildings (both green and non-green). Building energy benchmarking sounds like a rather complex and technical issue but it, in fact, is a relatively straightforward two-step process.

The first step is to **monitor and report building energy usage data** so an initial baseline can be determined, which is crucial to correctly measure energy efficiency improvements. Without accurate baseline data, city governments and regulators cannot make detailed energy reduction targets and building owners will not be motivated to conduct energy efficient retrofits and make operational improvements.

The second step is to **publicly release energy use data** to inspire competition among building owners and stimulate a market-driven demand for buildings that operate more energy efficiently.

In the United States, building energy benchmarking has been put into practice by coalitions of city governments, NGOs, private companies, and federal government agencies, yielding great results in operational improvements and promoting market demand for energy efficiency. New York City, a city comparable in size and building density to large Chinese cities, has been at the forefront of pioneering building energy benchmarking in the United States. Relying on benchmarking as the crucial first step, New York City not only reduced the city's greenhouse gas emissions from large existing buildings by almost five percent, but also created about 17,800 construction-related jobs, and has a net savings of $7 billion **in energy costs** over 10 years. Furthermore, an EPA study concluded that ENERGY STAR buildings that consistently benchmark energy use achieve an average energy savings of 2.4 percent per year.

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Despite these successes in New York and other cities, Natural Resources Defense Council has found that many U.S. cities lack both the policies and technical expertise to promote benchmarking. Building owners and utilities often balk at benchmarking due to data privacy concerns.

Fortunately, since the late-2000s, a large support network of federal government programs, NGOs, and building industry association organizations has emerged to provide technical tools, policy guidance, and advocacy to overcome these hurdles. For example, the City Energy Project—a flagship initiative under the Urban Solutions program at the Natural Resources Defense Council and the Institute for Market Transformation—has been helping ten U.S. cities dramatically reduce energy use with custom-tailored policy packages and implementation programs that often rely on energy benchmarking as the first step to reducing building energy consumption. Building energy benchmarking is a promising tool for cities, but it requires building energy data transparency—a challenge for China.

BLEAK PROSPECTS IN CHINA?

The building energy benchmarking landscape is pretty bleak in China compared to that of the United States. The central government requires several large city governments to collect building energy use data, but this requirement is loosely enforced and thus, not implemented in many of these cities. The big aversion to data transparency has been one of the biggest obstacles to such energy benchmarking, but there are some promising signs. Specifically, the central government has mandated building energy data monitoring and collection for non-residential buildings larger than 20,000 square meters in several large cities such as Shanghai and Shenzhen. These large cities are now sitting atop growing piles of building energy data making them great candidates for piloting building energy benchmarking platforms. To make this happen, we at NRDC have started introducing building energy benchmarking best practices to Shanghai and are conducting a feasibility study to estimate the energy and cost-savings potential for benchmarking in this coastal metropolis. The study will provide specific policy suggestions for how Shanghai can implement a benchmarking program and inspire Shenzhen and other cities to follow suit.

While Shanghai and Shenzhen are successfully monitoring building energy use, many local government officials see releasing this data to the public as an unnecessary risk for doing something beyond what the central government requires them to do. Our local government collaborators express concerns that civil society groups and academics may accuse them that buildings are not efficient enough, or may find embarrassing mistakes in the data collection or analysis.

Though energy use data transparency is worthy of the perceived risks, and we might be in the beginning stages of initiating Shanghai to the building energy benchmarking and transparency club, no one has yet succeeded in completely convincing local governments to make building energy data more transparent and accessible. NRDC's work advocating for benchmarking policies with different levels of government from national to local, has notably revealed that building owners and real estate markets are not demanding this information, and Chinese civil society has not been as engaged in the technicalities of benchmarking.

A PLATFORM FOR BUILDING ENERGY EFFICIENCY

Given China's expansive international experience and momentum around building energy efficiency, we thought that introducing and piloting building energy benchmarking to the country would be relatively straightforward. But as we quickly learned, the political landscape of Chinese cities is completely different from that of U.S. cities; the same familiar strategies for implementing benchmarking programs and platforms in the U.S. will not work here in China.

