Proposals for US-China Cooperation on Energy and Climate Change:

Building Energy Rating and Labeling Systems

Carbon Capture and Storage Technology

and

Energy Efficiency Resource Standards

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Introduction

Both the US and Chinese governments recognize the importance of cooperating on energy and climate change and are seeking concrete proposals for projects that can lead to significant GHG emissions reductions, be quickly implemented, come at a reasonable cost, and, most importantly, demonstrate that both countries recognize their mutual interest in collaborating on key mitigation policies and technologies and are already engaged in good faith efforts to combat climate change in advance of the Copenhagen meeting.

Based on NRDC's experience working in China on energy and energy efficiency, we have selected three proposals that we believe will benefit both countries and offer valuable opportunities for sharing technical and policy expertise and experience. The first proposal, building energy rating and labeling systems, is gaining momentum in several parts of the world, and will serve to strengthen compliance with building energy codes for China's massive and rapidly growing building stock.

The second proposal, focusing on CCS demonstration projects that can take advantage of China's existing industrial sources of pure CO_2, would seek to rapidly gain experience with sequestering hundreds of thousands and even multi-million tons of CO_2 in suitable basins. These demonstration projects, which would cost about $20-25 million each, could then set the stage for larger-scale retrofits of existing power plants.

The final proposal seeks to share US experience with energy efficiency resource standards with China, in order to establish a more sustainable mechanism for funding energy efficiency through China's grid companies, which are responsible for procuring electricity supply. Such a policy would have numerous benefits, including reducing peak load and energy consumption growth, and would serve to complement China's existing energy intensity target.

We believe these proposals are win-win opportunities and offer enormous potential for reducing greenhouse gas emissions. Although we have focused in our proposals on projects that can take place in China to address its rapid growth in infrastructure and energy use, we believe that the US would also learn and benefit a great deal from participating in these projects, because both countries share many of the same challenges in improving energy efficiency and reducing emissions from conventional thermal power plants.

Numerous other promising areas for cooperation also exist, such as cool roofs and real-time, web-based energy consumption display systems for apartment residents. In sum, we believe there are many ways that the US and China can cooperate more closely on energy and climate change that offer substantial benefits for each country and will serve to deepen the close relations and mutual respect between the countries.

For more information on these proposals and NRDC's work in China, please contact: Alvin Lin at alin@nrdc.org.

Cooperation on Building Energy Rating and Labeling Systems

I. Background: Building efficiency and greenhouse gas emissions

The US and China are together responsible for 40 percent of global carbon dioxide emissions from fossil fuel use and more than 35 percent of global energy consumption. Buildings account for 40 percent of America's energy consumption and total carbon dioxide emissions; in China, the energy consumption of buildings is 30 percent and growing quickly as more Chinese move to cities.

The Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report (2007) states that the building sector has the greatest potential of any sector for reducing greenhouse gas emissions. Countries will not be able to meet their climate change commitments without addressing building energy performance, in both existing buildings and new buildings.

According to a report on building efficiency in China to be released by the Boston Consulting Group and Natural Resources Defense Council, improved building efficiency could avoid 1.9 billion tons of CO_2 emissions in 2015 (assuming a best case scenario of 100% compliance for both new and existing buildings with stricter building codes) or 170 million tons of CO_2 emissions in 2015 (assuming a more realistic 5% compliance for existing buildings and 60% compliance for new buildings with stricter building codes).

The Kyoto Protocol's Clean Development Mechanism has been unable to harness the potential of reducing greenhouse emissions in developing countries through improved building energy performance.

II. Barriers to Improving Building Energy Efficiency in China and the U.S.

While building energy efficiency is internationally recognized as a key strategy for reducing carbon emissions, enforcement of building energy codes and lack of information about building energy performance are important barriers to improving building efficiency in China and the U.S.:

- *Building energy code enforcement*: Although building energy codes are becoming more stringent, the potential energy savings are not being realized because building code officials do not have the building science expertise or resources to conduct energy performance analyses of buildings.

- *Lack of information about building energy performance*: Information about the energy performance of a building is not readily available to allow consumers to make informed decisions in purchasing or renting real estate, nor is such information readily available to allow governments to provide financial incentives for energy efficient buildings.

