Received: 15 October 2021 | Accepted: 21 October 2021

DOI: 10.1002/ep.13771

SPECIAL SECTION

ENVIRONMENTAL PROGRESS & SUSTAINABLE ENERGY

US-China cooperation on low carbon development planning and analysis in China's provinces and cities

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Abstract

From 2009 to 18, the US based Center for Climate Strategies and Beijing based Global Environmental Institute led a cooperative US-China relations program on low carbon development (LCD). The template for bilateral cooperation leveraged traditional policy innovation and mainstreaming procedures in China through early stage training and counterpart exchange, co-development and piloting of tools, national endorsement for official use, training and capacity building, and cooperative planning actions. The experience suggests that the bilateral cooperation model through high level technical and institutional cooperation between governmental and nongovernmental experts worked well and can be replicated with customization to new bilateral relationships at different jurisdictional levels and for different issue areas. However, to succeed it requires years of stable investment and continuous counterpart engagement, and its application to new bilateral cooperation must address a variety of barriers. The China subnational LCD co-development process was enabled by an existing US template for state level comprehensive climate action planning applied in over 20 US states. Its domestication in China resulted in creation of the China Subnational LCD Planning and Analysis Toolkit, a pilot in Chongqing, official endorsement by China's National Development and Reform Commission (NDRC), and further recognition through a US State Department – China NDRC EcoPartnership. Ultimately, it involved many partners, including the Chinese Academy of Sciences Institute for Policy and Management, the Guangzhou Institute of Energy Conversion, and over 30 provinces and cities. It led to new China efforts addressing renewable energy implementation in South China, and for LCD and renewable energy cooperation in Southeast Asia.

KEYWORDS

climate change, energy policy, environmental planning, life cycle analysis, renewable energy

1 | CCS/GEI US-CHINA PROGRAM HISTORY AND PLATFORM

From 2009 to 2018, the Washington, DC based Center for Climate Strategies (CCS) and the Beijing based Global Environmental Institute (GEI)* conducted a bilateral strategy program to improve US China relations on issues related to climate change mitigation. The US-China program involved joint activities by a range of partners and participants inside and outside government to encourage forward thinking on US China relations and support advancement of energy modernization, economic shift, and low carbon development (LCD) in China's provinces and cities, the South China region, and Southeast Asia. Cooperative actions included high-level dialog and exchange; partnership-based capacity building and technical tool and template development; planning and analysis pilots; and mainstreaming actions to foster technical readiness and transition to scale up implementation. The cooperation also provided insights on US-China bilateral cooperation approaches to align national interests and avoid undue competition and conflict, specifically through incorporation of LCD mechanisms into US trade and technology programs and China's Belt and Road and South–South Cooperation on Climate Change programs. Figure 1 illustrates key components of the LCD program and adoption process in China.

The basic technical approach of the CCS-GEI program, following official endorsements by US and China national governments, was to equip subnational officials and analysts in China with training, tools, and methods on LCD Planning and Analysis (or a "Toolkit"†). The Toolkit was supported by a comprehensive LCD Planning and Analysis Curriculum. The program engaged learners in "learning by doing" pilots and provided technical support on local LCD policy planning and analysis. Training was provided to Government officers and research institute analysts in a wide range of China's cities and provinces in order to help subnational policy makers build innovative and integrated program capacity on LCD and green growth.

The CCS US-China program was launched between CCS and GEI in 2009 in recognition of a widely applied template for US state level action on climate change by CCS. The template supports comprehensive, multi-objective climate, energy, and economic action planning and analysis, and its potential for application to China's LCD interests through its 12th Five Year Plan and subsequent five-year plans. In the US from 2004 through 2009, CCS conducted over 20 comprehensive state level climate action planning and analysis processes in cooperation with US governors and over 1500 diverse stakeholders from civil society, business, finance, academia, and government.‡ These initiatives were conducted in cooperation with numerous governmental partners (governor's offices and cabinet officials) and were designed to align climate change goals with existing high-level priorities (such as economic, energy, and environmental goals) and to support implementation of new program actions and policy and market shifts at the subnational and national levels. Similarly, China's 12th Five Year Plan also envisioned goal driven programs for simultaneous attainment of economic development, energy intensity reduction, and greenhouse gas (GHG) emissions reductions by Chinese provinces and cities under a national commitment framework.§