Through years of joint efforts from the public, private and research sectors, we have finally seen some progress in piloting a building energy-benchmarking program in Shanghai. We are prepared that some city governments will be more averse to publicly releasing building energy use data than others, and the building energy efficiency policy packages will have to be tailored to the uniqueness of each city. However as the U.S.-based City Energy Project Director, Melissa Wright of NRDC, emphasized during one of our cross-world Skype calls, the ultimate success of these programs both in the U.S. and in China comes from our firm belief that building energy benchmarking is a win-win for everyone. Hopefully sooner rather than later, China's flocks of construction cranes will be leaving behind a growing stock of greener, more energy efficient buildings.

Demand Response in Shanghai: Building an Efficient Grid for Cleaner Air

By Hyoungmi Kim

KEEPING POWER GRIDS IN BALANCE

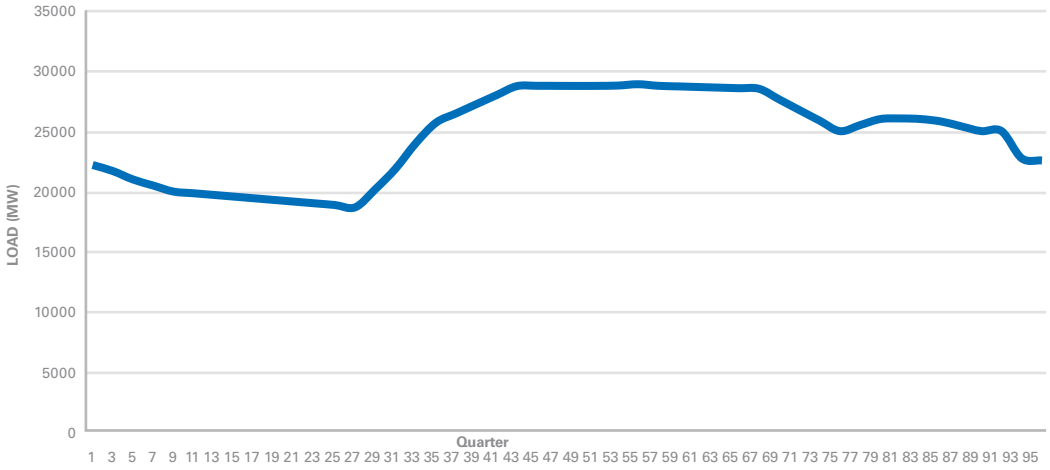
Most people are unaware of how power grids function until they don't.

Overloaded and poorly maintained grids leave cities in the dark. Six million people in India suffered from a power cutoff in 2012, while in the same year, a massive cascading blackout crippled households across the northeast U.S. and Canada.[1]

China is all too familiar with these problems. The economy's rapid urbanization rate and booming industries have strained the grids' ability to consistently meet end users' electricity demands, causing occasional brownouts or blackouts. As the growing middle class increasingly uses air conditioners, peak demand for electricity has spiked, creating a massive "peak-valley" differential between the maximum and minimum daily grid load, as well as pushing the network to a breaking point. In the summer of 2013, for example, the difference between the daily maximum peak load and the minimum off-peak load in Shanghai reached 12.02 GW —roughly equivalent to what it takes to power 3 million American homes each year.[2] (See Figure 1 below for Shanghai's load curve on 7 August 2013).

To meet the summer peak demand, Shanghai has to keep a fleet of inefficient coal-fired power plants running only in a short period of time each day. Powering these plants up and down is economically and environmentally costly. However, if Shanghai could phase out these small-scale coal-fired plants by reducing peak demand, the potential benefits would be enormous – not only to cut coal consumption and pollutant emissions, but also to increase efficiency and reliability of the grid operations.

Figure 1: Shanghai's Daily Load Curve with 96 Data Points, August 7, 2013



Source: Shanghai Municipal Commission of Economy and Information

In 2013, peak loads exceeding 28 GW occurred roughly 50 hours throughout the year in Shanghai. If the city could cut 10 percent of hourly power demand during the highest peak, estimated CO_2 emission reductions would be about 9,654 metric tons, equivalent to the annual emissions from 1,328 American households' electricity consumption (based on the U.S. EPA Calculator).