III. Measuring Building Performance Through Energy Rating and Labeling Systems[1]

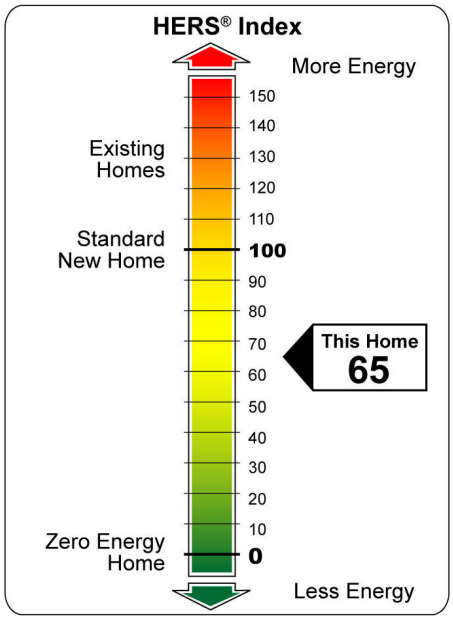
Governments and organizations in the US, China, EU and India are all seeking to address these barriers to building efficiency by establishing building energy rating and labeling systems that measure the energy performance of buildings. In addition, the United Nations Environment Programme has established a Sustainable Buildings and Climate Change Initiative focused on establishing a global benchmarking system for sustainable buildings that can be the basis of incorporating building performance savings into a global carbon market.

An energy rating and labeling system allows the energy performance of a building to be measured and compared to the relevant, local building energy code so that governments can measure and improve compliance with building energy codes and incentivize greater energy efficiency in buildings.

The RESNET system in the US

In the US, for example, the Residential Energy Services Network (RESNET) energy rating and labeling system rates the energy performance of residential buildings on a Home Energy Rating System (HERS) Index scale of 0 to 100. The HERS score rates a building's energy performance in heating, cooling, water heating, lighting, appliances, and onsite power generation. A HERS score of 0 represents a net zero energy home, while a HERS score of 100 represents a home built to the specifications of the International Energy Conservation Code (IECC) (known as the "HERS Reference Home"). A HERS score greater than 100 indicates that a building's energy performance does not meet the IECC building energy code.

[1] Building energy performance rating and labeling systems should be distinguished from green building labeling systems such as LEED, which provide a checklist, scoring system for buildings based on a variety of green features including site planning, water efficiency, resource efficiency, indoor air quality, and energy efficiency. Energy rating and labeling systems are focused solely on building energy performance compared to a baseline, code-compliant reference building.



The lower a home's HERS Index, the more energy efficient it is in comparison to the HERS Reference Home. Each 1-point decrease in the HERS Index corresponds to a 1% reduction in energy consumption compared to the HERS Reference Home. Thus a home with a HERS Index of 85 is 15% more energy efficient than the HERS Reference Home and a home with a HERS Index of 80 is 20% more energy efficient than the HERS Reference Home.

The HERS index is currently used to verify building energy performance for the EPA/DOE ENERGY STAR Program, DOE's Building America Program, and the Treasury Department's federal tax credit qualification. The RESNET system is also currently used in 16 states for minimum code compliance. In 2008, 17% of all new homes sold were rated through RESNET's standards as being at least 15% more efficient than the U.S. model energy code and 4.6% as being at least 50% more efficient than the model energy code.

In addition, the Waxman-Markey energy and climate bill currently being considered by Congress calls for increasing the performance of building energy codes by 30% and adoption of a national building energy performance label. The legislation refers to the RESNET standard as the basis for the labeling of residential buildings.

Finally, as part of the economic stimulus funding to states, each governor had to sign a statement to the federal government that they would adopt procedures to ensure a minimum of 95% compliance to their building energy codes.

Building Energy Rating and Labeling Systems in China

In China, there are presently efforts to develop building energy rating and labeling systems at the national level and by the Shanghai government.

In 2007, the Natural Resources Defense Council and RESNET began to work with the Shanghai Real Estate Science Research Institute (SRESRI) to develop a building

energy performance rating and labeling system that would harmonize with the RESNET standards and would adopt a uniform calculation of carbon savings for improved building energy performance. SRESRI published a voluntary building energy rating standard for multifamily high-rise buildings in Shanghai based on a 0 to 100 scale, which the Shanghai government has approved.

The Ministry of Construction[2] borrowed the ideas in the Shanghai standard to develop national building energy rating and labeling guidelines, based on a five star scale. New government buildings and large public buildings larger than 20,000 m^2, and existing government buildings and public buildings that receive financial support from the government, must be assessed under the national rating system. The central government has left the details over how to implement the guidelines to provincial and local governments.

The European Union's Energy Performance of Buildings Directive

To assist member nations in meeting their commitments in the Kyoto Protocol, the European Union adopted the Energy Performance of Buildings Directive (EPBD). The directive has the following elements:

- All member nations must adopt stringent building energy codes with effective enforcement provisions.
- The energy performance ratings of buildings must be disclosed at the time of sale or change of occupancy.
- The first priority is the rating of public buildings and posting of the building energy performance label in a public, visible location of the building.
- Rating standards are to be harmonized within the European Union.

India's Star Rating and Labeling Program for Office Buildings

In February 2009, India launched a five star rating and labeling program to rate the energy efficiency of office buildings, based on actual performance, measured as kWh per square meter per year. The program initially targets 3 climactic zones for air conditioned and non-air conditioned office buildings, with five stars being the most efficient and one star being the least efficient. The program is intended to provide public recognition of energy efficient buildings and create demand for more efficient buildings.[3]

The United Nations Environment Programme's Sustainable Buildings and Climate Change Initiative (SBCI)

SBCI is a partnership between UNEP and leading construction companies seeking to promote sustainable building and construction practices, with a particular focus on energy efficiency and greenhouse gas emissions. Its goals include:

[2] Now renamed the Ministry of Housing and Urban and Rural Development.

