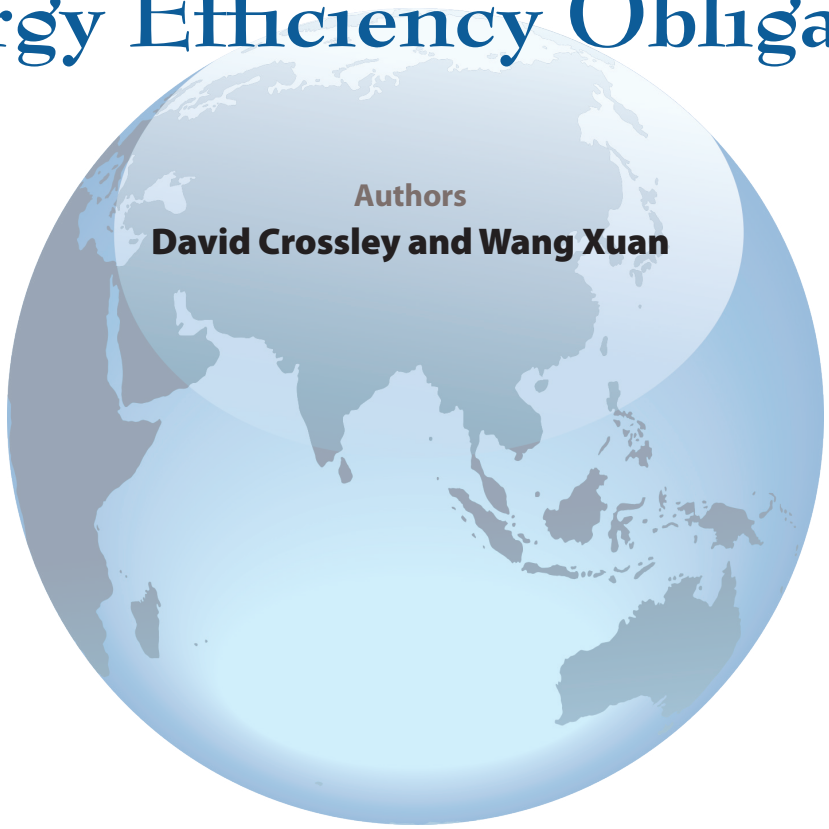
Policy Brief

China

Case Study: China's Grid Company Energy Efficiency Obligation



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Acknowledgements

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List of Acronyms

CNY	Chinese yuan or renminbi (currency unit)
CPP	Conventional power plant
DSM	Demand-side management
EEO	Energy efficiency obligation
EM&V	Evaluation, measurement and verification
EPC	Energy performance contract
EPP	Efficiency power plant
ESCO	Energy services company
GDP	Gross domestic product
GW	Gigawatt
GWh	Gigawatt-hour
MW	Megawatt
NDRC	China National Development and Reform Commission
tce	Ton of standard coal equivalent; by convention one tce equals 29.3076 gigajoules. China typically converts all its energy statistics into tce.
TWh	Terawatt-hour

1. Introduction

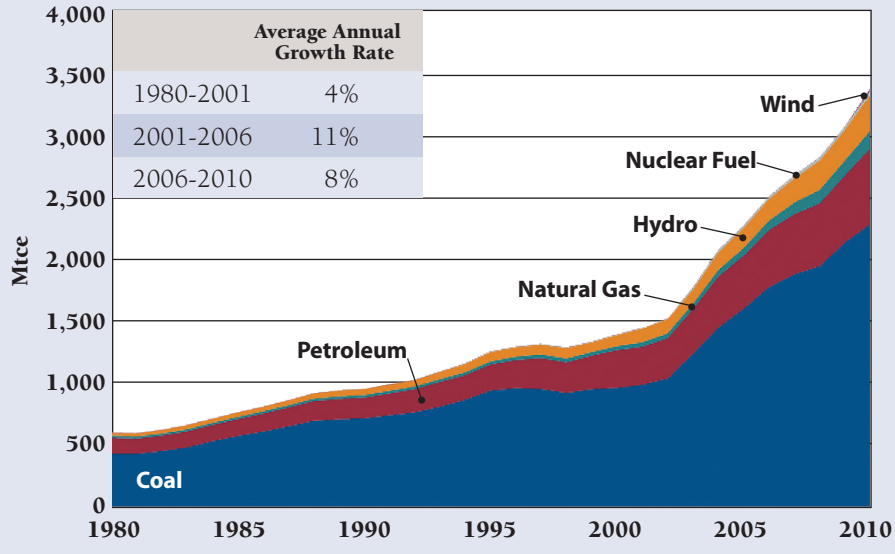
China's consumption of primary energy has been growing rapidly for many years, as shown in Figure 1. While energy consumption is increasing in tandem with the growth in gross domestic product (GDP), the energy intensity of the Chinese economy decreased at an average rate of 5% per annum from 1980 to 2002, followed by a short-term increase between 2002 and 2005, and then the resumption of a steady decline (Figure 2, page 4). Energy intensity in the United States is also declining, but at a lower rate than in China. Since 1973, United States energy intensity has declined at a rate close to 2% per year, although with a few noticeable annual increases.[1]

