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The Economy and Environment Program for Southeast Asia (EEPSEA) was established in May 1993 to support training and research in environmental and resource economics across its 10 member countries: Cambodia, China, Indonesia, Laos, Malaysia, Papua New Guinea, the Philippines, Sri Lanka, Thailand, and Viet Nam. Its goal is to strengthen local capacity for the economic analysis of environmental problems so that researchers can provide sound advice to policymakers.

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The Hidden Benefits of Cooling the Global Greenhouse : A Lesson from China

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For many scientists, global warming is the most important environmental challenge we face. However, many developing country governments are taking a 'wait and see' attitude to the problem. This is primarily because international agreements on the issue currently focus on action by developed countries. Many politicians also see global warming as an unnecessary financial burden that could stifle competitiveness. →

A summary of EEPSEA Research Report 2004-RR2, *Options for Mitigating Greenhouse Gas Emissions in Guiyang, China: A Cost-Ancillary Benefit Analysis*
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No-regrets options do exist

Now, however, a new study from China has investigated the additional pollution-reduction benefits that anti-global warming action can bring. It finds that the economic value of these benefits can be so great that, under certain circumstances, such action can pay for itself. The report concludes that China, and other developing countries, have available a number of "no regrets" policies towards global warming. If put in place, they would cool the planet and, over time, benefit the national purse.

Focusing on Local Benefits

The research was carried out by Jing Cao, currently at the John F. Kennedy School of Government at Harvard University. She looked at the situation in Guiyang, the capital of Guizhou Province. With a population of over two million, the city is a key industrial base in southwest China. It suffers from severe air pollution, mainly due to the operation of old and inefficient coal-fired power stations, steel plants, cement factories and other industrial boilers and plants.

Cao investigated how measures to reduce the amount of carbon dioxide produced by these sources would affect the level of other pollutants in the city's air. (Carbon dioxide is the key greenhouse gas (GHG) thought to be responsible for global warming.)

Cao took inspiration from many previous studies that have shown that GHG reduction projects can bring substantial reductions in associated emissions such as sulfur dioxide, particulate matter, and other pollutants, some of which are hazardous to human health and the natural environment. Cao's innovation was to economically value any such additional "ancillary benefits" so that she could advise the city government on whether it would make economic sense to implement any climate change prevention policies.

Informing Global Warming Policy

The work was done against a background of rapidly increasing carbon dioxide emissions in China. As the second largest emitter of GHGs and the most populous country in the world, China currently accounts for about 13% of global carbon dioxide emissions. This is mostly because of its high reliance on coal consumption and sharply increasing use of automobiles.

The need for tools to help make decisions about global warming policies is vital. Even though China is not currently bound to any GHG emission or carbon abatement limits, it announced at the World Summit on Sustainable Development held in Johannesburg, South Africa (September, 2002), that it has completed domestic procedures for the approval of the Kyoto Protocol, and that it will play an active role in mitigating GHG emissions. But since ancillary benefits are rarely incorporated into cost-benefit analyses by the Chinese government, current decision-making on climate change is often prone to bias.

Choosing Appropriate Technology Options

The first step in the study involved deciding what different GHG mitigation options should be investigated. There are abundant coal reserves in Guizhou, and most of the province's industrial production is very reliant on this fuel. Cao therefore focused on cutting-edge technologies that can reduce the amount of carbon dioxide produced when coal is burnt in power stations and during other industrial processes. These technology options included Integrated Gasification Combined Cycle (IGCC), Atmospheric Fluidized Bed Combustion (AFBC), Pressurized Fluidized Bed Combustion (PFBC), Oil Fired Combined Cycle (OILCC) and Gas Turbine Combined Cycle (GASCC). Cao also looked at the impact of traditional energy-saving projects. In particular, she

for climate change

investigated the effect of renovating or upgrading boiler systems.

Among the options excluded were carbon sequestration by reforestation (since Guiyang is an urban area) and wind or geothermal power generation (neither of which are appropriate to Guiyang's location).