CLOSING THE PEAK-VALLEY GAP THROUGH DEMAND RESPONSE

In order to address the growing peak-valley differential, Shanghai launched China's first demand response (DR) pilot program in 2014. This initiative is one of several DR pilot programs that the National Development and Reform Commission (NDRC), China's central economic planning agency, has endorsed over the past few years. (See Box 1 for some background information on the pilot cities).

DR refers to measures that reduce the load on the grid: end-users are asked to reduce or shift their electricity use when there is a power shortage or during a system peak. In return, participating end-users typically receive monetary compensation. The Shanghai Municipal Commission of Economy and Information convened a group of local and international experts to collectively design and implement China's first DR program.

Box 1. Background Information on Demand-side Management Development in China

China's National Development and Reform Commission (issued national demand-side management (DSM) regulations in 2010, which for the first time required utilities to meet energy savings targets – no less than 0.3% of the sales volume and 0.3% of the maximum load in the previous year. To further promote DSM, in 2012 NDRC announced the first four DSM city pilots – Beijing, Foshan, Suzhou and, Tangshan — providing special government funding to support the three-year projects. Unlike DSM that focus on long-term energy efficiency improvement through methods such as infrastructure retrofitting, demand response (DR) aims at short-term energy demand reductions in response to real-time electricity price changes. Shanghai is the first DR city pilot, apart from the four DSM city pilot.

SHANGHAI'S SUCCESS

The industrial sector accounts for nearly 60 percent of the total electricity consumption in Shanghai. Therefore, to significantly reduce the electricity load on the grid, it is vital that the DR program can effectively engage industrial customers. Shanghai has a well-established online monitoring platform that tracks the use of public and commercial buildings in each district, putting the city at a huge advantage over other Chinese cities in implementing a DR program. By the end of 2014, the Shanghai municipal government had successfully

recruited 31 industrial and 33 residential building customers for the DR program, the majority of which are state-owned.

In 2014, Shanghai launched two DR events over the summer: one was for a test-run of the operating system and the other was an actual DR project where participating customers received notifications to reduce their electricity demand during a designated time, for example, between 2 to 4 p.m. on August 29. A total of 27 building customers and 7 industrial customers participated in the second event, which delivered a more than 10 percent peak load reduction on average among the participating customers. In turn, these buildings received 2 RMB for every kW they saved.[i] Moreover, if the customer company was registered in both Shanghai's Changning and Huangpu districts, it received a double bonus totaling of 4 RMB per kW demand drop, once verified. Shanghai successfully proved the potential and feasibility of DR in China.

Shanghai's success in carrying out the DR program came largely from the strong capacity of a diverse implementation team led by the city's Municipal Commission of Economy and Information. (See Figure 2 for a list of the organizations). Collaboration among businesses, environmental and energy NGOs, and government experts created momentum and synergies that facilitated cooperation across the Shanghai government and business communities.

Figure 2: Shanghai Demand Response City Pilot Implementation Team

- Shanghai Municipal Commission of Economy and Information
- State Grid Shanghai Municipal Electric Power Company
- Beijing Smartchip Microelectronics Technology Co., Ltd, State Grid Information & Telecommunication Co., LTD
- Shanghai Twenty-first Century Energy Conservation Technology Co., LTD
- Shanghai Electric Apparatus Research Institute
- Hangzhou Telek Technology Co., LTD
- Tongji University
- Honeywell
- LY Enerlytics
- Natural Resources Defense Council
- Energy Foundation

[i] The administrative division in Shanghai includes 17 districts and 1 county. The above-mentioned two districts are Changning and Huangpu.

A MODEL FOR OTHER CHINESE CITIES?

2015 was a watershed for China's power sector as the Chinese government issued "Document Number 9" and other policy documents to speed up reforms. One document issued by the National Development and Reform Commission in April, in particular, required the four DSM pilot cities – Beijing, Foshan, Suzhou and Tangshan to follow Shanghai's successful example and to launch DR programs this year. DR is gaining greater momentum in China, illustrating huge potential to achieve greater emissions reduction, energy efficiency, and economic benefits. To scale up Shanghai's initial success, however, more needs to be done, specifically, to:

Establish a market to capitalize on the economic value of DR: DR in Shanghai emerged as mainly a government-driven effort. The absence of a market where DR resources get paid market value is the biggest challenge. In order for DR to be broadly adopted and economically viable in the long-run, Shanghai and other cities in China, need a market-based mechanism. In other countries, such as the US and UK, DR is procured by utilities or bid into a competitive market, where DR resources have "price tags" that the buying entities are required to pay. Oxford University in collaboration with the Shanghai DR implementation team issued a report entitled, *Assessment of Demand Response Market Potential and Benefits in Shanghai*. The report was released in July 2015, and received widespread attention from the government, grid companies, energy service providers and the media, as it set a milestone that for the first time China considered DR's market value as a resource to improve grid efficiency and stability. This effort is also in line with China's power sector reform to become more market-based.