The continuing reduction in the energy intensity of the Chinese economy can be mainly attributed to efficiency and productivity gains within industries; these gains were achieved through technological improvements, research and development, and innovation.[2] In addition, commencing in the 1980s, China developed a suite of broad and comprehensive energy conservation programs stemming from a realization that, if energy is not used more efficiently, the country's economic growth will be compromised by inadequate energy supply. Industry accounts for about 70 percent of final energy use (with electricity accounted at thermal replacement value) and is the largest single focus of China's energy conservation programs, but programs cover all sectors and are implemented primarily through government agencies.

Demand-side management (DSM) in the electricity sector was first introduced in China in the early 1990s when there was growing recognition of energy and environmental problems resulting from increasing electricity consumption driven by rapid economic growth, though there had been some demand response-type activities targeted at meeting peak loads since the 1970s. Initially, targeted demand response and load management, rather than energy efficiency, were seen as a systematic way to balance economic, environmental, and social development.[4] During the early years, DSM in China was mainly supported by government funding.

Figure 1

China's Primary Energy Consumption by Source, 1980 to 2010[3]



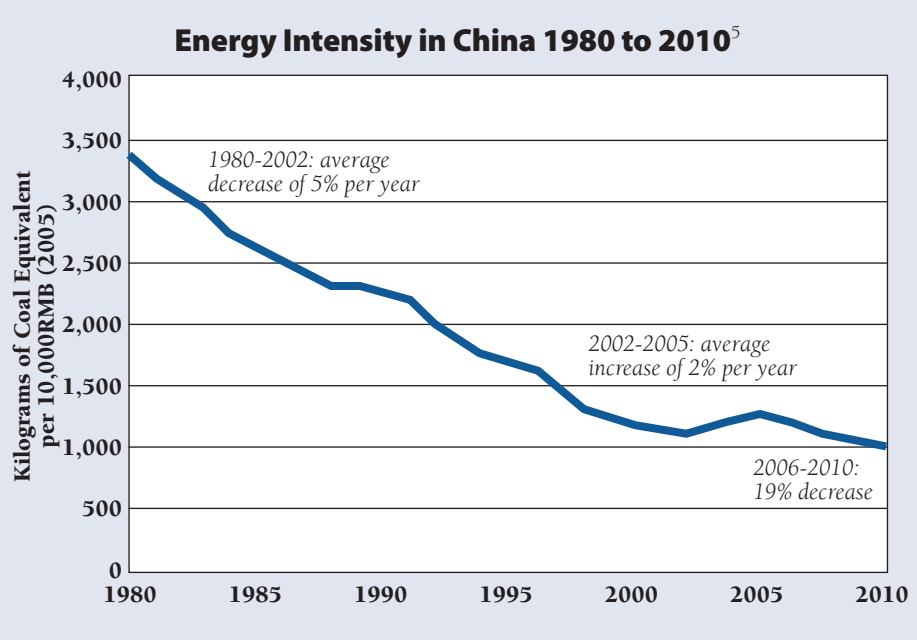
1 United States Energy Information Administration (2013).