[3] See www.bee-india.nic.in/ecbc.php

- Establishing a global benchmarking system for sustainable buildings that can be the basis of incorporating building performance savings into a global carbon market.
- Assisting governments to develop policies and programs to foster sustainable buildings.
- Incorporating improved building performance into the successor of the Kyoto International Climate Treaty.

IV. Opportunities for US-China Cooperation on Building Energy Rating and Labeling Systems

Given the existing efforts by the US and China in developing building energy rating and labeling systems, there are three valuable opportunities for closer cooperation to develop robust energy rating and labeling systems in both countries.

<u>Proposal # 1 (for immediate action)</u>: Joint development and harmonization of building energy rating and labeling systems

In the US, RESNET only applies to residential buildings three stories or lower. For high-rise multi-family and commercial buildings, a similar rating and labeling system known as COMNET is currently under development, but this system is in its infant stages. In China, development of a building energy and rating system has focused from the beginning on on high-rise buildings, both residential and commercial. Joint development of a high-rise building energy rating and labeling system would be a good opportunity for closer US-China cooperation on building energy efficiency. Cooperation on the development of a high-rise energy rating and labeling system would make it likely that the Chinese and US high-rise energy rating and labeling system would be based on a common, or "harmonized," platform. Having harmonized energy rating and labeling systems facilitates discussion among countries regarding:

- Enforcement and compliance with local building energy codes.
- Measurement, reporting and verification of building energy performance improvements and greenhouse gas emissions reductions.
- Opportunities for international funding of building energy efficiency through carbon credits in the successor to the Kyoto Protocol.

Moreover, for the past three years, RESNET has been discussing with the European Union's EPBD Concerted Action the goal of harmonizing the U.S. and European energy performance rating and labeling standards. Harmonization of energy rating and labeling standards among the US, China and the EU would facilitate discussions among these governments about improving building efficiency and opportunities for cooperation. The end result would be a harmonized method of rating and labeling a building's energy performance and the calculation of carbon emission savings from improved building energy performance. These systems could effectively feed into the development of a global benchmarking system that would serve as the basis for incorporating building energy efficiency into a global carbon market.

<u>Proposal # 2 (for immediate action)</u>: Development of customized building energy rating software

In the RESNET system, customized building energy rating software provides a rating tool for energy raters to consistently and accurately rate a building's energy performance by inputting data such as insulation, window performance, HVAC system efficiency, building size, and climate zone. Such software allows energy raters to quickly and efficiently rate a building's energy performance compared to the local building energy code.

The US can cooperate with China to develop building energy rating software specific to China's own energy rating and labeling standard, using the experience of organizations such as RESNET.

<u>Proposal # 3 (once proposals # 1 and 2 have been completed)</u>: Capacity building and implementation of building energy rating and labeling systems

Development of a building energy and rating system is only the first step—effective implementation, including training and certifying energy raters to use the rating software to rate buildings and quality control of energy ratings, is essential to ensure that a rating and labeling system can achieve greater building efficiency and code compliance.

China's new buildings constitute about 50 percent of new construction worldwide. Rating even just new buildings will require a large team of energy raters. Private sector energy raters, who are trained and certified by the energy rating system, can serve as a valuable supplement to government inspectors, who often do not have the time or resources to measure building energy performance and who also are focused on compliance with building safety and construction codes.

The US can share its experience in states that have implemented RESNET on how to develop a program to train and certify private sector energy raters and to ensure that energy ratings are accurate. Such capacity building is key to ensuring the integrity of an energy rating and labeling system, and can create green jobs in both countries.

Cooperation on Carbon Capture and Storage Technology

Coal is responsible for over 40 percent of global CO_2 emissions.[4] Over 80 percent of China's CO_2 emissions come from coal use.[5] China's annual CO_2 emissions from coal use are projected to double to more than 5 gigatons of CO_2 in 2030.[6] China's rapid development and growth in energy demand means that, even with aggressive investments in energy efficiency and renewables, coal-based thermal power generation will remain the largest single source of China's greenhouse gas emissions for the medium term. Capturing and storing carbon dioxide from China's thermal power plants and industrial sources represents a key transitional mitigation technology for China and other major developing and developed countries.

According to the International Energy Agency, Carbon Capture and Storage (CCS) technology can contribute around 20 per cent of the global cut in emissions necessary to cap CO_2 in the atmosphere at 450 ppm in 2050, the level necessary to avert dangerous climate change.[7] Estimates by the International Energy Agency suggest that CCS technology could capture and store 9 gigatons of CO_2 each year by 2050.

