Promoting Energy Efficiency as a Cost-Effective Resource in China: A Review of Jiangsu's Efficiency Power Plant Pilot[1]

Bo Shen and Barbara Finamore,[2] Natural Resources Defense Council
Mona Yew,[3] Pacific Gas and Electric Company

ABSTRACT

China faces significant energy and environmental challenges as it strives to maintain its high rate of economic growth in the midst of economic downturn, growing electric demand, and increasing pressure to reduce its greenhouse gas emissions. In spite of great efforts made by the Chinese government to reduce the country's energy intensity, energy efficiency has not yet been used as a cost-effective energy resource to help China meet these challenges.

As a result, a few provinces have taken the lead to drive change through a "bottom-up" approach in China. One such province is Jiangsu, which is one of the fastest growing and most dynamic provinces in China and also a sister province of California, one of the leading states in the United States in energy efficiency achievements. Jiangsu has embraced the concept of using Efficiency Power Plants (EPP) – a virtual power plant comprised of a set of demand side management (DSM) activities – to help curb its industrial electricity demand and consumption.

This paper describes Jiangsu's efforts under a Jiangsu-California cooperative agreement to implement an EPP pilot. The joint work has helped Jiangsu build a large-scale industrial EPP program equivalent to a 300MW power plant during the period from 2005 to 2007. The implemented energy efficiency measures have helped Jiangsu reduce 580 megawatts of peak load, save 2 TWh of electricity annually, and reduce CO_2 emissions by 1.88 million tons (State Grid Corporation DSM Instruction Center 2008, 3). However, a large-scale expansion of EPP projects would require central government policy support.

Introduction

China has achieved remarkable economic growth over the last decade. Yet with increasing prosperity and a rapidly growing economy have also come sharp and unsustainable increases in energy consumption. As China becomes the world's fastest growing consumer of electricity, it is also becoming one of the world's largest CO_2 emitters.

China recognizes that its current energy and environmental trends are neither sustainable nor consistent with the country's long-term economic, energy, and environmental interests. The Chinese government has set an ambitious goal of reducing energy consumption per unit of GDP by 20% between 2006 and 2010 as part of its eleventh Five-Year Plan, as well as launched a "Top-1000 Program" that aims at reducing energy consumption of China's 1000 highest energy-consuming industrial enterprises. As China's industrial sector accounts for approximately 70% of

[1] The Natural Resources Defense Council's (NRDC) work discussed in this article was supported by grants from the Energy Foundation, the google.org, and REEEP. The authors would like to thank Michelle Li for the help on graphs.
[2] Dr. Bo Shen is the Director of the China Energy Efficiency and Demand Side Management Project, and Barbara Finamore is a Senior Attorney and the Director of the China Program for the NRDC.
[3] Mona Yew is an employee of Pacific Gas and Electric Company (PG&E) on secondment to the NRDC. The views expressed in this paper are her own and do not reflect that of PG&E.

the country's total energy consumption (NDRC & National Bureau of Statistics 2007, 2), reducing the electric demand and energy usage in China's industrial sector is clearly the key to making the 20% energy intensity reduction goal.

One critical way to improve China's energy efficiency is through the use of demand side management programs, or DSM. China has already adopted a number of policies and measures to promote the use of high efficiency equipment in the industrial sector, such as adjustable-speed motors, water pumps, high-efficiency transformers, compact fluorescent lamps (CFL), and so on. However, China's approach to DSM has been focusing on individual retrofit projects, and as such, there has been no concerted effort to develop the capacity needed to identify and implement DSM – specifically, energy efficiency – projects on the sort of scale that can be used as a programmatic resource.

There is a growing trend in China that large-scale, cost-effective DSM programs are developed through the implementation of the Efficiency Power Plant (EPP) – a virtual power plant comprised of a portfolio of demand side management activities. An example of such an approach is the large-scale industrial EPP pilot in China's Jiangsu Province, developed under a California-Jiangsu partnership on energy efficiency improvements. The initial success of the program has caught the attention of the Chinese top leadership, which led to Jiangsu being designed as a model for industrial energy efficiency programs in China. This paper describes the efforts and results of the Jiangsu's pilot. It also provides several policy recommendations aimed at facilitating the further development of large-scale energy efficiency programs in China.