At program inception, CCS and GEI launched a multi-year bilateral exchange between technical and thought leaders in both countries. In the US, this included sector level planning and analysis experts, university economic and energy specialists (e.g., the University of Southern California), leading macroeconomic modeling groups (e.g., REMI, Inc.), and environmental and energy officials of leading US states (e.g., New York and California). In China, early stage exchange included the Chinese Academy of Sciences (CAS) Institute for Policy and Management (IPM),¶ The Chinese Academy of Governance (CAG), the Guangdong Province Development and Reform Commission (GDRC), the CAS Guangzhou Institute of Energy Conversion (GIEC), Jinan University, Guangdong Province, and the City of Guangzhou. The exchange program then shifted to an intensive phase of co-development of a Toolkit for subnational LCD planning and analysis between CCS, GEI, and CAS/IPM.

In 2013, the Toolkit and its suite of integrated technical tools was piloted in the Provincial City of Chongqing and officially endorsed for national application by the Chinese National Development and Reform Commission (NDRC). Ultimately 33 China provinces and cities would receive capacity building and or a combination of capacity building and technical support for applying the Toolkit. In its final 2 years of formal operation, the US-China program began a special focus on South China renewable energy technology implementation and financing with partner GIEC. Objectives also included the expansion of LCD and renewable energy planning cooperation to Southeast Asia, starting in Myanmar. Cooperation activities throughout the decade-long program were led by CCS, GEI, GIEC, and CAS/IPM with participation by many local and national partners (see Figure 2). By 2018, the program had provided direct training for over 200 local officials and experts in China who subsequently trained 1000 additional local counterparts. Overall, LCD trainings support in 18 cities and 13 provinces addressed policy and sector program action that could cover 33% of China's GHG emissions, 36% of electricity consumption, and 40% of China's GDP.

2 | CHINA SUBNATIONAL LCD TOOLS, TEMPLATES, AND TRAINING

CCS, GEI, and CAS-IPM staff worked closely over a period of 5 years to co-develop the Toolkit and its many elements as the anchor for future capacity building, mainstreaming, and cooperation. The starting

*CCS and GEI are nongovernmental organizations located in the US and China respectively. More information about them is available at www.climatestrategies.us and http://www.geichina.org/en/.

†More information about the China Subnational Low Carbon Development Planning and Analysis Toolkit is available at http://www.climatestrategies.us/chinalcdplanning.

‡Over 20 final state action plan reports conducted by CCS through Governor's Executive Orders, directives, and state legislation are available at http://www.climatestrategies.us/us-projects-programs.

§https://www.chinadialogue.net/UserFiles/File/PDF_ebook001.pdf

¶CAS/IPM has since been reorganized as the China Academy of Sciences Institutes of Science and Development (CASISD), http://english.casisd.cn/at/overview/.

