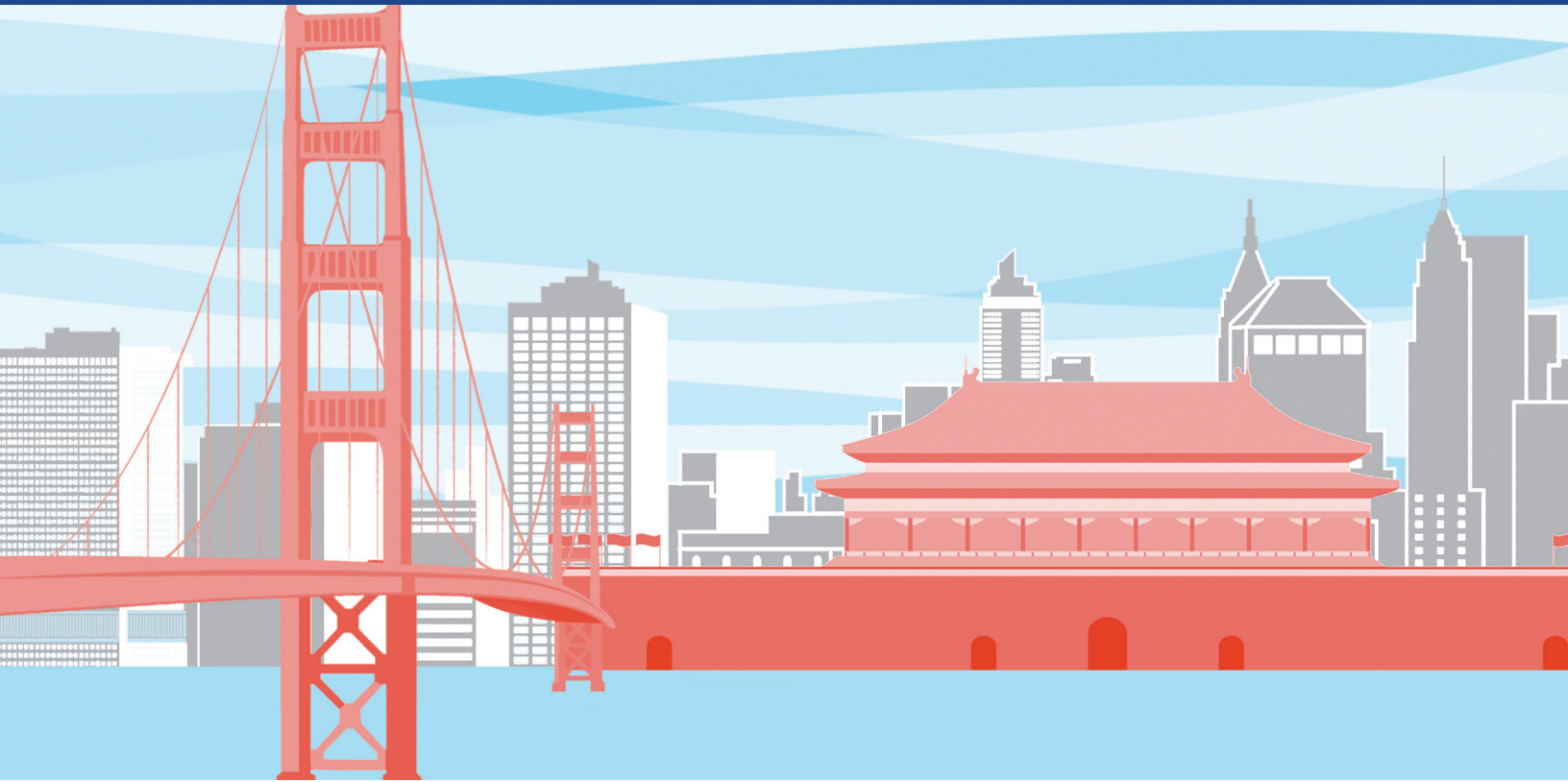


An Asia Society Special Report



EXECUTIVE SUMMARY

A Clear Opportunity:

U.S.-China Collaboration on Clean Air

A PARTNERSHIP AMONG:



A CLEAR OPPORTUNITY: U.S.-CHINA COLLABORATION ON CLEAN AIR

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Asia Society is the leading educational organization dedicated to promoting mutual understanding and strengthening partnerships among peoples, leaders and institutions of Asia and the United States in a global context. Across the fields of arts, business, culture, education, and policy, the Society provides insight, generates ideas, and promotes collaboration to address present challenges and create a shared future. Founded in 1956 by John D. Rockefeller 3rd, Asia Society is a nonpartisan, nonprofit institution with major centers and public buildings in New York, Hong Kong and Houston, and offices in Los Angeles, Manila, Mumbai, San Francisco, Seoul, Shanghai, Sydney, Washington, DC and Zurich.



Clean Air Alliance of China (CAAC), initiated by 10 key Chinese academic and technical institutions in clean air field, aims at providing an integrated clean air collaboration platform in China for academic and technical institutions, provinces and cities, non-profit organizations and enterprises. The overarching goal is to improve air quality in China and mitigate the negative impacts on public health due to air pollution. The members of CAAC include academic institutions, provinces & cities, as well as other nonprofit organizations and enterprises that care about clean air.



Energy Foundation China, established in Beijing in 1999, is a grantmaking charity organization dedicated to China's sustainable energy development. It is registered under the Ministry of Civil Affairs as Energy Foundation Beijing Representative office and supervised by the National Development and Reform Commission of China. It is a part of the Energy Foundation, which is based in San Francisco, California, U.S.A.

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A CLEAR OPPORTUNITY: U.S.-CHINA COLLABORATION ON CLEAN AIR

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FOREWORD

CHINA'S EMERGENCE AS A GLOBAL ECONOMIC POWERHOUSE has been remarkable. However this economic success was not achieved without environmental consequences. China is now one of the world's largest greenhouse gas emitters and the country is facing severe air pollution challenges. The Chinese government sees poor air quality as a critical public health issue and is implementing a number of measures to tackle this challenge, ranging from industry regulations, regional action plans to national policies and laws. This has not only spurred a huge market for clean air technology development but also has created abundant new opportunities for the United States and China to work together to support the global climate change goals.

This report, *A Clear Opportunity: U.S.-China Collaboration on Clean Air*, was drafted through a unique collaboration between the Asia Society, the Clean Air Alliance of China—a leading consortium of top research institutes studying China's clean air challenges—and the Energy Foundation. As awareness of the detrimental effects of urban air pollution on public health grows, this report seeks to build from a number of earlier efforts undertaken by the Asia Society to promote and encourage a productive partnership between China and the U.S. on clean air and climate change. We believe that air quality management is one of the most fruitful areas for collaboration between the two countries, because it can also benefit both countries in their quest to reduce greenhouse gas emissions.

Indeed, the U.S. and China already have a long history of successful collaboration on climate change, most recently through the ratification of the Paris Climate Agreement. And while at the time of this writing it remains unclear if the incoming U.S. President will continue America's engagement with China (and the world) to address global climate change, we believe that the two nations' collaboration on the environment provide some common ground for improving the bilateral relationship, which we hope can further catalyze cooperation in other areas.

Throughout the course of its own development, the U.S. has confronted its own air pollution challenges in many of its cities. This report seeks to identify the critical regulatory and technological needs of China to help improve its air quality, highlight some of the best practices the U.S. has achieved in tackling its own air quality challenges, and explore further opportunities for U.S.-China collaboration. From the deployment of monitoring equipment and new technologies to the establishment of new rules and regulations for high polluting industries, the report highlights the most promising strategies that have been implemented in the U.S. and that China can now draw from in managing its own air pollution challenges.

California's experience is especially illustrative. The state is home to some of the most innovative cleantech companies in the world, and has some of the country's most stringent regulations on polluting industries. Moreover, California has demonstrated that it is possible to enact strong clean air regulations while sustaining high level of economic growth. For China, cleaning its air while maintaining growth is an important goal.