Fast Growing Energy and Electricity Demand in China

Between 2000 and 2006, China's total energy consumption has jumped 10.1% each year on average (National Bureau of Statistics 2007)[4]. During this same period, the country has experienced even higher increases in electricity consumption at an average annual rate of 13.5%, with the industrial sector leading the increase at 14.3%[5] (National Bureau of Statistics 2007). According to China's State Electricity Regulatory Commission (SERC), China took 38 years to reach the milestone of 100 gigawatts of installed generation capacity. In 2007, however, China increased its generation capacity by 100 gigawatts in just one year, 82% of which came from coal-fired facilities (SERC 2007, 15). This is the equivalent of adding two large-scale coal-fired power plants a week. And yet, the electric supply is hardly keeping up with demand[6]. At the same time, China is facing intense pressure to reduce its carbon emissions, much of which coming from the coal-heavy power sector. China must find alternative means to meet its energy demand, reduce related emissions, and keep up with its planned economic growth targets[7].

[4] Calculation based on annual energy consumption data contained in the China Statistical Yearbook, Chapter 7-2, Total Consumption of Energy and Its Composition, published by the National Bureau of Statistics of China.

[5] Calculations based on annual electricity consumption data contained in the China Statistical Yearbook, Chapter 7-6, Electricity Balance Sheet, published by the National Bureau of Statistics of China.

[6] For example, a recent interview with Jiangsu's electricity sector officials has revealed that the forecast for the power shortfall in Jiangsu between available supply and demand in 2009 could be as high as 7000 MW under worst case scenarios.

[7] The Chinese government has set the GDP growth goal at 8% for 2009 – a period for which many countries have forecast negative growth (Bao 2009).

Energy Efficiency as a Cost-Effective Resource

Unlike renewable energy, which has much higher up-front costs to build, energy efficiency is perhaps the most cost-effective resource to address China's energy and related environmental challenges. The value of energy efficiency has been demonstrated in many regions, most notably in California, which has successfully held its per capita electricity consumption flat for over 30 years due largely to its aggressive energy efficiency and codes and standards programs (Rosenfeld 2009). Various studies have also shown the value of energy efficiency as a cost-effective resource in China[8], where the energy system is far less efficient compared to the world average. According to a report released by China's Energy Research Institute, China's energy intensity per unit of GDP production is currently 2.3 times, 4.5 times, and 8 times higher than that of the United States, the European Union, and Japan, respectively (Zhou, Yu & Zhu 2005, 1). High energy consuming sectors such as steel, metals, chemicals, and building materials accounted for more than 70% of China's industrial energy use, while contributing only 20% to the industrial value-added (China Energy News 2006).

China has in fact made great efforts in reducing the total energy intensity of its economy over the past decade, especially in the industrial sector. However, the total electricity consumption in the industrial sector remains high, accounting for 76% of China's total electricity consumption in 2007 (China Electricity Council 2008, 2), due to heavy industrial growth. The industrial sector thus presents a unique opportunity for China to drastically reduce its energy consumption growth rate. A recent McKinsey Global Institute study also concludes that the opportunity to improve energy productivity in China's industrial sector could be as high as 10% of the global opportunity (Bressand et al. 2007, 19).

Developing Energy Efficiency Resources through Investing in a Portfolio of DSM Opportunities

China has decades of experience with demand side management. However, its focus has historically been focused on load management through pricing mechanisms such as time-of-use electricity tariffs that create large spreads between peak and off-peak prices, and interruptible pricing that compensate end-users for voluntary demand reductions during the peak time. Load management also includes techniques such as peak shaving through which larger customers adjust their production schedules corresponding to peak load in order to reduce peak demand as well as utilization of off-peak storage like ice-storage air conditioners and heat-storage electric boilers (Hu, Moskovitz & Zhao 2005).

Recent programs in China have extended the focus to improving end-use energy efficiency and encouraging energy conservation. A number of policies and measures have been adopted to promote the use of high efficiency power equipment such as adjustable-speed motors and water pumps, high-efficiency transformers, compact fluorescent lamps (CFL), and so on. However, China's approach to energy and demand savings stops at individual retrofit projects. This approach has been unable to encourage local governments and engineering firms to develop enough capacity to identify and implement DSM projects on the sort of scale that they can be used as a programmatic resource. In addition, China faces unique challenges beyond those typical barriers (e.g. lack of capital, lack of access to information, etc.) that are common to

[8] For example, Moskovitz et al. 2007, Finamore et al. 2006.

energy efficiency programs. Some of China's challenges reside in its inherent power market structure regarding generation pricing and tariff setting methods, while others relate to the lack of legal basis to adopt effective DSM policies and funding mechanisms[9].