Set unified technology standards and communication protocols: Last year's DR efforts in Shanghai were specifically focused on targeted small group of customers, but the implementation team faced challenges with technology standards and data communication. If the pilot is to be scaled up, standards and protocols should be upgraded first.

Push for more innovation: Based on the city's current implementation capacity, Shanghai needs to innovate and explore the integration of electric vehicles and renewable energy resources with existing DR programs. Future DR policies should include a more comprehensive grid system and boost smart grid development.

Scorecards as New Tool for Catalyzing Energy Efficiency in U.S. Cities

By David Ribeiro & Michael Jarrett

Cities are laboratories of innovation when it comes to energy efficiency, with many pushing for more energy savings. Cities like Chicago have adopted and implemented benchmarking requirements for buildings, providing information critical for quantifying and evaluating building energy use. Utilities serving Boston and Portland have made significant investments in electricity and natural gas efficiency programs. Others like Seattle and Washington, DC have made strides in their efforts to save transportation-related energy use.

Energy efficiency is one of the least expensive, most abundant, and most underused strategies for local economic and community development. Saving energy and using it efficiently can not only make communities more resilient while protecting human health and the environment, but also save money for households and businesses, catalyze local reinvestment, and create jobs in the community.

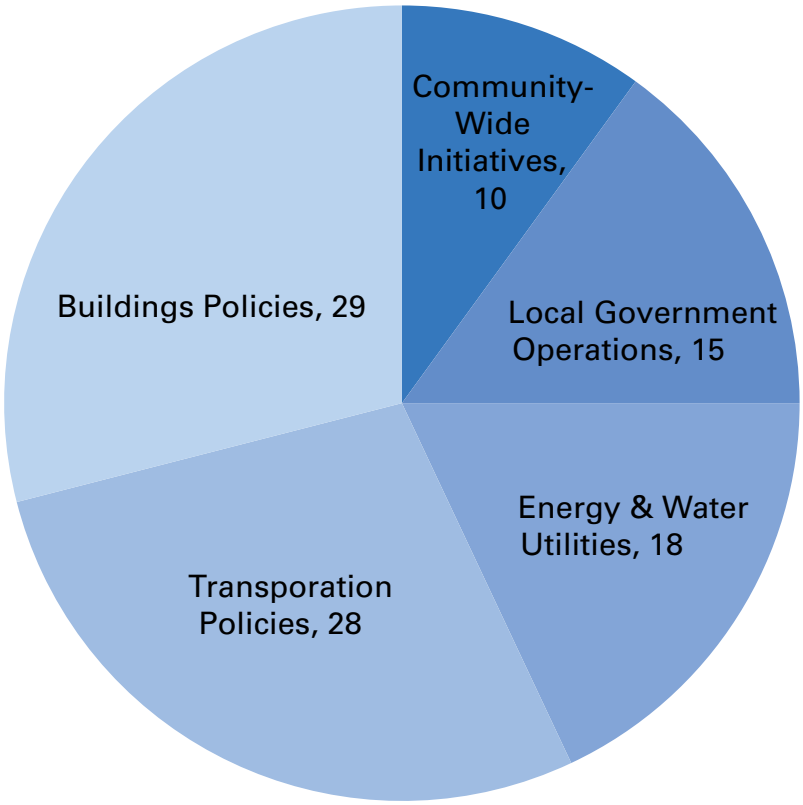
Many U.S. cities have leveraged various initiatives to improve energy efficiency, such as through changes in land use and zoning, building codes, public finance, transportation investment, economic and workforce development, and in many cases, the provision of water and energy. Cities as diverse as Boston and Charlotte have adopted energy efficiency initiatives that have changed the landscape for their citizens, improving where they live and work.