The G8 + 3 (including China and the U.S.) last year called for the launching of 20 large-scale CCS projects by 2010, to resolve the regulatory and technical issues necessary to enable broad, commercial deployment of CCS technology by 2020.

Given the importance both the US and China place on CCS as a key transitional GHG mitigation technology, we recommend that the US cooperate more closely with China on CCS. The main immediate priority should be to build practical experience and scientific knowledge by injecting large volumes of CO_2 underground at the least cost, and using those demonstrations to begin characterizing key basins. A second step could include a retrofit of a large coal-fired power plant for CCS. Knowledge exchange on technical and regulatory issues can take place as part of those projects and through additional forums if needed.

Existing International Cooperation Efforts on CCS with China

The Chinese government and Chinese enterprises have been involved in examining CCS technologies for China. China is a member of international CCS coordinating bodies such as the Carbon Sequestration Leadership Forum and the recently established Global Carbon Capture and Sequestration Institute, of which the US is also a member. China is also cooperating with a number of countries on CCS projects specific to China (*see* Table 1 at the end of this section), such as:

a. *The UK-China Near Zero Emissions Coal project (NZEC)*[8]: Phase 1 of the project, focused on knowledge exchange and capacity building,

[4] Energy Information Administration, *International Energy Outlook*, *2008*. Figure 76.

[5] "Carbon capture critical for China and coal – IEA," Reuters, 20 April 2009.

[6] IEA World Energy Outlook 2007.

[7] IEA (2008) Energy Technology Perspectives - scenarios and strategies to 2050, OECD/IEA, Paris

[8] http://www.nzec.info/en/

will conclude this fall. Phase 2 will continue cooperative activities, and Phase 3 aims to build a demonstration CCS plant by 2014.

b. *Cooperation Action within CCS China-EU (COACH)*[9]: Project aimed at examining coal gasification, polygeneration CCS schemes in China, identification of reliable geological storage sites, and looking at funding mechanisms, regulatory framework and public acceptance.

c. *EU GeoCapacity project*[10]: EU project examining CO_2 storage capacity in Europe, and also including scientific exchanges with China.

d. *Support to Regulatory Activities for Carbon Capture and Storage project (STRACO2)*[11]: EU-funded project designed to support the development of regulatory frameworks for CCS in the European Union and China.

e. *Asia Pacific Partnership projects, including the Pilot Gaobeidian capture-only plant*: China's Huaneng Group cooperated with Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) to build China's first carbon capture facility in Gaobeidian, Beijing. This is a conventional, post-combustion power plant, from which 3,000 tons of food grade CO_2/year has been captured from part of the flue gas since last July.

Although the above initiatives will produce valuable information and more coordination would be desirable, we believe that the key need lies in learning through implementing large projects, and not through an expansion of the current initiative structure. The US has not been as active as other countries in cooperating with China on CCS. However, the US can play a key facilitating role that will greatly advance CCS in China and worldwide. This is best done through a handful of projects that require relatively modest funds and can provide two-way benefits as US and Chinese experts learn from each others' experiences.

Proposal #1 (for immediate action): The US should assist with five large-scale "low-hanging fruit" demonstration projects in China

China has approximately 100,000 MW equivalent in gasification capacity in plants that produce fertilizer, liquid fuels, chemicals, or refine petroleum. These plants feature pure CO_2 streams that can be captured readily. Moreover, a number of these are sited near geologic formations with good storage potential. Despite the large potential to reduce emissions from these sources, the lack of related subsurface expertise in China needed for a project of this scale is a barrier.

[9] http://www.co2-coach.com/

[10] http://www.geology.cz/geocapacity

[11] http://euchina-ccs.org/index.php

The US and China could cooperate to share capital costs and expertise in establishing five such projects in China, strategically chosen in different basins that need to be characterized for their CO_2 storage potential.[12] The US would provide the needed project design and subsurface expertise. The progression of steps for such a project would start with a feasibility study, proceed with a smaller injection on the order of hundreds of thousands of tons of CO_2 and, if successful, end with a multi-million ton injection program. The three steps can be accommodated in the space of five years. The parties involved would include corporations from both countries, research institutions, and other players, such as environmental NGOs and local community representatives, to study aspects of public education and acceptance.

Below we summarize what would be involved:

- Five-year timeline for projects.
- Estimated cost is $20-25 million per project ($100-125 million in total, which is a fraction of the stimulus money dedicated to CCS or DOE's other programs).
- Technical cooperation on site characterization, risk management, subsurface monitoring and modeling, as well as storage prospectivity estimation in the basins involved, which should be chosen strategically to represent the diverse geologic settings that China would need to deal with in widespread CCS deployment (basin characteristics, proximity to large sources).
- Target of 3-5 million tons CO_2 per project, which would result in a total of 15-25 million tons of CO_2 emissions reductions for the five plants over five years.
- Technical, financial and economic analysis (on plant economics, appropriate government-private sector cost-sharing and structures).