There is a growing trend to apply the concept of "Efficiency Power Plant" (EPP) in China for large-scale, cost-effective DSM programs. An EPP refers to a virtual power plant that aggregates a number of DSM options and couples them with various financial and technical strategies. Depending on the mix of DSM projects, an EPP may have the characteristics of a peaking power plant (e.g. with primarily load management projects) or a base load plant (e.g. with permanent load reductions through energy efficiency projects). In other words, an EPP is essentially a portfolio of energy efficiency and demand response and/or load management programs. Because of the aggregation, EPP investments, including the cost of rebates and other incentives, can be financed through the use of debt, equity, or other sources of capital. EPPs can be very cost-effective compared with conventional power plants in China. The weighted average cost of an EPP (15 fen/kWh) is estimated to be a third of the cost of new power source (35-40 fen/kWh) (Moskovitz et al. 2007, 3) If properly structured, choices about the purchase of efficiency versus conventional power sources could be made in an integrated, least-cost fashion. A number of EPP pilots are under way in China at the provincial level, such as in Jiangsu.

Efforts under California-Jiangsu Partnership in Developing an EPP Program in Jiangsu

Located in the Yangtze River delta region, Jiangsu is one of the fastest growing and most dynamic provinces in China. With its economy growing at a double-digit rate for 16 years in a row, Jiangsu has become an economic powerhouse in China, producing over 10% of the country's total GDP in 2007[10] (National Bureau of Statistics 2008). Jiangsu and California, each leading their respective countries in economic growth, forged a collaborative friendship in 1985. The two sister regions share many similarities but have significant differences, particularly in the use of energy (see Figure 1). In 2007, for example, 95% of electricity generated in Jiangsu came from coal and 82% of the electricity consumption went to the industrial sector. The numbers are only 16% in both cases in California. Electricity use in Jiangsu is four times less efficient than in California.

California-Jiangsu Agreement on Energy Cooperation

California and Jiangsu signed an Agreement for Cooperation (Agreement) in 2005 to share California experience and offer Jiangsu technical and policy expertise with regards to energy efficiency. The Agreement seeks to establish a partnership to advance the two state/province's common interests in developing and implementing energy efficiency and demand response programs, establishing renewable energy policies, removing market barriers, and opening up the market for clean and energy efficient technologies and products.

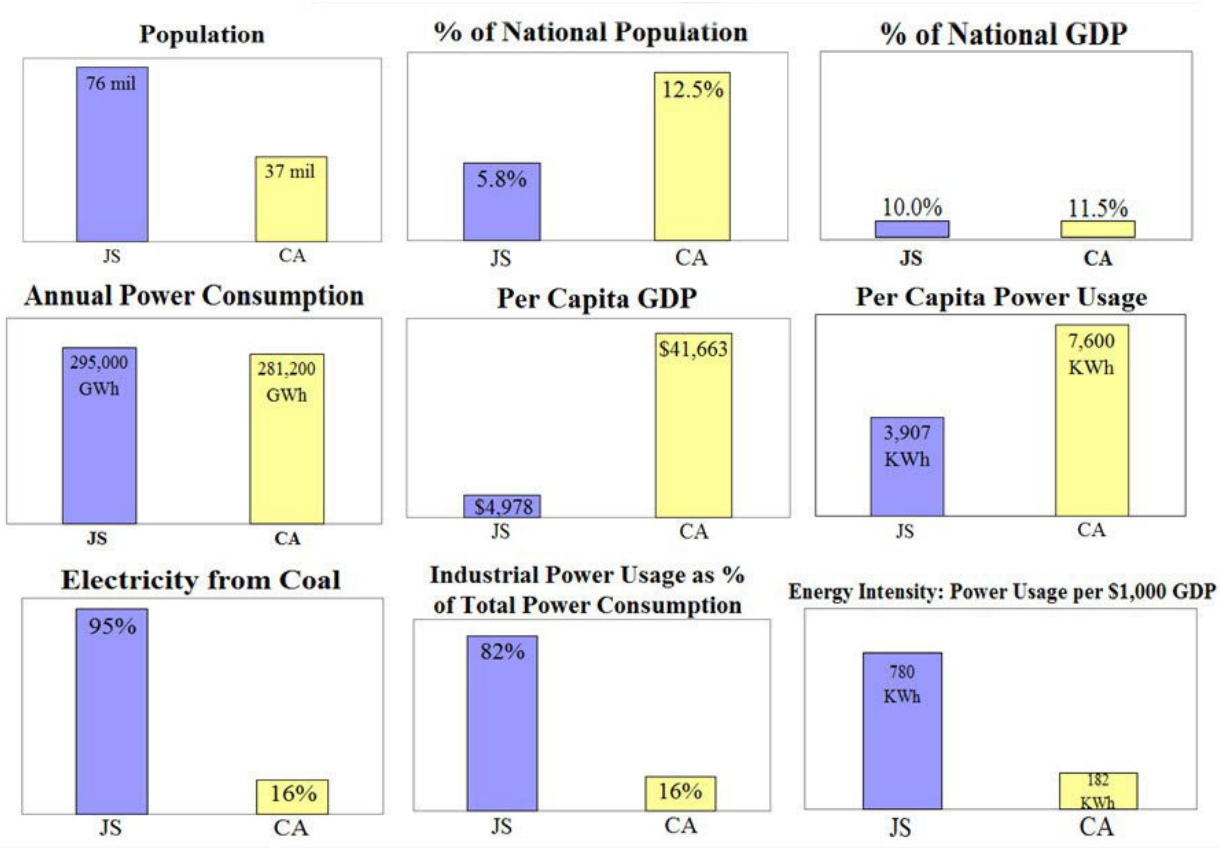
Implementing this Agreement has involved coordination among a number of government agencies, utilities, private companies, nonprofit organizations, energy service companies, public-private partnerships, industrial associations and technical organizations. The Natural Resources