Our report demonstrates how the U.S. and China can benefit from greater collaborations

on air quality and climate change. In addition to new market opportunities for U.S.-based clean air technology providers, the sheer scale of the challenges in China provide companies in both countries with fertile testing grounds for the large-scale deployment and scaling up of technologies that can broaden the opportunities for new innovations.

On the regulations side, U.S. regulators can monitor how markets in China respond to new rules and standards, which can provide new insights into if, where, how, and when new regulations are most effective. Finally, air pollution is ambulatory; poor air quality in one country or region can also have impacts on other countries or regions. While California, for example, still copes with air quality problems in its large cities, severe air pollution in China has been found to travel across the Pacific and into the state. As such, air pollution is not just a local problem, it is an international one.

This project benefited from our partnership with the State of California and the many agencies tasked with spearheading the State's ambitious clean energy goals. These include California's Air Resources Board, Environmental Protection Agency, and Energy Commission.

The private sector was also consulted in the process of drafting this report and provided invaluable insights. Numerous companies were found to be developing and bringing to market new technologies that support clean air and clean energy goals here in the U.S.

Non-governmental organizations and consulting firms conducting their own independent analyses of the technologies and regulations already in place also offered invaluable advice.

This report hopes to highlight the large ecosystem of partnerships consisting of government, the private sector, and non-governmental organizations working toward cleaner air and lowering greenhouse gas emissions in the U.S. and China.

Clean air has enormous public health benefits and is central to livability in today's cities. China's leaders recognize this, and are aggressively pursuing solutions to clean its air, through stronger regulations and wider deployment of clean air technologies, but are now confronting the challenge of implementing solutions at an unprecedented scale and speed. Meanwhile, the U.S. continues to consume a large share of the world's energy, and air pollution in many parts of the country persists, but it has also put into place some of the most comprehensive clean air rules and regulations which other countries are looking to emulate. Because there is a natural synergy here and because the U.S. and China have an important responsibility to collaboratively lead this effort in the world today, it is our hope that this report will provide some new ideas and suggest some new opportunities for greater cooperation between the two countries.

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EXECUTIVE SUMMARY

AIR POLLUTION CONTINUES TO POSE A MAJOR THREAT to human health in China. China's recent Air Pollution Prevention and Control Law and Atmospheric Pollution Prevention Action Plan demonstrate the government's resolve to significantly improve air quality. Achieving the vision and goals laid out in these documents will require a rapid and extensive deployment of clean air technologies and an enabling regulatory environment that encourages manufacturing innovation and technology adoption. With appropriate planning, this large-scale deployment of clean air technologies could also reduce China's greenhouse gas emissions, helping achieve the country's longer-term climate policy goals.

China and the United States have a long history of collaboration on air quality and climate policy, driven by common interests. Air pollution from China affects parts of the United States, providing an impetus for federal and state agencies in the United States to work together with their counterparts in China on air quality issues. The U.S.-China Climate Change Working Group and other bilateral initiatives reflect recognition by both countries that their joint leadership is critical for mitigating climate change. Cooperation on air quality and climate change has become a pillar of the U.S.-China relationship.

The benefits of continued collaboration will grow over the next decade. As China seeks to achieve dramatic improvements in air quality, regulatory experience from the United States could play an important supporting role. In turn, regulators in the United States will have much to learn from China's experience as it struggles with its own air quality challenges. Greater harmonization of longer-term air quality and greenhouse gas regulations between the two countries would also provide an important signal for investments in clean technology innovation. A common, competitive market for these technologies would be vast, resulting in lower costs.

This report, drafted through a unique collaboration among the Asia Society, the Clean Air Alliance of China (CAAC), the Energy Foundation China, and an extensive group of advisors and experts, explores the potential for continued U.S.-China collaboration on clean air technologies and policies. It seeks to identify priority areas for collaboration on clean air technologies, enabling regulations, and market facilitation. Cleaning the air will also support broader efforts between the U.S.-China collaboration to mitigate climate change.