THE 2015 CITY ENERGY EFFICIENCY SCORECARD

The American Council for an Energy-Efficient Economy (ACEEE) created a *City Energy Efficiency Scorecard* that compiles information on policies and local actions that cities are deploying to advance energy efficiency.[1] It is the first report to rank U.S. cities exclusively on their energy efficiency efforts, identifying those cities that excel and those with the most room for improvement. The second edition of the *Scorecard*, which we published in the spring of 2015, compares 51 U.S. cities across five policy areas: local government operations, buildings policies, transportation policies, community-wide initiatives, and energy and water utilities. (See Figure 1 for policy areas and point allocations in the Scorecard).

Figure 1: 2015 City Energy Efficiency Scorecard (Policy Areas and Point Allocations)

Maximum Score in Each Policy Area



Source: 2015 City Energy Efficiency Scorecard

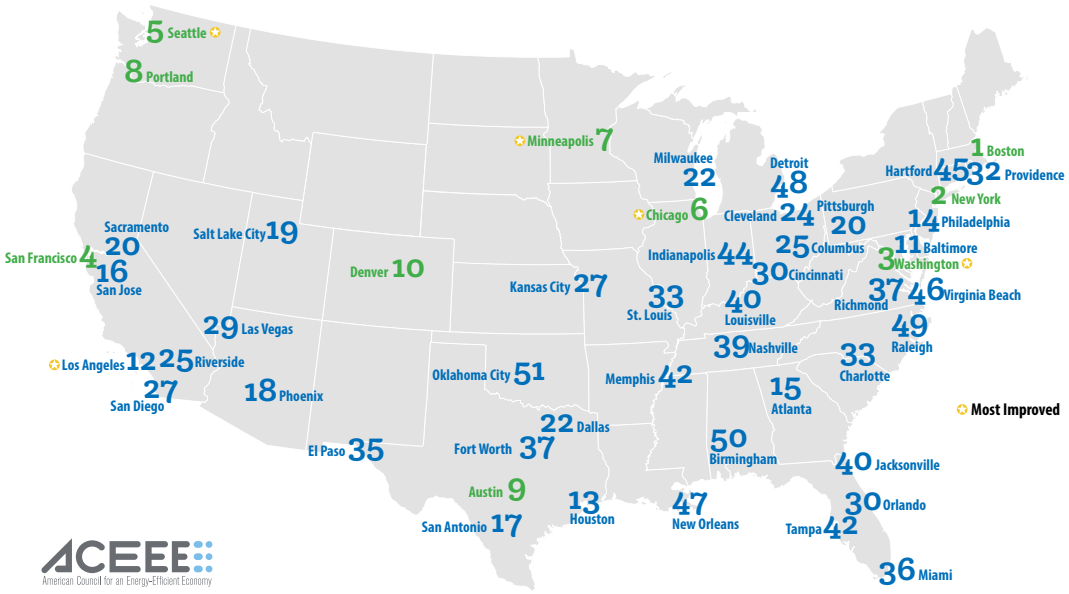
Besides offering the beginning of a roadmap for any local government aiming to improve its city's energy efficiency, the *Scorecard* also creates friendly competition among cities to improve their scores.

The *City Scorecard's* focus on best practice policy metrics makes it applicable to diverse communities, even those not included in the report. The metrics score cities based on qualitative policy information and reward cities that are implementing policies and programs that will likely lead to more efficient outcomes. We scored cities on actions, policies, and implementation, rather than on explicit outcomes whose exact relationship to policy actions can be difficult to gauge. Where we could, we went beyond policy adoption and targets to evaluate cities on actual policy implementation. For example, cities like Los Angeles, Sacramento, and San Antonio received points for having adopted either energy or climate goals, and received additional points for being on track to achieve those goals.

SCORING TRENDS

In the *2015 City Scorecard*, we compare results to the *2013 Scorecard* to identify overall scoring trends, and compare each city's performance to their 2013 scores. 65 percent of all surveyed cities in the last *Scorecard* have taken steps in the right direction and achieved higher scores. We are also seeing that energy efficiency has broad appeal from coast to coast. In the top ten, three cities are from the east coast, another trio is from the west coast, two are in the Midwest, one is from Colorado, and the other is from Texas.

