End-Use Energy Modeling for China's 10th Five-Year Plan

Alan LAMONT, Lawrence Livermore National Laboratory[1],
Jonathan SINTON, E. O. Lawrence Berkeley National Laboratory[2],
GUO Yuan, Beijing Energy Efficiency Center[3]

LBNL - 48044

Abstract

The government of China views energy efficiency as one of the key approaches to ensuring that China has adequate energy to support economic growth, and to reducing environmental impacts from energy production. The 10th Five Year Plan will include a series of recommendations for new policies and programs to encourage energy efficiency. The Beijing Energy Efficiency Center and several US national laboratories are teaming up to develop models and analyses to assist in formulating recommended policies and support those policies throughout the discussions and debates that will produce the final Five Year Plan.

[key words: energy end-use, energy analysis, energy policy, China]

I. Introduction

The government of China is preparing its 10th Five-Year Plan (10th FYP), to be issued in March of 2001. The 10th FYP will articulate the basic governmental objectives and policies for 2001 to 2005. It provides the basic guidance to all levels of government and many parts of industry in China including generally non-binding targets for outputs, investments, and preferred technologies. As China has moved toward a more open economy, China's government has attempted to transform itself from a player to a referee. The 10th FYP is expected to emphasize policies and regulations that will indirectly steer the economy through market forces rather than directly control decision making at all levels.

---

[1] Ph: 510-495-2477, Fax: 510-486-6996, lamont1@llnl.gov

[2] Ph: 510-486-7081, Fax: 510-486-6996, JESinton@lbl.gov

[3] Ph/Fax: 86-10 6973-2059, guoyuan@public.east.cn.net

The development of energy supply, promotion of energy efficiency, and control of pollutant emissions will be a key part of the 10th FYP. Policies are being developed to ensure that the market promotes energy efficiency both through market forces and through more indirect government programs, such as standards setting, information dissemination, and restructuring to ensure that energy costs are borne by the appropriate parties.

China has long recognized the need to use sound modeling and analysis in developing its policies. The Beijing Energy Efficiency Center (BECon) is taking on more responsibility to provide the analysis needed in the energy sectors. BECon belongs to the Energy Research Institute, a research body that belongs to the State Development and Planning Commission (SDPC), and is similar to the national laboratories in the U. S.

Since the types of models and analyses needed to support the 10th FYP are similar to these types of analyses that the U. S. national laboratories conduct in support of energy policy formulation in the U.S. (for example, see [1]), BECon is working with Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, and the National Renewable Energy Laboratory to assist it in developing a set of energy system models and apply them to develop and evaluate policies for the 10th FYP. This project, the China Energy and Carbon Scenarios Project (Project) is unique in that it will provide direct support for China's internal planning process for energy efficiency. This paper describes the objectives, emerging approach and the initial efforts to develop an analytic underpinning for this modeling effort.

In this paper we describe the background to the Project, including the current market and institutional barriers that hinder adoption of energy efficient technologies and practices. We then describe the significance of the national planning process in promoting energy efficiency, and then show how the Project will provide support to that process. We end by discussing the proposed modeling approach for the Project, the sectors to be covered, actions that China has taken or could take to promote energy-efficiency which will be considered in developing scenarios.

II Energy efficiency policy and planning in China and barriers to market solutions

Energy efficiency has been a key component of China's energy development strategy since the early 1980s [2]. Energy conservation policies and programs have contributed significantly to cutting growth in energy use to about half the rate of economic growth over the last two decades Without these

vigorous efforts to promote energy efficiency, China's energy consumption, as well as pollutant emissions, would be much higher than current levels. However, these efforts were based on a planned economy and aimed at ameliorating severe energy shortages that left a large fraction of industrial capacity idle. In the context of a planned economy, the government usually identified the amount of energy to be saved and allocated responsibility and budgets for energy savings among regions and sectors. With a policy of promoting a market economy and the elimination of energy shortages (as result of rapid development of energy supply industries), the traditional energy conservation planning approach is no longer suitable.