China is entering a new phase of air quality management, transitioning from an era in which the main concern was primary pollutants (sulfur dioxide, large particulate matter) emitted directly from industrial smokestacks to one in which secondary pollutants (fine particulate matter, ozone) resulting from a diverse combination of stationary and mobile sources are a larger concern, particularly in large urban areas. This transition occurred over several decades in the United States. In China, the speed at which it has occurred – less than 20 years – is requiring equally rapid transformations in technology and regulation.

China's longer-term emission reduction goals reflect both this new reality and the scale

of air quality problems. China, for instance, required that all cities should strive to meet the national annual emission standard for fine particulate matter (PM_{2.5}) by 2030. Achieving this and other air quality targets will require reducing primary PM_{2.5}, sulfur dioxide (SO₂), and nitrogen oxide (NO_x) emissions by more than 50% below 2013 levels over the coming decade-and-a-half.¹ These emission reduction goals can only be realized through a dramatic scale-up in clean technologies, from diesel pollution controls to renewable energy, which will create the world's largest market for many of these technologies.

To support this transformation in technologies, in 2015 CAAC inaugurated a Bluetech Award aimed at identifying key technologies that could have transformative effects in improving air quality and human health in China.² For its 2016 Bluetech Award, CAAC identified five priority areas based on its analysis of needs for meeting longer-term national air quality goals. These five areas, the focus of this report, include the following:

- Diesel vehicles and equipment;
- Sources of volatile organic compounds (VOCs);
- Coal-fired power plants;
- Residential and industrial coal use; and
- Air quality monitoring and indoor air purifiers.

For the first four of these categories, there are strong synergies between efforts to improve air quality and efforts to reduce greenhouse gas emissions. For instance, it may be more economical to replace older coal-fired generation with non-fossil fuel generation than to retrofit it with advanced emissions control equipment. For cars and buses, vehicle electrification may be a more cost-effective approach to meeting air quality and long-term climate goals than focusing on emissions control equipment for internal combustion engine vehicles.

PRIORITY AREAS FOR COLLABORATION ON CLEAN AIR TECHNOLOGIES

The United States is a technology leader in a number of the five Bluetech areas. Based on a review of emerging technologies (Section 2 of the report), we identify five priority technology areas for China-U.S. collaboration on clean air technologies:

- **Advanced air quality monitors.** Emerging air quality monitoring technologies are enabling a clearer picture of the timing, location, and exposure impacts of air pollution. In China, careful deployment of these technologies would enhance understanding of the sources of air pollution, enable more effective air quality and emissions standards based on a deeper understanding of pollution exposure and health impacts, and allow regulators to prioritize strategies that reduce the most harmful sources of pollution.
- **Integrated designs and clean fuels for heavy-duty vehicles.** Federal regulations in the United States have spurred a new generation of heavy-duty vehicles that are able to meet stringent emissions limits while improving fuel efficiency and performance;

¹ Hao, Yin, and Cen (2016).

² See <http://en.bluetechaward.com/>

California and other U.S. states are exploring longer-term alternative fuel sources for heavy-duty vehicles. In China, new engine and pollution control designs for diesel heavy-duty vehicles would enable lower emissions standards for new vehicles, while planning for cleaner fuels for heavy-duty vehicles would help achieve longer-term air quality and climate goals.

- **Electrification of passenger vehicles and buses.** Both China and the United State have been leaders in supporting the early development and deployment of electric cars, buses, and short-haul heavy-duty vehicles that have no tailpipe emissions; when combined with renewable or nuclear electricity generation, these vehicles can have zero total emissions. New technologies for vehicles and charging infrastructure can lower the cost of transportation electrification as an air quality and climate policy strategy in China.
- **Low environmental impact solvents.** Solvents – used in paints, lubricants, inks, adhesives, and cleaning products – are a major source of urban ozone pollution and may contribute to ozone depletion, toxic air, and climate change. An emerging generation of solvents is able to meet multiple environmental standards, which will help China achieve a range of environmental goals.
- **Leak detection and repair for refineries, chemical plants, and pipelines.** Remote sensing technologies are enabling more accurate detection and lowering cost control of fugitive pollution and greenhouse gas emissions from refineries, chemical plants, and pipelines. In China, advanced leak detection and repair technologies would enable regulators to rapidly and cost efficiently achieve significant emissions reductions from these sources.