The US could also work with China to develop regulatory guidelines for siting of storage sites; capturing, transporting and storing CO_2; managing, monitoring and verification of CO_2 storage; and handling of sites after storage has been completed. The World Resources Institute, which organized a stakeholder advisory panel to develop the *Guidelines for Carbon Dioxide Capture, Transport and Storage*[13] in the US, has already begun to organize a similar process for preparing CCS guidelines specific to China.

EPA is likely to begin developing national CCS regulations in the near future that will cover safeguards for protecting human health and the environment, financial responsibility for injection sites, and other regulatory questions as part of climate and energy legislation being considered in Congress. The US could use its expertise in developing such regulations to assist China in developing CCS regulations, particularly as they relate to protection of the environment and health.

[12] One facility that could be scaled up and used directly is the Shenhua direct coal liquefaction plant in Inner Mongolia. DOE is already involved in the project through an Annex II agreement to the US-China Fossil Energy Protocol.

[13] Available at http://www.wri.org/publication/ccs-guidelines.

Proposal #2 (next step, longer term): The US should establish two large-scale demonstration projects of its own with China

In order for CCS to make a significant contribution to reducing global, Chinese and US emissions, it will have to be applied as a retrofit technology to the enormous fleet of existing coal-fired power plants. A number of slipstream projects are planned and/or under construction already. However, the lack of a full-scale retrofit project is a distinct gap. The US and China could cooperate in setting up two such retrofit projects, along the lines of cooperation outlined for the five nearer-term projects described above. Although the implementation of such a project would follow the five "easier" projects above, organizational, technical and economic planning could begin now, offering vendors and scientists an immediate focal point.

Proposal #3 (near term and ongoing): In order to facilitate and further benefit from the projects above, the US and China could establish a **US-China Carbon Sequestration Partnership** with an associated fund to:

- Conduct studies and exchange information on related policy, regulatory and economic matters.
- Compile technical or other "best-practice" documents, based on the experiences gained in the projects.
- Engage in outreach and education activities on CCS with key stakeholders and audiences.

The partnership should include government bodies as well as stakeholders from industry, research organizations, academia and NGOs. We stress however, that the partnership should not be the focus of US-China cooperation, but rather an organic outcrop from practical experience gained from projects.

Timing: We believe that the announcement of the collaborative ideas listed above could take place rapidly. Such an announcement would significantly enrich the global CCS roadmap, and prepare the path to Copenhagen, where we believe that a broader developed-developing country CCS cooperation framework (such as a technology transfer/deployment fund) should be investigated.

Table 1. China's International CCS Cooperation Projects		
Project	**Participants**	**Description**
UK-China Near Zero Emissions Coal (NZEC) project	UK Department of Energy and Climate Change Chinese Ministry of Science and Technology	Supported by funding of up to £3.5 million from UK government. Phase 1 (2007-09) will be completed in the fall, and included knowledge transfer between EU and Chinese experts; modeling China's future energy requirements, taking CCS into account; case studies of potential CO_2 technologies; capacity building for evaluating storage potential and storage sites; and developing a technology and policy roadmap for CCS. A final report for Phase 1 will be issued in November 2009. Phase 2 will continue these cooperative activities, and Phase 3 aims to build a demonstration plant by 2014.
COoperation Action within CCS China-EU (COACH)	Partially funded by the EU, with 20 European and Chinese partners from academic and research institutions, manufacturers, oil and gas companies, and service companies.	€2.6million budget. Goal is to prepare for implementation in China of large-scale polygeneration energy facilities with CCS and options for coal-based electric power generation and production of hydrogen and synthetic fuels. COACH addresses three issues: (1) Coal gasification for appropriate polygeneration schemes with CCS; (2) Identification of reliable geological storage of CO_2 in China. (3) Funding mechanisms, regulatory framework and public acceptance.
Support to Regulatory Activities for Carbon Capture and Storage (STRACO2) project	Administrative Centre for China's Agenda 21 (ACCA21) Chinese Academy of Science: The Institute of Engineering Thermo-physics (IET) and Institute of Policy and Management (IPM)	EU funded project is designed to support the development of a regulatory framework for CCS in the European Union. The project includes a work package dedicated to CCS regulatory development in China and studies the applicability of European regulation to China. STRACO2 will be holding an international regulatory conference with a focus on the EU and China on 12-13 November in France.
EU GeoCapacity project	25 European participants and Tsinghua University	Main objective is to assess the European capacity for geological storage of CO_2, as well as development of innovative methods for capacity assessment, economic modeling and site selection criteria. An important mission is to initiate scientific collaboration with China and possibly other CSLF members. Final project report to be issued shortly.
Asia Pacific Partnership		Built first carbon capture plant demo project in China, Huaneng/Australia Gaobeidian plant in Beijing. Conventional power plant, capture only, 3000 t/a.