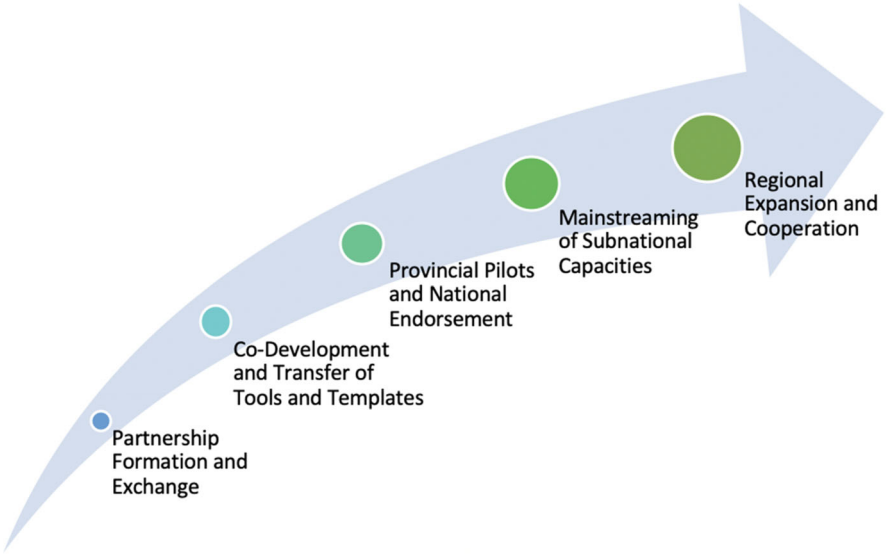

FIGURE 1 Process for China adoption of subnational low carbon development

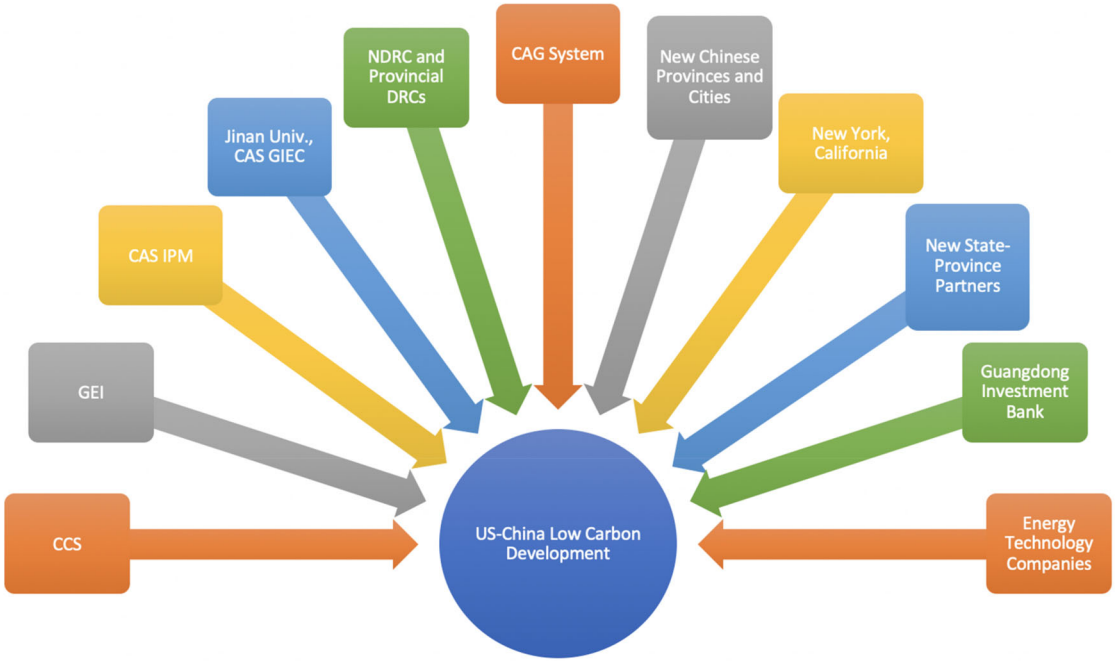

FIGURE 2 CCS-GEI LCD program partners

point for the template was the CCS Action Planning and Analysis Toolkit applied in the US.** Following initial technical transfer activities, a process of intensive "domestication" for China use was implemented through a process of co-development and piloting. A parallel training and capacity program was also developed in native language, including a curriculum, tool system, and learning by doing program.

**More information about the CCS Ten Step Action Planning Process and Action Planning Toolkit is available at http://www.climatestrategies.us/action_planning.

The Toolkit is structured as an integrated modeling framework and decision support system to facilitate stepwise decisions required for full spectrum LCD policy development and implementation in all economic sectors. This includes specialized procedures and technical tools for a series of developmental planning and analysis steps that include: (1) analysis of historic and future GHG, energy, resource and socioeconomic baselines; (2) identification, scoping, and screening of LCD response actions within and across sectors; (3) direct, integrated, and indirect analysis of costs and benefits of LCD actions, including GHG impacts, energy and resource supply shifts, net present value

