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Pursuing a Low-Carbon Action Plan: The Case of Chongqing City

Xianchun Tan and Henry Lee

Xianchun Tan is a Professor at the Institute of Policy and Management, Chinese Academy of Sciences. She was a Postdoctoral Research Fellow with the Environment and Natural Resources Program in 2016-2017.

Henry Lee is the Director of the Environment and Natural Resources Program and a Senior Lecturer in Public Policy at the Harvard Kennedy School.

China has committed to stabilize its greenhouse gas emissions and increase the percent of non-fossil fuel energy to 20% by 2030. This goal will require significant programmatic and policy changes across all sectors of its economy. The challenge is how to make these changes without incurring measurable political and economic costs. Ideally governments will draw lessons from efforts in other countries, but the Chinese system is unique. Hence it has created its own learning experiences by investing in multiple pilot policies and programs at the provincial and city levels.

Many of China's cities are very large and include multiple districts, counties, and neighborhoods; and each one can serve as the locus of a separate low carbon pilot. These pilots are designed by local officials that are informed by guidelines from the central government. Thus, China often will have many "policy experiments" all taking place simultaneously. Lessons from these pilots are then used in the development of national and provincial programs and guidelines that shape future local initiatives across the country. These pilots are the ultimate example of "learning by doing."

In designing low-carbon development strategies, China has relied heavily on multiple pilots. In 2010 and 2012, its National Development and Reform Commission (NDRC) approved pilots to reduce carbon emissions in six provinces and 36 cities. One of the cities was Chongqing, which is one of the largest cities in the world, measured by area (82,400 square kilometers) or by population (30.16 million people). To put Chongqing in perspective, the city's population is about 77%

of that of California's. It is divided into 21 districts and 17 counties. In 2015, its GDP reached $240 billion, which is equivalent to Finland's.

Chongqing is located in southwest China and is the economic center of the upper Yangtze basin. It is one of five national central cities and has the same jurisdictional status as a Province.

This policy brief synthesizes existing studies on the impacts of the low-carbon pilots implemented by the city of Chongqing and draws insights from these experiences for the development of national policies and programs.

The Pilot Programs

Over the period 2010-2015, Chongqing adopted 41 low carbon action policies and 28 pilot projects or about 91.7% of those suggested in the 12th Five-Year Plan. These came on top of reductions in energy intensity of 20.95% which exceeded the city's target in the 11th Five-Year Plan.

While its success in meeting these targets was laudable, the annual CO_2 emission growth rate exceeded 8.7% over the ten-year period from 2000-2010. Approximately 70% of the city's emissions came from coal burning, both by electric utilities and industrial manufacturers. If one takes into account coke and other coal combustion products the percentage is closer to 80%. Chongqing is in the middle stage of industrialization, and thus its energy demand is continuing to rise, as compared with Beijing, whose economy is primarily service-oriented, or some of the western provinces where the industrialization process is only beginning. Slowing down the growth in carbon emissions, while maintaining the same rate of economic growth and avoiding any reductions in employment is a challenge for cities and provinces that are reliant on heavy manufacturing and coal-fired power plants of which there are many in China.

To assess the impact of Chongqing's low-carbon pilot plan and project its impacts into the future, The Institute of Policy and Management of the Chinese Academy of Sciences and the Center for Climate Strategies (a U.S. think tank) developed two models that complement each other. The first is a bottom-up model that allows analysts to assess the carbon emission reduction potential and the costs and benefits of specific policies and programs. The second is a top-down model that allows analysts to evaluate the macro-economic impacts of policies on sector-based employment, production output, and the impact on GDP and inflation. The second model has been

used throughout the country and has separate input-output data bases for almost all of China's 26 provinces and most of its larger cities.[1]

One of the challenges in assessing the impacts of low-carbon initiatives is how to differentiate lower energy consumption stemming from economic structural changes that occur due to broad macro-economic changes from reduction due to government programs and policies. For a city such as Beijing, whose economy is already 85% service oriented, this is not a problem, but for Chongqing, still in the middle of its industrialization drive, parsing the differences between these two forces can be difficult.

Findings

Using these models, researchers at the Institute of Policy and Management made the following findings.

Chongqing's low-carbon policies have resulted in many successes. In 2012, it reduced its carbon emission intensity by 8.14% and the cumulative reduction over the period of the 12th Five-Year Plan is likely to be in the vicinity of 11.5%. In addition, Chongqing, has planted 204,000 hectares of new forest, which has increased the city's forest coverage by 42%.

While Chongqing will meet its CO_2 reduction goals in the 12th Five-Year Plan, it will have great difficulty meeting its targets in the 13th Five-Year Plan for 2020 – a 40-45% reduction from 2005 levels – without paying a higher cost in terms of economic growth.