[9] For a detailed discussion on barriers to DSM in China, please see Hu, Moskovitz & Zhao 2005.
[10] Calculation based on data contained in the China Statistical Yearbook, Chapter 2-1 Gross Domestic Product and Chapter 2-15 Gross Regional Product, published by the National Bureau of Statistics of China

Defense Council (NRDC) and the China US Energy Efficiency Alliance (based in San Francisco) are both signatories to the Agreement and have been instrumental in facilitating and carrying out these cooperative activities.

The main focus of the Agreement to date has been the cooperative efforts on the development of a large-scale industrial EPP program in Jiangsu, described below, in order to: (1) achieve cost-effective and verifiable energy savings and carbon reductions; (2) pave the way for scale-up in Jiangsu in order to achieve full EPP implementation; and (3) provide successful pilot project models as well as training and technical materials that will promote EPP replication in other provinces of China.

Figure 1. Comparison between Jiangsu and California



Source: California Energy Commission 2007; National Bureau of Statistics 2007; State Grid Corporation DSM Instruction Center 2008

Strategic Plan for DSM

NRDC's team of experts assisted the Jiangsu Economic and Trade Commission (JSETC) in developing the province's Demand Side Management Strategic Plan for Jiangsu Province, China (Plan). The Plan called for the implementation of a portfolio of DSM projects through which every one RMB[11] invested in energy efficiency would return seven RMB to the local economy. Specifically, the opportunities identified in the Plan could cut annual electricity use by