Predicting Pollution Patterns

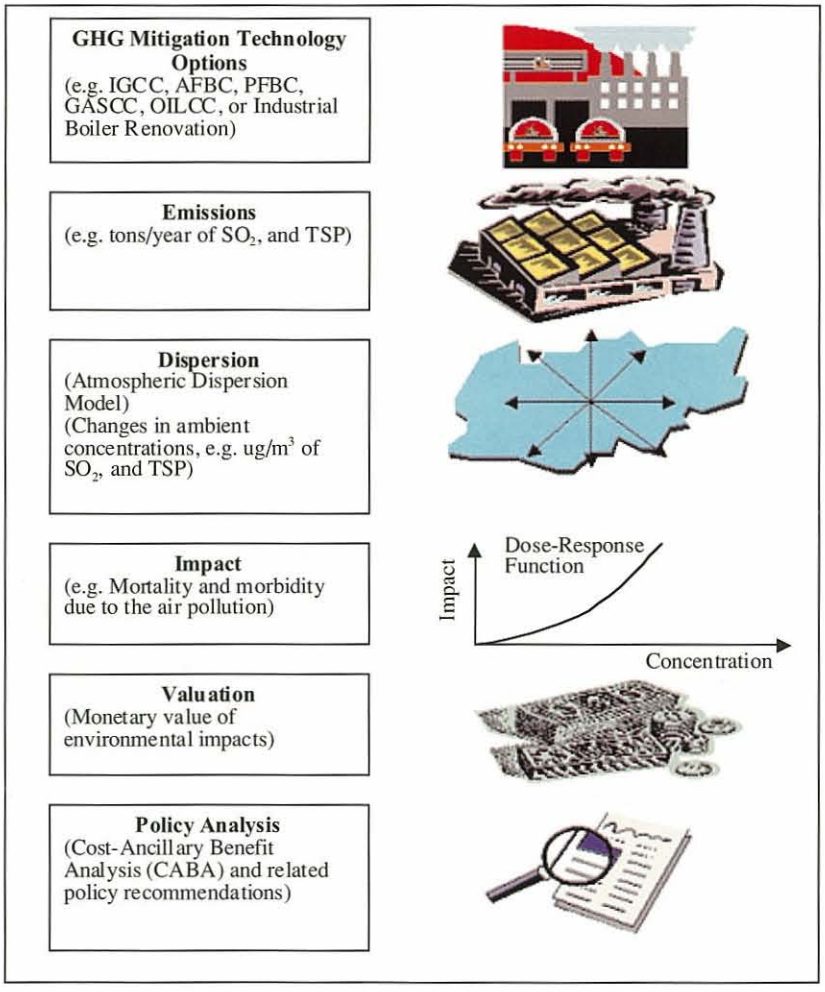
Cao then investigated what impact the implementation of each of the cleaner technologies would have on pollution in the city - and how much each would cost. She focused on how levels of carbon dioxide, sulphur dioxide and total suspended particulate (TSP) would change if each of the different technology options were put in place. The different technologies were compared against the 'baseline' pulverized coal plant technology that is currently widely used in the city's power plants and industrial sites.

Data on current levels of pollution emission from each of the city's main polluting enterprises was taken from detailed city-wide industry pollution emission surveys conducted in 1996 and 1998. Estimates of the pollution reductions that each new technology option would bring were calculated using data on factors such as emissions coefficients, combustion efficiency and coal consumption. This information - along with details of implementation costs - came from previous studies.

Health Impacts and Benefits

The third step in Cao's research looked at how the different levels of pollution would affect people's health. To see how the pollution from factories and power stations would spread, she used an adjusted Gaussian Plume Air Dispersion Model, designed by Professor Li Jinlong at Peking University. This was used to predict annual average ambient concentrations of SO2 and TSP.

She then used a dose-response function to see how the different levels of pollutants would affect people's health. Once this was done, Cao calculated the value of any resulting improvements in the health of the city's population. To do this, she used data from national and international studies to place a monetary value on the different levels of illness and premature



Flow chart of assessment of ancillary benefits by using the damage function approach

mortality that would result for each different technology scenario.

Comparing Costs

The final stage was to conduct a cost-ancillary benefit analysis (CABA) of each technology option. She first calculated the overall costs and benefits of each technology option to society as a whole and compared them to those of Guiyang's current (baseline) technology. For example, she looked at the impact of setting up a 300MW IGCC plant. She found that the difference in initial capital investment costs between an IGCC plant and an equal-capacity 'baseline' plant is 470 USD/KW. However, an IGCC plant is more efficient than a 'baseline' plant and so uses less fuel. Its running costs, however, are slightly higher. Overall, compared with the baseline technology, IGCC technology can save 4.4 USD/KW. Its ancillary benefits were about 19.1 USD/KW each year, giving an annual total benefit of 23.5 USD/KW. This was then compared with the initial capital cost in a cost-benefit analysis framework.

The Best Options

Cao found that the various GHG reduction options would produce substantial ancillary benefits in both the electricity and the industrial sectors. The value of the ancillary benefits ranged from 89 to 278 USD/tC (US dollars per ton carbon) for the different options every year. Under the most plausible assumptions, AFBC turned out to be the most-favoured GHG mitigation option for the power sector. If the discount rate was less than 12%, the best option was PFBC, followed by IGCC. Cao found that although the initial capital investment costs for OILCC and GASCC were lower than the other options, their annual fuel costs were very high, making them the least-favoured options. In the industrial sector, coal pre-treatment and boiler renovation was the best option when the discount rate was higher than 8%. When the discount rate was lower than 8%, applying new and efficient boiler systems gave better results.

No Regrets, More Action!

These results show that "no regrets" GHG mitigation options do exist for both electricity generation and industrial boiler improvements. Cao therefore recommends that China put together an energy policy to encourage local governments to research and implement those options that best suit their localities' specific circumstances.

Cao acknowledged that without compensation from the government, private firms would not readily make the initial investment necessary to 'clean up'-their plants, because many of the benefits accrue to the general public in the form of reduced health damages. This suggests that a subsidy or tax credit would be justified to encourage private firms to implement the most effective GHG mitigation options.

Cao also recommended that China should take advantage of its entry into the World Trade Organization, which will not only make technology transfer easier, but also stimulate much needed market, financing and law enforcement reforms. These will help create a climate that would encourage the kind of technological improvements highlighted here.

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