Cooperation on Energy Efficiency Resource Standards

China has many good policies in place to improve its energy efficiency and increase its renewable energy sources, chief among them being its national targets for reducing energy intensity by 20 percent from 2006-2010 and increasing the proportion of renewables in its energy supply to 10 percent by 2010 and 15 percent by 2020. China has been making steady progress in improving its energy intensity, achieving reductions of 1.79 percent in 2006, 4.04 percent in 2007, and 4.59 percent in 2008. It has accomplished this through a portfolio of actions, including the Top 1000 energy consuming enterprises program, the 10 key energy efficiency projects, economic restructuring, and replacing outdated power generation and industrial production facilities.

Although China's energy intensity target has been helpful in setting both a target and a benchmark for measuring progress, a more specific energy efficiency target such as the energy efficiency resource standards (EERS) currently being implemented in the US could provide China with a powerful policy tool for implementing investments in energy efficiency. An EERS functions by requiring that utilities acquire a certain amount of energy efficiency resources each year in addition to building new, cleaner sources of energy. Compared to China's present energy intensity target, which is calculated based on energy consumption per 10,000 RMB of GDP and does not require utilities to seek improvements in energy efficiency, an EERS would require that Chinese grid companies invest in and implement a specific percentage of energy efficiency gains each year as a portion of their past electricity sales.[14] Such a policy would require grid companies to plan for and include energy efficiency investments as a resource on par with investments in new supply, thus leading to steady investments in energy efficiency that accumulate over time and could offset baseline growth by 10 to 20 percent or more. An EERS policy would catalyze investments in energy efficiency at the kind of scale necessary to address China's rapidly growing energy demand and greenhouse gas emissions.

Table 2, at the end of this section, summarizes the differences between the energy intensity target system used in China with the EERS systems implemented in the US.

The US experience with Energy Efficiency Resource Standards

In the US, 19 states have implemented some form of an EERS.[15] Texas was the first state to adopt an EERS. Its initial EERS in 1999 required utilities to offset 10 percent of load growth through energy efficiency, but based on the success of the program, Texas raised this target in 2007 to 15 percent by 2009 and 20 percent by 2010. Vermont adopted an EERS in 2000 which allowed it to meet over 7 percent of its electricity requirements through energy efficiency by 2007, with 2007 energy

[14] In China, power generators and grid companies have been separate since 2003, when the government implemented reforms to separate generation and transmission in order to promote competitive electricity markets. In the US, most states have vertically integrated utilities, which own both power generation and transmission and distribution assets.

[15] For a summary of state EERS programs, see map available at http://www.ferc.gov/market-oversight/mkt-electric/overview/elec-ovr-eeps.pdf.

efficiency programs alone meeting 1.7 percent of Vermont's electricity needs. In California, energy efficiency programs in 2007 met more than 1.5 percent of the state's electricity needs and the California Public Utilities Commission (CPUC) has established targets for the period 2012 to 2020 equivalent to about 5 percent of load growth.[16] Utilities in California are required to seek to procure all energy efficiency resources that are available at lower cost than energy supply options, and have significant experience implementing large-scale energy efficiency programs. The utility PG&E, for example, has applied to spend $1.8 billion for its energy efficiency programs during 2009-11 in order to meet the goals set by the CPUC.

The present version of the America Clean Energy and Security Act being considered in Congress provides for an annual, combined renewables and energy efficiency target that would begin at 6 percent in 2012 and reach 20 percent by 2020. Utilities would be required to meet at least three-quarters of the combined target through renewable energy resources, with the remainder to be met through energy savings from energy efficiency measures procured by the utility. If a state's governor determines that utilities in the state cannot meet the minimum three-quarters renewables requirement, the governor may reduce the renewable requirement down to no less than three-fifths the total target, with the remainder to be met through efficiency measures.

How Energy Efficiency Resource Standards work in the US

An EERS sets savings targets for energy efficiency as a percentage of present energy demand, to partially offset projected load growth through investments in energy efficiency. Utilities are responsible for establishing energy efficiency programs that identify and invest in efficiency opportunities. For example, utilities may invest in programs such as:

- Energy audits that identify opportunities for improving energy use;
- Rebates or low-interest loans for more efficient appliances such as air conditioners, water heaters, furnaces and lighting
- Incentives or low-interest loans for home retrofits such as improving insulation;
- Marketing, education and technical assistance programs;
- Combined heat and power systems; and
- Improvements in transmission and distribution efficiency.[17]

Utilities are compensated for their spending on these programs through an increase in their rate, similar to how their rates would increases when building new supply.

EERS targets start low and increase with time as efficiency programs are established and gain momentum. For example, an EERS program may require a utility to obtain energy efficiency improvements equivalent to 0.75 percent of load growth during the first year the EERS is in place, rising to 1.00 percent, then 1.5 percent, etc. Cumulative savings targets are provided to give utilities long-term targets, such as a

[16] Laura A. Furrey, Steven Nadel and John A. "Skip" Laitner, *Laying the Foundation for Implementing a Federal Energy Efficiency Resource Standard*, ACEEE Report No. E091, March 2009, at pp. 9-10.