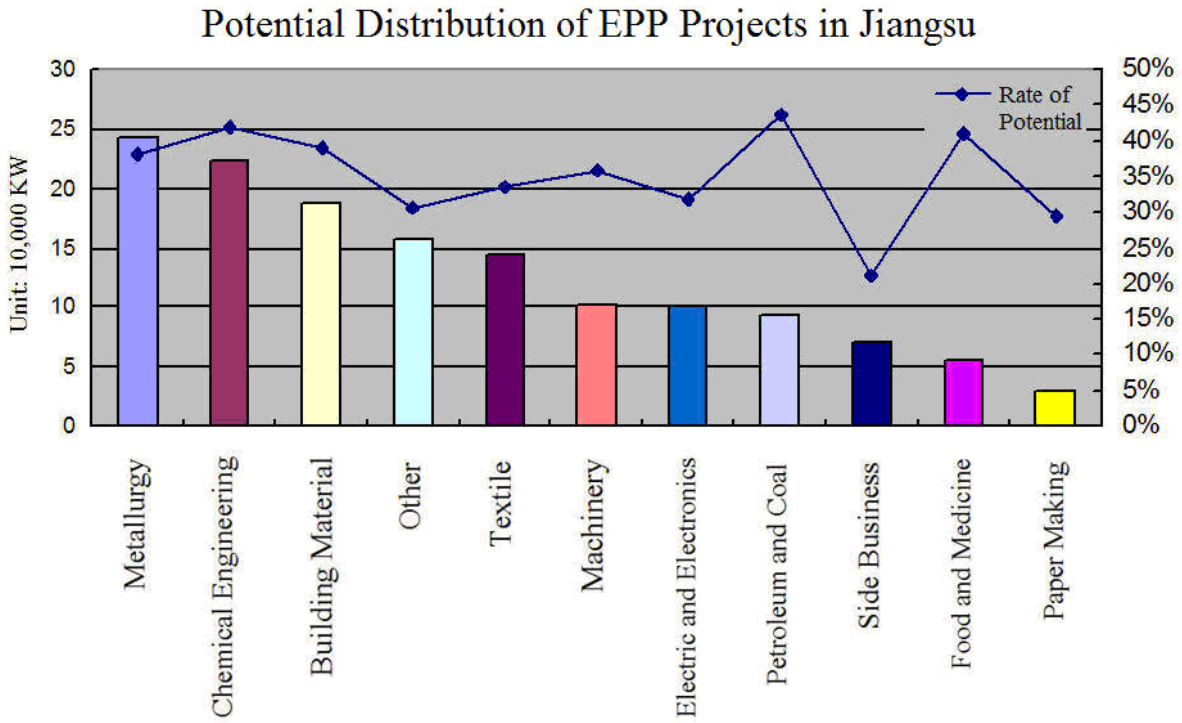
[11] Chinese currency, 1 RMB equals approximately to 15 US cents

30,633 GWh and 12,133 MW in cumulative annual electricity savings by implementing a ten-year portfolio of eight demand-side initiatives (Optimal Energy, Green Energy Economics Group & State Grid Corporation DSM Instruction Center 2006, 6). Based on growth projections in the Plan, the identified savings opportunities could potentially meet up to 8% of Jiangsu's projected growth in electricity needs and 15 percent of peak demand growth between 2006 and 2015 (ibid. 7). Furthermore, implementing the entire portfolio would eliminate 613 million metric tons of carbon dioxide and 8.6 million metric tons of sulfur dioxide associated with reduced use of coal by 2015 (ibid. 14).

Identify DSM Opportunities

Jiangsu started its EPP efforts by conducting a comprehensive energy efficiency potential survey in 2005. The survey collected and analyzed the equipment make, model, age, and efficiency data from 16,275 large industrial and commercial customers that comprised 61% of the total electric consumption in the province (State Grid Corporation DSM Instruction Center 2008, 4-5). Jiangsu prioritized its EPP pilot efforts based on the survey results, targeting motor/drive retrofits, variable speed drives, and lighting retrofits in six major industrial categories - chemical, metallurgy, building materials, textile, machinery, and electronics (ibid. 5).

Figure 2.



Source: Optimal Energy, Green Energy Economics Group & State Grid Corporation DSM Instruction Center 2006

There is a general lack of awareness of energy saving methodologies as well as limited information on energy saving options and associated costs throughout China. NRDC organized a group of international experts to work with JSETC to conduct a series of energy audits in some

of the most energy-intensive factories. The audits would serve the dual purpose of raising the awareness of the factory owners and operators regarding the energy and demand saving opportunities, and identifying specific projects in upgrading power equipment, retrofitting industrial facilities, and improving production processes. Each comprehensive energy audit included a thorough study of the facility's energy use profile, a list of recommended energy efficiency measures based on an economic and cash flow analysis of all efficiency measures studied, and a financial analysis for an optimal mix of government incentives (see discussion below)[12] and private investment. The audits also presented recommended monitoring and verification measures. JSETC has now instructed every industrial facility applying for financial incentives to use the same analysis process in developing the incentive application.

Establish DSM Incentive Fund[13]

Financial barriers such as limited access to private capital and commercial loans for energy efficiency improvements are traditionally addressed through incentive funding for energy efficiency projects. As there is currently no centrally authorized DSM funding mechanism, each province must find its own source of funds to help local enterprises meet their energy savings targets, and Jiangsu is no exception. Jiangsu has been able to negotiate a DSM carve-out from the utility company's operating budget – up to 100 million RMB (equivalent to US$ 15 million) per year – to provide incentives for industrial energy efficiency projects. However, this funding is determined annually and contingent upon the availability of funds from the utility company, and therefore not guaranteed.