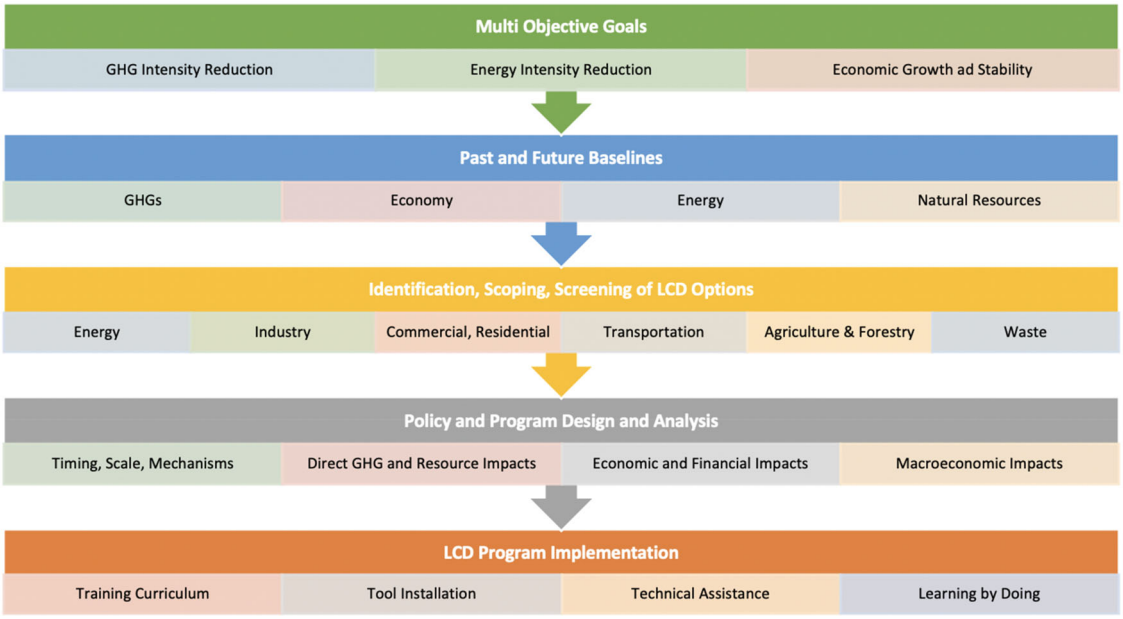

FIGURE 3 China subnational LCD Planning and Analysis Toolkit Framework

(NPV) economic impacts, cost effectiveness impacts ($/ton GHG removed), and macroeconomic impacts (employment, growth, and income). Economic sectors covered by the Toolkit analysis and decision support system included: energy supply (heat and power); residential, commercial, and institutional (energy use); industry (energy use and process emissions; transportation (fuels, vehicles, and infrastructure); agriculture and forestry (land use change and management practices); and waste management (reduction, reuse, and recycling) (Figure 3).

A series of joint technical activities were involved in customizing the Toolkit for China.[††] These were carried out through a combination of in person technical workshops in China and remote activities between partners inside and outside China. The process was enabled by dual language capabilities and a web-based information sharing platform along with regular text and phone communication between participants at the individual and or group levels. The stepwise activities that partners engaged in during this period included the following technical development steps:

- Establishing overarching goals and objectives for GHG intensity reduction, energy intensity reduction, and economic growth with flow down procedures for policy and technology development and performance analysis.
- Creation of China goal driven integrated modeling framework with soft links between stages of decision making and analysis, including baselines, options, direct, and indirect impacts analysis.
- Structuring empirical baselines to match the structure and composition of China's subnational economies and energy and resources base, and the new policy and technologies to be analyzed.
- Structuring data sources and collection methods to match China subnational baselines and baseline shift analysis needs as well as institutional constraints and capacities.
- Structuring catalogs of policy and technology options in each sector to match subnational opportunities and needs in China, including existing program enhancements and innovations from China and other regions, including the US, consistent with 12th Five Year Plan goals.
- Creating Multi Criteria Analysis (MCA) scoping and screening procedures and tools for selection of high priority policy and technology options in all economic sectors to enable local prioritization of LCD needs, consistent with 12th Five Year Plan goals.
- Creating design templates for specification of customized implementation parameters for policy and technology applications to support detailed impact analysis, including the timing, level of effort, coverage, and China specific implementation mechanisms for each proposed new action.
- Structuring analysis methodologies to capture the net impacts of policy and technology induced baseline shifts at the individual (line item) and aggregate (integrative) levels, and to enable granular policy and technology performance review as well as broader sector level evaluations.
- Structuring empirical analyses by China users to include explicit determination of analysis methods, data sources, and key assumptions as well as the scope of new actions to be analyzed.
- Creating general equations for each sector to enable development of customized calculation of direct impacts on GHG, energy, and resources based on design parameters of new actions.