China's demand for energy services will rise as the economy expands and living standards improve. Even with continuing attention to energy efficiency, China could become the world largest energy consumer, as well as the largest greenhouse gas (GHG) emitter, by the year 2030. Because China's energy oil and natural gas resources, are limited, China will rely heavily on soft coal while increasing oil and natural gas imports. This could influence world energy markets. Reliance on coal has resulted in serious environmental problems in China, and is affecting the global climate. Energy efficiency is regarded as the most cost-effective approach to reduce GHG emissions in China in next a few decades.

Under current conditions, market forces alone are unlikely to bring about satisfactory investment in energy efficiency due to: high transaction costs, inadequate information among end users, a tradition of industry passing all increased costs on to the consumer, lack of an institutional structure to promote energy efficiency, lack of availability of high-efficiency products (equipment and materials), inadequate laws and regulations to supplement market forces where the market is ineffectual (such as standards setting), and a host of other factors. China is developing programs to address these concerns. A range of possible government programs and actions are discussed later in this paper.

III Energy efficiency and the policy-making process

The formulation of the 10th FYP has already begun and will be completed early in 2001. Many of the recommendations regarding energy efficiency originate with the staff of BECon, based on extensive research and discussion with stakeholders. The draft proposals are then delivered to the State Development Planning Committee for review and modification. These drafts will be circulated and discussed during 2000 and early 2001 at various of government before they are finalized in the 10th FYP.

The process of formulating the draft recommendations and the discussions that follow will rely in part on modeling and other analysis to identify the sectors of the economy with greatest cost-effective potential energy savings, and the types of programs that could be expected to be most effective in achieving those savings. It is expected that BECon will be frequently asked to explain and justify their recommendations, and comment on other proposals, using the analyses and models prepared in the course of the Project.

The Project will support the creations of a group of policy analysts in the area of energy efficiency and renewable energy, produce alternative policy scenarios and evaluate their impacts, ensure that these results are made available and play a part in the policy discussions, and publicize the results to a broader audience in China and other countries.

IV Approach to modeling and analysis

The Project will use scenario analysis to investigate the impacts of a variety of possible energy efficiency and renewable policies and programs on energy supply and use, pollutant emissions, and costs.

A. Team composition

The Chinese team will be led by BECon, a research organization under the Energy Research Institute (ERI). ERI is providing direct support for energy efficiency policy in the State Development and Planning Commission (SDPC) which has responsibility for formulating the Five-Year Plans.

Actual implementation and day-to-day management under the Five-Year Plans is overseen by other branches of government such as the State Economic and Trade Commission (SETC) and line ministries such as the Iron and Steel Bureau, the Chemicals Bureau, the Ministry of Construction, and the State Building Materials Administration. The Chinese team includes researchers from BECon as well as researchers from line ministries so that that the project will influence policy through researchers who are closely involved with implementation as well as those who advise the top national planners.

On the U. S. side, the project team includes mainly researchers who are thoroughly involved in policy analysis for various sectors in the U. S. and elsewhere. The Lawrence Berkeley National Laboratory (LBNL) is responsible for overall project coordination and establishing a consistent analytical framework. LBNL will also work directly with the Chinese modelers in the industry and buildings sectors. Oak Ridge National Laboratory will be responsible for the U.S. efforts in the transportation sector, the National

Renewable Energy Laboratory for renewable energy, and the Stockholm Environmental Institute for training and support of LEAP—the modeling framework chosen for the project.

B. Sectoral focus

The modeling will focus on the more energy-intensive sectors and sub-sectors, particularly those which are growing most rapidly. Currently key sectors are:

Industry: Iron and steel; nonferrous metals (copper, aluminum, lead, and zinc); Chemicals (ammonia, chlor-alkali, and ethylene); pulp and paper and building materials may be included at a later date. The industrial sector analysis will also consider the impacts of improving equipment such as industrial boilers, motors, and motor systems including fans and pumps.

Buildings: Urban residential, and urban commercial (possibly also rural residential). For each category, envelopes, equipment (HVAC), all major appliances and possibly office equipment will be covered. are to be covered.

Transport: public transport, private motor vehicles, and passenger and freight rail.