[17] *Id.* at pp. 7-8.

cumulative 10 or 15 percent savings over a ten year period. EERS programs should require that energy savings claimed by utilities be measured, reported and verified in accordance with rules set by regulators

One important aspect of EERS is that they encourage utilities to conduct integrated resource planning, with energy efficiency as a resource to be considered alongside planning of new energy supply. This results in greater investments in energy efficiency because improvements in energy efficiency are cheaper, faster and cleaner than building new supply. Studies in the US have shown that investments in energy efficiency are available at an average cost of about 3 cents per kilowatt-hour, compared with a cost of 7.3 to 13.5 cents per kilowatt-hour to build new coal, natural gas or nuclear power plants.[18]

Some states allow utilities to meet energy efficiency improvements through payments to third-party implementers such as ESCOs or establish special-purpose agencies to administer energy efficiency programs and goals.

Finally, EERS provide for penalties if utilities do not meet the energy savings targets required under the EERS or procure energy efficiency through payments to third-party implementers. States may also implement decoupling of utility profits from electricity sales, and provide incentives to utilities for improving the energy efficiency of their customers.

Adapting Energy Efficiency Resource Standards to China

In China, EERS policies would complement China's existing energy efficiency policies by creating a mechanism by which grid companies, which are responsible for procuring sufficient generation capacity to meet their customers' needs, also become responsible for developing the energy efficiency resources to meet their customers' needs more cheaply, quickly and efficiently.

In December 2002, China split the State Power Corporation of China into five national power companies[19] and two grid companies[20] in order to introduce competition in the electricity markets. An EERS in China should focus on the two national grid companies, since they are responsible for forecasting energy demand and procuring new supply. The central government could require that each of the grid companies meet a certain percentage of their load growth each year through investments in energy efficiency, increasing the required percentage as the grid companies gain experience investing in and implementing energy efficiency programs.

The key goal of an EERS policy in China would be to set mandatory energy efficiency targets to be met by energy efficiency programs administered by China's grid companies, and to allow the grid companies to recover the costs of energy efficiency programs through an increase in the retail electricity prices they can charge.

[18] *Id.* at pp. 1-2.

[19] Namely, the China Huaneng Group, China Datang Corporation, China Huadian Corporation, China Guodian Corporation, and China Power Investment Corporation.

[20] Namely, the State Grid Corporation of China and the China Southern Power Grid Corporation.

An EERS policy would benefit grid companies, the government, industries, and consumers, in that:

- An EERS would create a sustainable mechanism for grid companies to invest in energy efficiency, leading to reduced peak loads and more gradual energy demand growth, helping to balance electricity supply and demand, and reducing the likelihood of electricity shortages.
- Grid companies' investments in energy efficiency would be recouped through adjustments to the retail electricity prices they are allowed to charge, just as they are allowed to recover investments in new supply. Indeed, because the energy savings available through energy efficiency are generally cheaper than building new supply, an EERS can save grid companies money by lowering their costs compared to purchasing new supply.
- By creating a mechanism for large-scale investments in energy efficiency, EERS will also support the continued development of energy service companies in China and the development of energy efficiency related technologies and products. By providing a reliable source of funding for energy efficiency investments, an EERS policy also addresses the challenges business enterprises frequently face in obtaining funding for energy efficiency investments.
- An EERS can also reduce the annual increase in electricity bills because, even though electricity prices may rise slightly to fund energy efficiency programs, the reduction in electricity consumption through efficiency programs is often more than enough to offset higher electricity prices.

If paired with further policy reforms, such as decoupling of a grid companies' revenue and its electricity sales, and providing financial incentives for procuring energy efficiency, an EERS could lead to more stable and even increased revenue streams for grid companies even when electricity consumption falls, provided that they can demonstrate that consumption fell as a result of their energy efficiency measures. Grid companies could develop new sources of revenue, focusing not simply on selling more electricity but on providing *useful energy*, allowing customers to do the same work more efficiently. Such a system aligns government energy efficiency goals with grid companies' profit incentives.

An EERS would complement China's energy intensity policy

An EERS would complement and integrate well with China's existing energy intensity policy. China's energy intensity target is measured as the amount of energy consumed per 10,000 RMB of GDP. Provincial and local officials as well as state-owned enterprises are evaluated in part on their success in reaching energy intensity reductions targets. The central government has also initiated several significant initiatives to improve energy efficiency, including the Top 1000 energy-consuming enterprises program, the 10 key energy efficiency projects, economic restructuring, and replacing outdated power generation and industrial production facilities

However, because China's energy intensity metric relates energy consumption to economic production, it reflects both energy savings achieved through energy efficiency measures as well as energy savings due to economic restructuring from

more energy-intensive sectors to less energy-intensive sectors. As a result, it may not be as useful a measure of actual improvements in energy efficiency as an energy resource standard, which focuses solely on energy savings attained through energy efficiency measures.