Figure 2: 2015 City Energy Efficiency Scorecard Rankings



Source: 2015 City Energy Efficiency Scorecard

Many cities gained more points in this Scorecard edition for their policies on buildings, energy and water utilities, and transportation. Several cities earned more points for adopting or improving policies that support energy data transparency. In addition, cities—and states in some cases—have undertaken efforts to increase the stringency of their residential energy code. In the transportation sector, more cities are adopting policies to shift travel from personal vehicles to more efficient modes of transportation by removing minimum parking requirements, adopting vehicle-miles-traveled goals or modal-share targets, and developing transportation demand management programs.

Cities also made improvements in their water-related goals, earning more points for their energy efforts within water services. Since 2013, five of the cities in the *City Scorecard* (Atlanta, Baltimore, Boston, Charlotte, and Sacramento) have added new water savings targets.

CITY EXAMPLES

Some of the top scorers from the *2013 City Scorecard* returned as high performers in the 2015 edition. Other cities have made big jumps in their scores, showing that mayors and local lawmakers in America's largest cities are taking innovative steps to increase energy efficiency. Below are examples of some of the top-ranked and most-improved cities in the *2015 City Scorecard*.

Boston

Boston retained its position at the top of the rankings by earning more than 80 percent of available points. Boston scored well across all policy areas due to its broad set of efficiency policies, especially buildings policies. Through Renew Boston, the city works with its energy utilities to offer homeowners and small businesses no-cost energy assessments and incentives for upgrades. The City Council also adopted the Building Energy Reporting and Disclosure Ordinance in 2013 to bring more transparency to energy and water use data in commercial and large residential buildings.

New York City

New York City rose from the third rank to the second and remained a leader in buildings policies. Its Greener, Greater Buildings Plan and related policies require building rating and transparency for commercial and multifamily buildings, as well as require actions to improve efficiency in its largest buildings. New York City is also the leading city for community-wide initiatives, due to its planning for future distributed energy systems, urban heat island mitigation strategies, and progress toward achieving its community-wide greenhouse gas emissions reduction goal.

Washington, DC

Washington, DC jumped into the top five this year with a substantial score increase. DC is one of the leading cities for transportation policies. DC particularly excels with its mode-shift policies that encourage efficient types of transportation (e.g., public transit, ridesharing, bicycles, walking). The city aims to achieve a 75 percent increase in commuter trips by transit, biking, and walking by 2032. To achieve this, the city has invested in public transit facilities, hosts several car-share programs, and is home to one of the most successful bike-share programs, Capital Bikeshare. DC earned double accolades in the *Scorecard* for being ranked third and for being the most-improved city overall.

Los Angeles

Following closely behind DC for most improved, Los Angeles (LA) earned 20 more points than in 2013. A strong new energy savings goal and high marks in energy and water utilities helped LA move up. The LA Department of Water and Power commissioners recently adopted a policy requiring the utility to achieve 15 percent energy savings through energy efficiency measures by 2020.

EXPANDING THE REACH OF ENERGY EFFICIENCY GLOBALLY

Just as the *City Scorecard* has been valuable for benchmarking energy efficiency efforts in U.S. cities, a similar initiative could be valuable for initiating policy action in cities in other countries.

The benefits of increasing energy efficiency are not just limited to the United States. Two-thirds of global energy consumption occurs in cities.[2] Similarly, about 75 percent of the world's global-warming greenhouse gases—the majority of which are from electricity production—is generated in urban areas.[3] Leading on both of these trends are many Asian and African countries, which are urbanizing faster than the rest of the world.[4] Energy efficiency actions by local governments, businesses, and citizens will place cities at the forefront of addressing the world's energy and environmental challenges. Scorecards and certifications to rank cities on the adoption and implementation of energy efficiency policy could help build momentum for energy efficiency in these cities.

ACEEE's firsthand experience tells us this *City Scorecard* could be beneficial in China as well. ACEEE has worked in China for two decades, partnering with Chinese organizations and agencies on a variety of projects, including voluntary lighting and electric motor programs; appliance efficiency standards; and work on the role of energy efficiency in the utility sector.

This article was adapted from the 2015 City Energy Efficiency Scorecard released by ACEEE for which David was the lead author.