According to the JSETC, the process for reviewing incentive applications and selecting projects consists of two phases. First, the incentive applications are prescreened at the local level where the projects and savings claims are reviewed for reasonableness and approved/rejected/adjusted accordingly. Each city or county may also set a savings threshold, e.g. 300 – 1000 kW of minimum demand savings, based on local industries or economic factors. The prescreened projects are then submitted to the provincial government and further reviewed by a group of invited experts from provincial energy conservation centers or DSM centers, universities, and utilities. The final selection is based not only on the merits of the projects and potential savings but also on geographic equity. To avoid tax and complicated accounting procedures incurred by a cash award, the incentives are offered to the selected projects in the form of utility bill credit, half upfront and half upon project completion. The provincial and local energy saving inspection center staff is responsible for verifying the project installations and savings upon project completion, which may include data logging and measurement as needed. After a project passes inspection and verification, the energy saving inspection center staff notifies the utility company to transfer the remaining incentive.

[12] In addition to incentive funds available in Jiangsu, the Chinese government instituted an incentive program to help meet its energy reduction target during the 11th Five-Year Plan. The program pays 200-250 RMB, depending on geographic location, per ton of coal equivalent saved after verification. Eligible enterprises must meet a minimum savings threshold of 10,000 tons of coal equivalent and have a satisfactory energy plan and management and accounting system.

[13] The information contained in this section was obtained from interviews with JSETC (JSETC 2009).

Develop Effective Mechanisms for DSM Implementation

Implementation holds the key to the success of the EPP pilot. China in general has little to no experience in implementing large-scale energy efficiency programs. While the JSETC has been serving as the program administrator for the EPP pilot, it lacks the manpower and experience to fully plan, administer and implement a comprehensive program. As a result, the participating factories are generally left on their own to develop and implement energy efficiency projects.

NRDC has helped Jiangsu and other regions in China overcome the knowledge gap by cooperating with China's National Development & Reform Commission (NDRC) and the State Grid Company in developing the country's first DSM Implementation Manual for Industrial Retrofit Program (Manual). The Manual, which has recently been approved by the NDRC for publication, will provide a step-by-step guide for Jiangsu and other provinces in China in designing and implementing DSM programs in a consistent manner. The Manual, which includes a discussion on representative DSM program administration models utilized in the U.S. (i.e. utility based, government affiliated, and implemented by independent third parties) may also help spark debate on how best to institutionalize energy efficiency administration and implementation in China. NRDC has taken the initial steps in working with Jiangsu to explore an effective administration framework that the province could adopt.

NRDC is also exploring ways to integrate energy service companies (ESCOs) as an effective DSM delivery channel as well as helping to provide appropriate mechanisms for measuring and verifying results. Among NRDC's efforts are a pilot project to develop a performance-based contract between JSETC and a Taiwanese energy service company, and training sessions to introduce international protocols for measuring and verifying energy savings, such as the International Performance Measurement and Verification Protocol (IPMVP), to Jiangsu. The NRDC is also in the process of helping China develop a national framework for evaluating, measuring, and verifying the performance of programmatic DSM, including methodology, institutional structures, administrative frameworks, and implementation platforms.

Results to Date from the Jiangsu EPP Pilot

The collaboration has already yielded tangible results for Jiangsu. According to the JSETC, the joint work has helped the province build a large-scale industrial EPP program equivalent to a 300MW power plant in the three years from 2005-2007. Jiangsu has raised a total of 240 million RMB for incentives and successfully leveraged 1 billion RMB of private investment (State Grid Corporation DSM Instruction Center 2008, 3). The installed energy efficiency measures have helped Jiangsu reduce 580 Megawatts of peak load, save 2 TWh of electricity annually, and reduce CO2 emissions by 1.88 million tons (ibid. 3). In a very exciting development, Jiangsu's work in developing the nation's first large-scale DSM pilot program caught the attention of China's leaders, who cited Jiangsu's program with approval and submitted it in early 2007 to relevant central government departments with instructions to promote it as a national model[14].

Based on Jiangsu's success, China has invited NRDC and its partners, including those in California, to work with three additional provinces/cities[15] to develop similar programs. The

[14] Information based on personal communication from officials of Jiangsu Economic & Trade Commission.
[15] The three provinces/cities include Hebei Provinces, Beijing, and Jiangsu's Suzhou City.

NRDC and the China-US Energy Efficiency Alliance are also jointly launching a year-long nationwide capacity building initiative on energy efficiency implementation at the request of China's National Development & Reform Commission. The goal is to replicate Jiangsu's success in other parts of the country and provide guidance on energy efficiency implementation.