Integrating: Energy supply, other than electric power generation, will be considered. Such issues as oil supply, and the balance of oil vs. coal, and development and imports of natural gas will be considered here. Renewable energy sources will be given special attention.

C. Policies and actions that may be considered in scenario analysis

The analysis will proceed by evaluating a number of proposed policy scenarios—each scenario representing a possible set of policies or actions that might be included in the 10^{th} FYP. The Chinese government can encourage energy saving investments and practices within a market framework through policies such as:

Approval for new projects: The government can set guidelines for the types of projects that should receive approval (types of facilities and/or products).

Discouragement of certain classes of facilities: Policies can discourage certain types of facilities (e.g. small power plants, open hearth steel furnaces, etc.) accelerating their retirement.

Encouragement of voluntary agreements with industry: Agreements to observe specific practices (e.g., installation of more efficient equipment, limits on discharges, etc) can be made in lieu of specific government regulations.

Procurement programs: The government can specify what they will purchase to encourage the development of new technologies or practices.

Appliance, equipment, and automotive standards: These specify standard methods for evaluating equipment and specify performance levels that should be met by new equipment or by equipment to be procured by the government.

Building codes: These can specify the standards and performance for construction and for the equipment to be used in the building.

Direct investment: Though seen less and less, the government can make investments in new projects on its own initiative.

Information exchange and training: Programs to train enterprise level energy managers and make available information (technical specifications, performance, etc) needed for conducting the analyses have already been started.

Structural changes in markets: More and more markets especially coal) are moving towards market-based pricing for energy commodities improving decisions making and analysis by the energy manager training programs described above.

Import/export controls and treatment of foreign investors: Importation or exportation of particular types of technologies or energy commodities can be encouraged or discouraged.

D. Model development

Currently we are planning to use a fairly simple accounting framework such as the LEAP software [3], supplemented by spreadsheet analysis. Thus the models will generally represented the expected impact of policies on the structure of the energy system.

Defining the model structure will be done initially through a series of workshops held in the US During the Spring of 2000. These workshops will emphasize: types of policies and policy analysis that have been used in the US and elsewhere, training in use of modeling software, formulation of models at the appropriate level of detail, approaches to representing proposed policies within the modeling framework, issues in gathering and validating data, and interpretation of modeling results. After this series of workshops, the Chinese team will continue to develop models and analyses over the coming year with consulting assistance from member of the US team.

V Conclusions

This project begins a collaboration between researchers at both Chinese and American institutions to suggest new ways that modeling and analysis can be brought into the Chinese policy process. Over the next few years this will require modeling and analysis to help identify desirable policies initially. It will also require modeling and analysis to defend proposals and contribute to the ongoing discussions that refine the final policies.

American researchers have attempted to influence policy formation for a number of years with some successes and some failures. U.S. policy analysts have learned from these efforts and can make contributions to the process in China. This project will provide the Chinese researchers with a detailed understanding of the ways that the U.S. has formulated policy analysis and will provide suggestions about how that experience might be adapted to China. It is hoped that some of these approaches will prove useful for China.

At the same time, the problems facing China, and the measures that are available to the Chinese government are often very different from the experience in the U.S. or Europe. The political process and the needs for analytical support within the political process are also be expected to be different. It is hoped that a broader understanding of the ways that modeling and analysis fit into the Chinese context will assist all the modelers and analysts in the team to better understand how modeling can best be tailored to meet the needs of policy formulation in a broader range of political and social contexts.

VI References

[1] M. A. Brown and M. D. Levine (eds.), Scenarios of U.S. Carbon Reductions :Potential Impacts of Energy-Efficiency and Low-Carbon Technologies by 2010 and Beyond, Lawrence Berkeley National Laboratory (LBNL-40533) and Oak Ridge National Laboratory (ORNL/CON-444), 1998.

[2] J. E.Sinton, , M. D. Levine, and Q. Y. Wang, "Energy Efficiency in China: Accomplishments and Challenges", *Energy Policy* 26(11): 813-829. September 1998.

[3] Stockholm Environment Institute, LEAP: Long Range Energy Alternatives Planning System, User Guide, Stockholm Environment Institute , Tellus Institute, Boston, 1997