[††]More information about the CCS-GEI Toolkit development process can be found in Reference 1.

- Creating pathways and links between direct and indirect impact analysis of LCD policy and technology actions with China macro-economic models.
- Establishment of consolidated spreadsheet modeling tools for use in training and future updating and expansion procedures in China.
- Implementation of learning by doing activities for each step of the process, such as analysis of representative, hypothetical LCD actions, and data sources for particular jurisdictions.

Following the successful piloting of the LCD planning and analysis process and Toolkit in Chongqing in 2013 and official national use by China's NDRC, CCS, GEI, and CAS/IPM began working with CAG to mainstream capacity building through nationwide training of civil servants. This process was interrupted by the industrial facility explosion in Tianjin in 2015,[‡‡] where the initial CAG had been planned, but it continued through broader program engagement. CCS and GEI subsequently launched a second phase to rollout the Toolkit to 30 Chinese provinces and cities, and by 2017 training and application had reached 33 cities and provinces across China (Figure 4).

3 | SOUTH CHINA RENEWABLE ENERGY COOPERATION

Based on national progress of the program and LCD Toolkit, in 2017 GEI and CCS launched a new round of cooperation focused on South China through expanded cooperation within Guangdong Province in coordination with GIEC. New technology and investment partners were also involved, including the Guangdong Investment Bank, local energy planners in the region, and US interests, including advisors to IBM, Nike, and other private enterprises as well as donors. This work culminated in the development of additional tools for technology and financial planning and investment mobilization in South China and in Southeast Asia. The tools included the Renewable Energy Implementation Toolkit (REI Toolkit), Technology Implementation Document (TID) template, and Renewable Energy (RE) Financial Analysis Tool.

Pilot implementation of the REI Toolkit was led by GIEC with support from CCS and GEI. Through its initial implementation, the team identified: key renewable energy zones for solar and biomass based power programs and projects; developed estimates of the economic potential for an industrial rooftop solar photo-voltaic (PV) program in the Huangpu Economic Development Zone of Guangzhou; and identified key impediments to achieving full market potential for the program through a financial assessment of several model projects.[§§]

At that time, GEI, GIEC, and CAS-IPM began expansion of the LCD program to other nations in the region, such as Myanmar, and also began formal coordination with China's Belt and Road and South–South Cooperation programs.

As the program expanded to Myanmar in 2018, CCS supported an LCD and Financing Workshop in cooperation with GEI and GIEC. The workshop included representatives from Myanmar's energy and environmental agencies as well as the Chinese solar energy industry (Guangdong Solar Energy Association and equipment manufacturers) that created a cooperation platform for technology and trade interests to showcase technologies and provide guidance on financing. An objective of ongoing and future work for CCS and its Chinese partners is to expand support to technology and other manufacturers to better understand the full impacts of their operational footprint. For instance, US based companies, such as Nike, have expressed interest in better understanding and forming Asian supply chains, including the sustainability aspects of existing relationships, and exploration of an open collaboration platform in combination with Chinese counterparts. Given current trade issues between the US and China, and COVID concerns, these capabilities would be of high value to both nations as well as the rest of south Asia.

4 | CONCLUSIONS AND IMPLICATIONS

The US-China program built a successful platform for international cooperation on policy planning and implementation on critical themes and issues. This platform enabled a productive dialog and mutually beneficial exchange and co-development of solutions-based approaches for governance and finance, as well as mutually beneficial approaches to address competitive and cooperative interests. US partners shared important understandings on the US system of governance and the prominent role of states in national policy evolution and innovation. In China, partners provided special insights into China's policy making and international cooperation approaches on climate change, energy, and economic issues.