An EERS, on the other hand, is measured as a percentage of energy savings achieved through efficiency measures as compared to past electricity sales. It thus offers a more useful and concrete measure for determining the effectiveness of energy efficiency programs because it measures energy savings through efficiency measures against actual electricity sales, rather than energy consumption reductions as against GDP. The amount and percentage of electricity growth met through energy efficiency measures and through construction of new supply can thus be measured and compared to provide a better understanding of the effectiveness of efficiency programs.

At the same time, it bears emphasizing that an EERS would not impose any limits on China's economic growth, because it mandates only that a certain percentage of electricity consumption growth be met through efficiency, not that electricity growth itself must be limited. An EERS is not an absolute cap on electricity consumption, but a more concrete target for assuring that as much of China's energy demands are met through energy efficiency rather than through building new power plants. EERS could play a vital role in assuring that energy efficiency plays a key role in meeting the energy needs of China's rapidly growing economy.

Table 2. Comparison of China's Energy Intensity Target and U.S. Energy Efficiency Resource Standards		
	Energy Intensity Target	***Energy Efficiency Resource Standard***
What is it?	A target in China's 11th Five Year Plan (2006-10) to reduce China's energy intensity by a cumulative 20 percent from 2005 levels, or an average of 4 percent each year.	A requirement by states in the US that utilities obtain a certain percentage of energy efficiency resources each year, as a percentage of past electricity sales, adding up to an aggregate percentage of energy efficiency improvements by a certain date. For example, in Texas, utilities were required to meet 20 percent of load growth from 1999 to 2010 through energy efficiency investments.
How is it measured?	Energy intensity is measured as energy consumed per 10,000 RMB of GDP.	A baseline level of electricity sales is set for a particular utility, such as the average of the two prior years of its electricity sales. A utility is then required to identify, invest in, and demonstrate improvements in energy efficiency equivalent to a certain percentage of its baseline electricity sales. Typically this percentage begins low (e.g., 0.75 percent) and steadily increases (e.g., 1.5 to 2 percent) as the utility implements and gains experience with energy efficiency programs.
How is it presently implemented?	The Chinese government has implemented a number of policies to reduce energy intensity, including the Top 1000 energy consuming enterprises program, the 10 key energy efficiency projects, economic restructuring, and replacing outdated power generation and industrial production facilities.	Utilities in states with EERS are required to identify, invest in, and demonstrate improvements in energy efficiency. They may be allowed to implement such investments through third parties, such as ESCOs or state energy efficiency entities.
Who is responsible for implementing the target?	Chinese government officials at various levels and enterprises, primarily larger state-owned enterprises, are responsible for implementing energy efficiency improvements. The success of officials in implementing energy efficiency improvements may be considered in performance evaluations.	Utilities are responsible for achieving state EERS targets and are penalized for failing to achieve targets or rewarded for achieving and surpassing targets (in states with decoupling[21]).

[21] In states with decoupling, a utility's profits are "decoupled" from its electricity or natural gas sales so that it does not have an incentive to sell more energy. Many states also go further and provide financial incentives to utilities that demonstrate reductions in electricity or natural gas sales due to investments in energy efficiency.

How are energy efficiency investments made and what is the source of investments?	The government and enterprises must identify appropriate investments and bear the cost of investments. The central and provincial governments have established energy efficiency funds, including a program that rewards enterprises 200-250 RMB for every ton of coal saved, provided they demonstrate savings of 10,000 tons of coal equivalent per year from energy conservation projects.	Utilities (or a third party implementer) establish and implement programs that provide rebates to businesses and residents for equipment or appliance upgrades; improve the transmission and distribution of electricity; establish combined heat and power plants; educate and promote conservation; or any other program that reduces energy demand. Utilities are generally required to propose budgets for energy efficiency programs, which can then be recouped in rate-setting decisions from state utility commissions. Electricity or gas consumers may thus pay a slightly higher rate for their energy, which is generally more than offset by improvements in energy efficiency; studies show that consumers generally pay less overall for energy under EERS programs.
How is resource planning affected?	Grid companies at present are not required to invest in energy efficiency and do not have an incentive to carry out integrated resource planning which considers investments in energy efficiency as an energy resource.	Utilities in states with EERS are required to consider both energy efficiency investments and investments in new supply when considering how to most economically meet their customer's energy needs. This leads to integrated resource planning, with investments in energy efficiency gaining priority as the most cost-effective investment.
How successful have these policies been?	China has been making steady progress in improving its energy efficiency. China is presently considering setting a similar target for its 12th Five Year Plan (2011-15).	States with EERS have seen steady improvements in their energy efficiency, and few if any utilities have been unable to meet the energy efficiency targets set for them. In fact, several states have increased their EERS targets based on their past successes, including Texas, which increased its targets from 10% to 20% after experiencing success with its EERS policy.