PRIORITY AREAS FOR COLLABORATION ON ENABLING REGULATION

Regulation – from emissions standards to technology mandates – plays a critical role in enabling the development and deployment of clean air technologies. The United States has more than 50 years of experience in developing regulatory frameworks to encourage clean air technologies. This experience has been and could continue to be a valuable reference for regulators in China, as they plan and develop implementation programs to meet local and national air quality goals. In turn, regulators in the United States will be able to learn from emerging practices in China.

Our identification of priority areas for regulatory collaboration draws on a review of three regulatory areas in California (Section 3 of the report):

- The Diesel Risk Reduction Plan, which seeks to reduce particulate matter from all diesel emissions sources by 85% by 2020;
- Regulations for controlling VOC emissions, focusing on regulations for solvent emissions; and
- Joint planning for air quality management and greenhouse gas emissions reductions, which have enabled better integration between the state's efforts to achieve compliance with federal air quality standards and its goal of reducing greenhouse gas emissions by 80% by 2050.

Across these three areas, we distill a number of regulatory design considerations that may be valuable for regulators in China. These include the importance of the following:

- A **science and technology foundation** that provides a firm basis for air quality management;
- **Stakeholder engagement** that builds the consensus, trust, and commitment necessary to enable manufacturing innovation and technology adoption;
- **Long-term vision and clear goals** that provide long-term visibility and certainty on forthcoming regulations to manufacturers, equipment owners, government agencies, and the general public;
- **Integrated planning** that enables goals for multiple pollutants (PM_{2.5}, ozone, SO₂) and greenhouse gas emissions to be met simultaneously and at lowest cost;
- **Incentives** that encourage adoption of clean air technologies, as well as a source of **funding** to pay for incentives; and
- **Proactive enforcement** that uses the latest available technologies, matches enforcement programs to compliance strategies and technologies, imposes meaningful penalties for noncompliance, provides performance guarantees through warranties, and encourages transparency through accurate labeling and certification.

PRIORITY AREAS FOR COLLABORATION ON INNOVATION AND MARKET FACILITATION

As part of this study, we conducted a small survey of 18 clean technology manufacturers in the United States to gauge their interest and experience with the market for clean air technologies in China. The survey included interviews with manufacturers in most of the five Bluetech areas.

Survey respondents identified five areas where support from governmental and non-governmental organizations could facilitate smoother market entry into the Chinese market for clean air technologies:

- Assistance in building **local partnerships**;
- Stronger protection of **intellectual property rights**;
- An enhanced **regulatory framework** that provides stronger enforcement, clear incentives, greater transparency, and clearer roles and responsibilities;
- Greater **public awareness** of air pollution issues; and
- Greater international **harmonization** of air quality and greenhouse gas standards and the technologies used to meet those standards.

RECOMMENDATIONS

Going forward, we recommend three kinds of activities in which continued collaboration between China and the United States could produce transformative results:

- **Joint collaboration on strategies for meeting long-term air quality and climate goals.** By coordinating planning on longer-term air quality and greenhouse gas emissions

goals, China and the United States can provide manufacturers, financial institutions, and entrepreneurs with greater certainty regarding the technologies and the potential size of markets for different technologies needed to meet these goals.

- **Deeper collaboration on enabling regulations.** Deeper collaboration on enabling regulations for clean technologies would allow more in-depth exchange on the details of U.S. regulatory experience to support China's air quality goals. It would also build a foundation for engagement that enables regulators in the United States to learn from China's experience over the next decade, as U.S. regulators look for solutions to longer-term air quality challenges in the United States.
- **Joint efforts to facilitate market entry, innovation, and healthy competition.** Promoting open markets for clean air technologies in both countries would facilitate innovation and competition, lowering the costs of meeting longer-term air quality and climate goals. By harmonizing the requirements and timing of regulations, such as emissions standards, the two countries would create a much larger market for clean air technologies.

For more information, please visit AsiaSociety.org/AClearOpportunity

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