Endnotes

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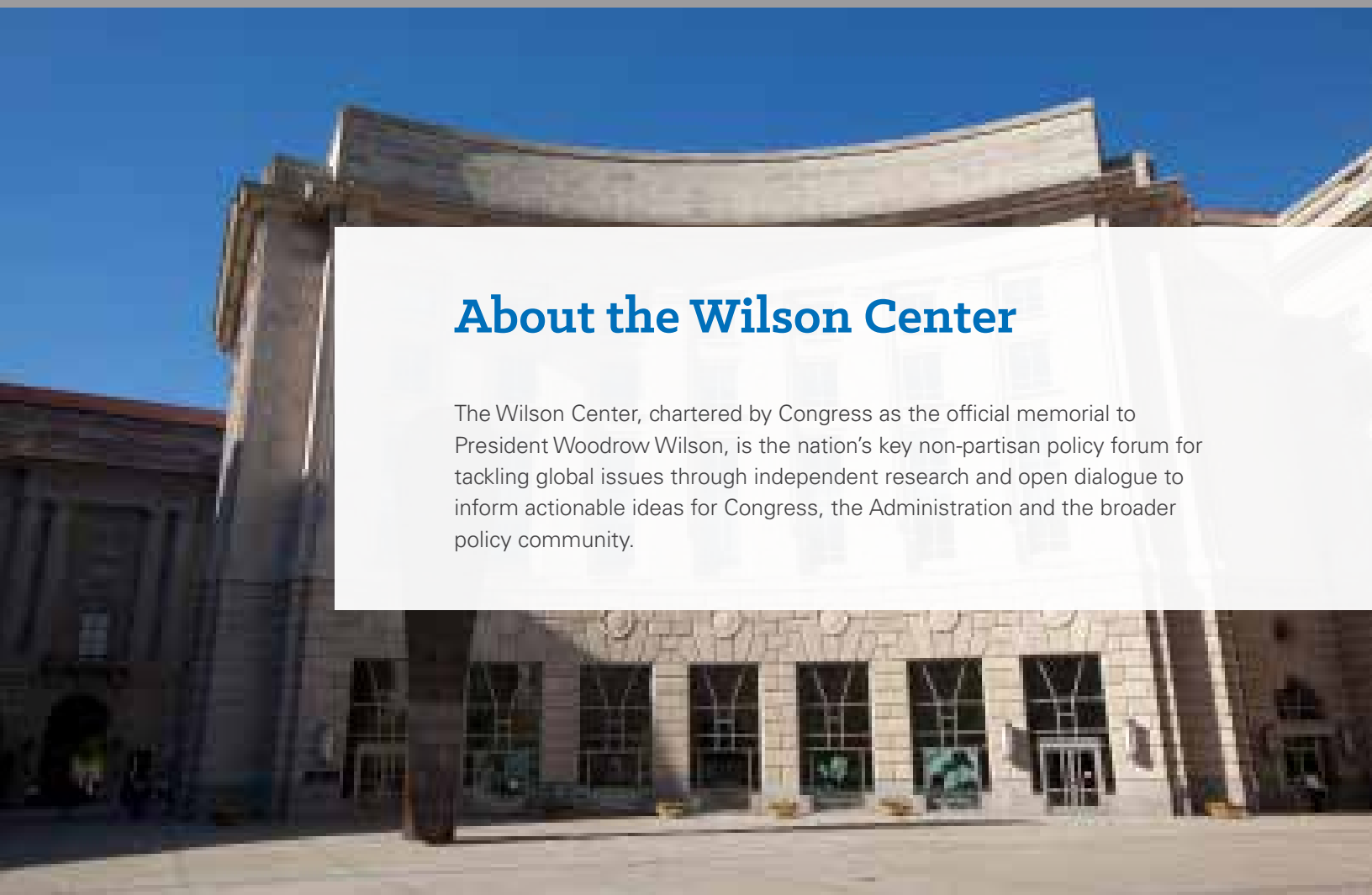
China Environment Forum's Role as Convener and Catalyst for Action

For 17 years the Wilson Center's China Environment Forum has carried out research and exchange projects on a broad range of energy and environmental issues in China—from U.S.-China clean energy cooperation and water-energy choke points in China to food safety and the ecological impact of China's overseas investment.