For instance: CAS-IPM, in its role as the fact finding and policy development arm of the National People's Congress on climate change and green civilization issues, provided clarity on the format for effective governmental planning and analysis and co-development of low carbon templates for China. Xie Zhenhua, former NDRC vice Chair provided high level guidance on China's cooperation interests on climate change with the US. Mr. Lu Xiulu, former Deputy Director of the Guangdong DRC facilitated a critical understanding of provincial governance, goals, and capacity needs for low carbon development in South China. Dr. Zhao Daiqing, Chief of the GIEC Department of Energy Strategy Research, provided a format for co-development of tools and capacities at the city and province level in South China. Local officials in China provided critical insights into capacity gaps and future program requirements, and technical and financial providers shared insights on critical barrier removal needs. An enabling environment of bilateral cooperation was critical to this dialog.

The relationships developed in the program and the personal conversations that forged them enabled a procession of high level technical and institutional coordination with governmental entities in China. These relationships also opened the door for new levels of commercial cooperation by China and US private enterprises and civil society organizations. It would appear that this approach was productive in

[‡‡]https://en.wikipedia.org/wiki/2015_Tianjin_explosions

[§§]Renewable Energy Implementation Toolkit: Development and Testing in South China, CCS, GIEC, GEI, http://www.climatestrategies.us/library/library/view/1214.

FIGURE 4 China provincial and city LCD planning and capacity building

the past decade and could also be of high value to the US and China in the next decade, notwithstanding changes in the global political environment.

At issue more broadly is the question of which role the US and China can play in other regions, including Southeast Asia and Africa, how their own interest can concede with those of other nations, how much bilateral cooperation is needed, for which issues, and by which paradigm(s). This includes national paradigm level decisions on whether the allocation of technologies and resources so critical to national economic, energy, and environmental security will be determined by a free, fair, and sustainable marketplace, or, instead, through the use of power, such as financial strength and lending.

Today we are in a crucial flashpoint in US and China activities that will influence economic, energy, and environmental policy and market paradigms in emerging regions. In our experience, much work remains to enable the level of commerce, trade, and investment actions needed for acceleration and scaling of low cost, high value LCD technologies and practices. The transition to a modern sustainable marketplace with open, deep, and fluid participation will require establishment of a strong bilateral cooperation platforms with public and private partners in each nation. It will require expansion of capacity and commitment within nations to ensure that they are capable partners and recipients of cooperative assistance. In addition, it will require high-level targeted strategy, expertise, and diplomacy over time.

The lessons learned from the CCS-GEI US-China program are critical to understanding how the US and China may seek to support this needed level of cooperation, how financial and technological assets may be deployed in other regions, and how those interests may collide or coincide with national interests. As we have learned through US-China cooperation, the model of joint, high level, technical and institutional cooperation between public and private partners that is focused on expert exchange, co-development, and mainstreaming actions may be a critical ingredient to success.

At this time, US-China relations have begun to shift away from cooperation, and this has complicated the ability of CCS and GEI to support US-China and Southeast Asia cooperation programs despite ongoing requests from partners. In Southeast Asia and other developing regions, cooperative assistance is needed at both the national and local levels. This assistance is needed across an array of planning objectives: energy security, economic development, financing and investment, technology mobilization, natural resources management, and environmental security.

The CCS-GEI US-China program experience provides a template to mold future US-China relations favorably in other regions for the development of local capacities and effective policy responses to a variety of issues under new governmental approaches.

DATA AVAILABLITY STATEMENT

Data is available through publications available at the CCS website and on request.

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REFERENCE

1. Yu Q, Roe SM, Xu S, et al. China-U.S. cooperation on China's sub-national low carbon planning toolkit development and application. *J Renew Sustain Energy*. 2015;7:041501. doi:10.1063/1.4927000

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How to cite this article: Peterson TD, Roe SM, Ugliano A, Yu Q, Liao C. US-China cooperation on low carbon development planning and analysis in China's provinces and cities. *Environ Prog Sustainable Energy*. 2021;e13771. doi:10.1002/ep.13771