Policy Recommendations to Facilitate Greater EPP Implementation

In spite of the initial success of the EPP project in Jiangsu, energy efficiency is far from reaching its full potential in either Jiangsu or China. The Jiangsu pilot illustrated that a provincial "bottom-up" approach can help draw attention and drive central government action – but only to an extent. Significant barriers – regulatory, policy, institutional, financial, informational, and market – still exist that prevent Jiangsu and the rest of China from developing large-scale energy efficiency programs. The following policies and institutional strategies – some are directly related to Jiangsu's experience described herein and others from prior research that address barriers to energy efficiency in China[16] – are recommended:

1. **Guiding policy from the central government that mandates cost-effective energy efficiency as a resource is critical.** In general, provincial governments have a certain amount of freedom to implement DSM or EPP initiatives, but only if a central policy or directive is in place. The national energy intensity reduction target has been an important driver in Jiangsu and also served to facilitate Jiangsu's DSM efforts. However, given China's electric energy and demand growth and global climate change challenges, the Chinese government can and should institute stronger or more explicit considerations for energy efficiency in various energy related policy decisions. (See below).

2. **The central government should provide policy and financial support to allow utility companies to implement energy efficiency.** Jiangsu's experience shows that the utility company can and does play an important, albeit small, role in implementing the EPP pilot. Replicating Jiangsu's success at a national scale would require central government action to give utilities full authority as well as revenue protection, such as through decoupling, to implement energy efficiency[17]. If decoupling is not feasible at this time and stage of power sector reform in China, then the government should consider compensating the utilities through other means. For example, the central government could allow the utility to reduce its revenue commitment to the government, with the balance used to fund EPP programs.

3. **The central government should create sustainable funding mechanisms for EPP programs.** As mentioned earlier, Jiangsu's EPP pilot funding is negotiated on an annual basis and by no means assured. Governments, both at central and provincial levels, should create dedicated funding through tariffs, special surcharges (e.g. urban construction fees collected through the utility bill), and/or other innovative mechanisms.

[16] For example, Finamore et al. 2003; Hu, Moskovitz & Zhao 2005; Optimal Energy, Green Energy Economics Group & State Grid Corporation DSM Instruction Center 2006.

[17] The central government sets both the generation procurement price and retail electric price. The funding that the utility provides for Jiangsu's EPP pilot as well as any revenue loss from the reduction of electricity sales would have a direct impact on (reduced) profit for the utility.

Ratepayer-supported energy efficiency funding such as a system benefit charge is difficult to initiate in China due to the fear that any electricity price increase would make inflation worse. It would, however, be important for the policy-makers to understand that any price increase from funding energy efficiency will be offset by the reduced electric bill from reduced energy use, and that energy efficiency can provide societal benefits for the economy and reduce pressure on natural resources and the environment, both locally and globally.

4. **China should adopt electricity pricing reform to encourage energy efficiency improvements.** Unlike the U.S. where utilities, state regulators and various stakeholders work together on pricing and other electric industry related issues, pricing reform is under the sole purview of the central government in China. As such, provincial governments do not have pricing "tools" that they can use to further incentivize energy efficiency. The central government should consider adopting new pricing tools such as inclining block tariffs, efficiency based differentials, and energy use quota that charges higher rates for over-the-quota usage of power. In addition, central government should adopt pricing mechanisms that align utility company financial incentives with investments in low-cost energy efficiency resources. For example, investment in EPP programs should be allowed cost recovery in the same way as costs of investing in regular power plants.

5. **Grid companies in China should be mandated to develop and implement cost-effective energy efficiency programs as part of their performance evaluation.** Much as provincial government officials' performance is evaluated based on their ability to meet the national energy reduction targets, the grid or utility companies[18] should have similar mandates to achieve national energy efficiency objectives. As one JSETC official put it, the utility companies currently support EPP pilots "to serve the country" (JSETC 2009). There is currently no incentive for grid companies to deliver superior (or even adequate) energy savings achievements, nor any requirement to conduct integrated resource planning that takes into account EPP as a resource, much less any mechanism that allows utility companies to procure energy efficiency resources in the same fashion as procuring conventional power supplies. The central government should institute such policies or requirements as part of its power sector reform.