Insight Out is a publication series that began in 2014 with support from the blue moon fund. This issue was made possible with support from the Henry Luce Foundation as part of our Choke Point: Cities initiative that is investigating interlinked energy and water issues in Chinese cities.



About the Wilson Center

The Wilson Center, chartered by Congress as the official memorial to President Woodrow Wilson, is the nation's key non-partisan policy forum for tackling global issues through independent research and open dialogue to inform actionable ideas for Congress, the Administration and the broader policy community.

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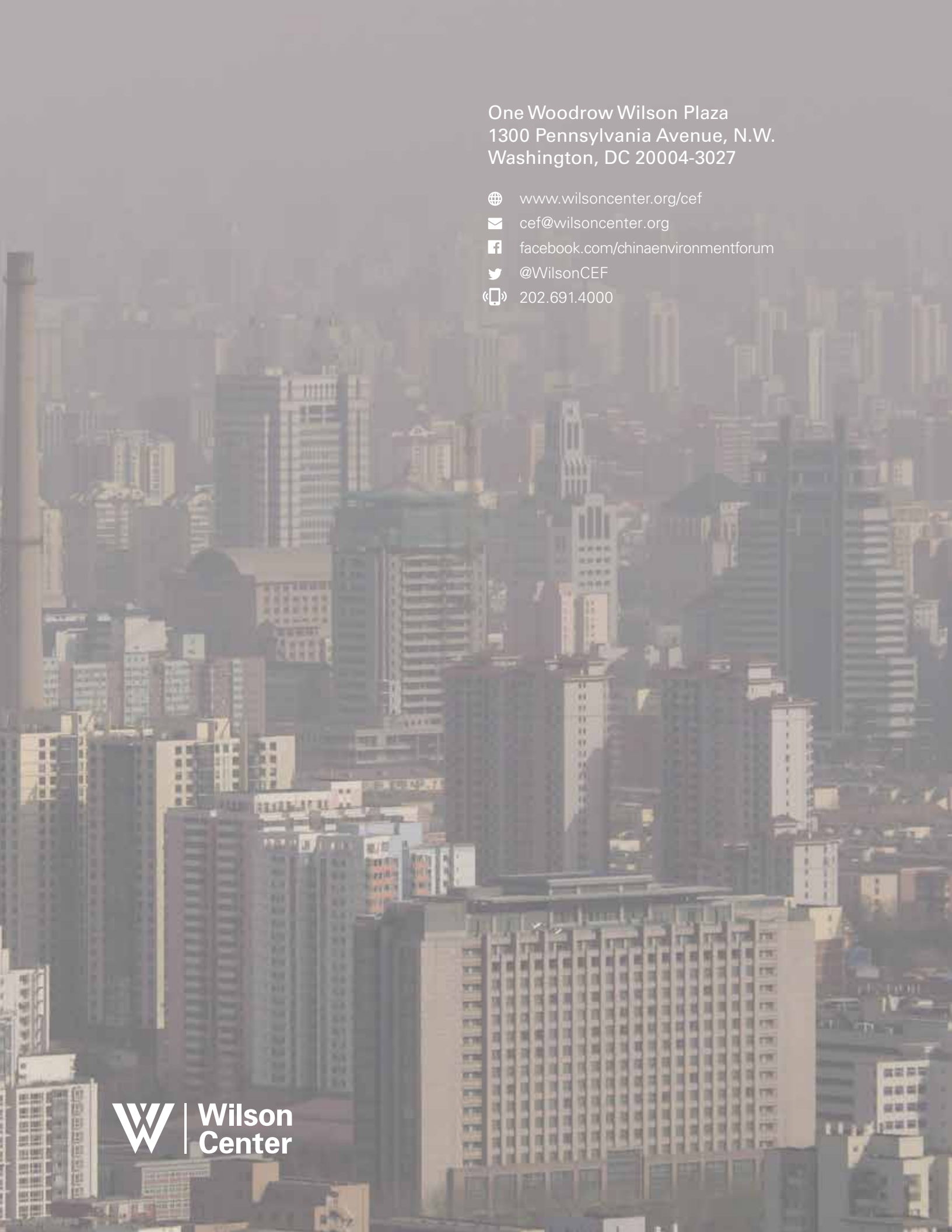

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