As shown in Figure 1, the potential reductions will be primarily in the industrial and power sectors. However the largest reductions (26.5%) will not come from government programs, but from structural changes in the industrial base as carbon-intensive industries are replaced by less carbon-intensive industries. About 19% will be from changes in the energy mix, but the opportunities will be limited by the region's low endowment of energy resources. About 5% will come from carbon sinks, but this number will remain small through 2035.

1 Tan, Xianchun; Dong, Lele; Chen, Dexue; Gu, Baihe; Zeng, Yuan, China's regional CO2 emissions reduction potential: A study of Chongqing city, Applied Energy, Vol 162, pp 1345-1354, 15/1/2016.

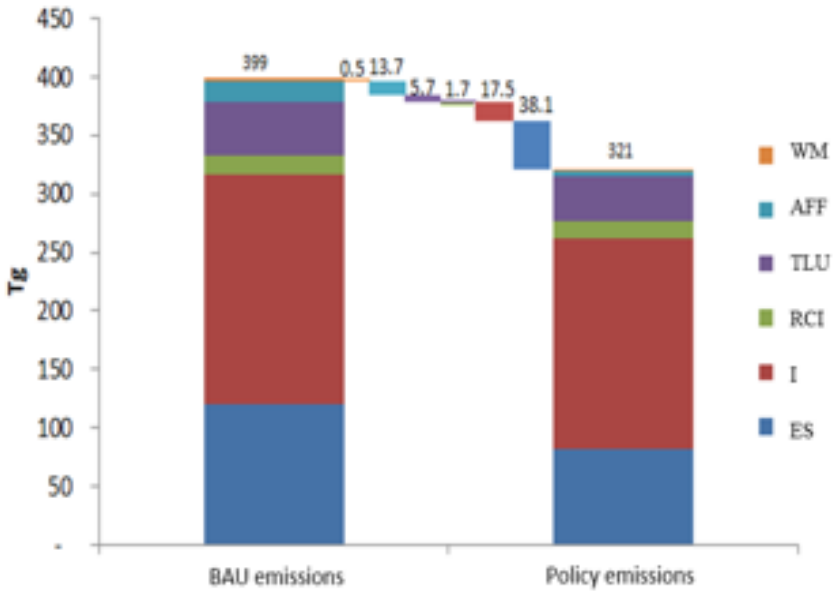

Figure 1. CO_2 reduction potential of sectorial policies in Chongqing in 2035 (WM: Waste Management; AFF: Agriculture and Forestry; TLU: Transportation and Land Use; RCI: Residential and Commercial buildings; I: Industry; ES: Energy Supply)

In assessing the many programmatic and policy changes, ten will account for 86% of the reduction over the next five years. In 2015, they will reduce CO_2 emissions by 39.8 million tons, which is about 10% of the city's total greenhouse gas emissions. However, the cost of these programs will be a 0.49% reduction in the city's GDP and a 0.72% increase in the unemployment rate. In 2020, the total CO_2 reduction will be 72.3 million tons from the business as usual projection and the cost will be a reduction in GDP of 0.54%. If instead of measuring the economic impact of the ten policies aggregated together, one looked only at investment in renewable energy and energy conservation in new buildings, one would find that each had a slightly positive impact on GDP – 0.0004% and 0.09%. Meanwhile investing in new energy technologies and improving light vehicle fuel efficiency would have a negative influence on GDP, at least in the first five years.

On the positive side, energy price inflation will decrease by 1.7%. Most of these reductions stem from investing in new energy-efficient buildings, improving the efficiency of light vehicles, and energy conservation in the industrial sector, resulting in a net reduction in cost – all three will lower the demand for energy supplies.

Implications

Chongqing is facing challenges similar to several of China's major heavy manufacturing centers. It will be difficult to reduce CO_2 emissions without affecting the level of economic and employment growth. Therefore the timing of various initiatives becomes important. The optimal sequence of policies and targets for one area of China may not be optimal for another. Thus, similar policy

options may achieve different results at different times depending on what stage of industrial development the province or city finds itself.

Chinese government officials will have to structure low-carbon initiatives so that they integrate economic considerations and carbon and conventional emission reductions simultaneously. Such a process will require a closer working relationship among the relevant departments in both the central government and local governments. Energy, environmental, and economic policies will need to be integrated so that they can all work to a common goal of a healthier, cleaner, and more prosperous China.

Given the complexity of balancing economic and carbon goals, policies that are more efficient become very cost-effective and should continue to influence future policy designs. Past studies have clearly shown that greater use of market incentives as opposed to relying exclusively on command-and-control options will cost less and have less of an impact on overall economic growth, while realizing reductions in carbon emissions.

Finally, the future of China's low-carbon development strategy will be played out at the provincial and local levels. Therefore the experiences of cities, such as Chongqing, become barometers for the ultimate design of China's low-carbon development strategy.

Environment and Natural Resources Program
Belfer Center for Science and International Affairs
Harvard Kennedy School
79 John F. Kennedy Street
Cambridge, MA 02138

www.belfercenter.org/ENRP

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