6. **China should strengthen international cooperation in energy efficiency.** Jiangsu's experience clearly demonstrates the benefit of knowledge sharing and international cooperation – and much more could be done, including information exchange and capacity building on best practices, utility infrastructure, policy support, and market transformation, to name just a few areas. China should continue international cooperation wherever possible and use the international best practices and lessons learned to help China develop a robust energy efficiency market.

[18] China's utility reform in recent years has transferred power sector from a vertically integrated model to an unbundled structure where generation is separated from transmission and distribution. However, the power market is still a single-buyer market. Generators sell power to the monopoly regional grid companies that own the utility companies and are responsible for the transmission and distribution of electricity. The terms "grid company" and "utility companies" are used interchangeably here.

Conclusion

Jiangsu's success underscores the importance of regional efforts to demonstrate the value of energy efficiency and kindle central government interest. Jiangsu's experience also confirmed what many already know – that the long-term sustainability of energy efficiency programs in China such as Jiangsu's EPP pilot and their expansion to a national scale can only happen with the central government's policy and financial support. With Jiangsu leading the pack and other DSM pilots in China not far behind, China has the perfect opportunity to build upon the momentum that has been gathering and propel energy efficiency to front and center of the nation's energy agenda. By acting now and adopting the policy recommendations listed above, China will be able to reap the benefits of energy efficiency, meet its rising energy demands, and join the world community in its fight against climate change.

References

Bao, Daozu. 2009. "Wen: We Can Achieve 8% Growth." *China Daily*. March 6.

Bressand, F., Farrell, D., Morin, F., Remes, J., Rosenfeld, J., Woetzel, J., Yu, J. 2007. *Leapfrogging to Higher Energy Productivity in China.* McKinsey Global Institute.

California Energy Commission. 2007. The *California Energy Almanac.*

China Electricity Council. 2008. *2007 全国电力工业统计快报 (2007 China Power Sector Statistics Bulletin).* January 11.

China Energy News, " 高能耗行业投资增长较快节能降耗形势严峻," August 2, 2006.

Finamore, B., Hu, Z., Li, W., Lei, T., Dai, Y., Zhou, F., and Yang, Z. 2003. *Demand Side Management in China – Benefits, Barriers and Policy Recommendations.* October. Natural Resources Defense Council.

Finamore, B., Plunkett, J. 2006. "Demand-Side Management Strategic Plan for Jiangsu Province, China: Economic, Electric and Environmental Returns from an End-Use Efficiency Investment Portfolio in the Jiangsu Power Sector." Presented at American Council for an Energy-Efficient Economy Summer Study, August 14.

Hu, Z., Moskovitz, D., and Zhao, J. 2005. *Demand-side Management in China's Restructured Power Industry - How Regulation and Policy Can Deliver Demand-Side Management Benefits to a Growing Economy and a Changing Power System.* ", Washington D.C.: The International Bank for Reconstruction and Development/The World Bank. December.

[JSETC] Jiangsu Economic and Trade Commission. 2009. Personal communication with Nianzhong Cao, Director of Power Division, and Gui Chu, Deputy Director of Power Division. May 21.

Moskovitz, D., Weston, F., Lin, J., Zhou, F.,Yu, C., Hu, Z., and Liu, S. 2007. *Meeting China's Energy Efficiency and Environmental Goals with Efficiency Power Plants (EPPs)*.

National Bureau of Statistics of P.R. China. 2007. *China Statistical Yearbook 2008*. P.R. China: China Statistics Press.

National Bureau of Statistics of P.R. China. 2008. *China Statistical Yearbook 2008*. P.R. China: China Statistics Press.

[NDRC] National Development and Reform Commission and State Statistics Bureau. 2007. "千家企业能源利用状况公报(Report on the State of the Energy Use of the Top-1000 Enterprises)."

Optimal Energy, Inc., Green Energy Economics Group, and the State Grid Corporation DSM Instruction Center. 2006. *DSM Strategic Plan for Jiangsu Province: Economic, Electric and Environmental Returns from an End-use Efficiency Investment Portfolio in the Jiangsu Power Sector*. January 20.

Rosenfeld, Arthur. 2009. "Energy Efficiency in California Standards and Programs," Presentation at the International DSM Implementation Forum, Beijing, February 26.

[SERC] State Electricity Regulatory Commission. 2007. *2007 Electricity Regulatory Annual Report.*

State Grid Corporation DSM Instruction Center. 2008. "建设江苏能效电厂."

Zhou, D., Yu, C., and Zhu, Y. 2005. 我国节能现状与"*十一五"节能重点*. China: Energy Research Institute, November 22.