2 Andrews-Speed (2012).

3 Levine (2012).

4 In China, DSM is focused only on savings in the electricity sector. DSM policies and programs are regarded as separate from those directed at achieving general energy conservation and energy efficiency goals. In all levels of government, the agencies managing DSM policies and programs are different from those managing energy conservation and energy efficiency.

Figure 2



After many years' experience with DSM, the central government in China realised that energy utilities can take an important role in achieving energy savings through end-use energy efficiency measures. In November 2010, the government issued Guidance on Electricity Demand-Side Management Regulations (关于印发《电力需求侧管理办法》的通知 (发改运行 [2010] 2643)).[6] This guidance document created the first energy efficiency obligation (EEO)[7] on the State Grid Corporation of China and China Southern Grid Company, the two large government-owned entities that operate electricity transmission and distribution networks and sell electricity directly to end-use customers in the majority of China.[8]

The obligation requires the grid companies to achieve energy savings of at least 0.3 percent in sales volumes plus demand savings of at least 0.3 percent in maximum load, both compared with the previous year's results. The EEO, which went into effect on 1 January 2011, also lays a foundation for the expansion of demand response programs by requiring the installation of load monitoring equipment on 70 percent of the peak load, and load control equipment on ten percent of the peak load, in any locality.[9]

This paper describes the development of policies and programs in China that eventually led to the grid company energy efficiency obligation, details the implementation of the EEO, and discusses the performance of grid companies in meeting their energy efficiency and demand reduction targets. Finally, the paper outlines some recent government power sector reforms that could lead to grid companies commencing to use energy efficiency as a power sector resource.

5 Lin, He, He, Hu, and Lu (2011); data from National Bureau of Statistics, China Statistical Abstract, various years.

6 China National Development and Reform Commission (2010a).

7 In China, the idea that this obligation is an energy efficiency initiative may be regarded as slightly strange, given that DSM policies and programs are regarded as being different from those relating to general energy conservation and energy efficiency goals. However, the obligation clearly conforms with international practice on energy efficiency obligations.

8 Electricity generation in China is carried out by separate generation companies and the grid companies purchase electricity in bulk from the generators.

9 China National Development and Reform Commission (2010a).

2. Government Energy Efficiency Policy

Chinese government involvement in energy conservation commenced in the 1980s with the establishment at various levels of government of energy conservation agencies with managerial functions.[10] Energy engineers and energy administrative bodies were also introduced into large and medium-sized state-owned enterprises, and specialized personnel were assigned to manage energy conservation. Over 200 Energy Conservation Centers were set up by local governments and sectoral agencies; their mission was to serve as consultants to government, and to provide energy conservation services to end users, including training and information. The Centers were originally supported with government funds, but later became dependent on revenues from sales of their services.

In 1997, an *Energy Conservation Law* was passed by the National People's Congress. This Law provided a policy framework that enabled China's 33 provincial-level governments to promulgate detailed local bylaws and regulations on energy conservation. In particular, the Law required all levels of government to arrange funds to implement energy conservation measures and to set limits, in terms of energy consumption per physical unit of product, for products that are energy-intensive to produce.

The Law also required local governments to establish a system for discontinuing backward, energy-intensive, energy-consuming products and equipment. This led to major programs to close down old, small-scale, and inefficient energy-intensive industrial capacity, including the progressive closure of old, emissions-intensive power stations. These programs continue today.

The 1997 *Energy Conservation Law* identified key energy-using entities as those that had an annual energy consumption equivalent to more than 10,000 tons of standard coal equivalent (tce). These entities were required to appoint an energy manager and to submit periodic reports to the government on energy consumption, energy use efficiency, and the energy conservation measures they implemented.

The Law also authorized various levels of government to "supervise and manage" energy conservation work in their jurisdictions. This led to the establishment by many provincial-level governments of Energy Conservation Supervision Centers, with powers to inspect facilities, to levy fines on offenders, and even to close down offenders.

In 2004, in response to the short-term increase in energy intensity that commenced in 2002, a *Medium and Long-Term Energy Conservation Plan* was issued by the National Development and Reform Commission (NDRC), the central government's powerful agency responsible for planning economic and social development in China. The overriding goal of the Plan was to reduce national energy intensity by 20 percent from its 2005 level by 2010.[11]

The Plan specifically defined "Ten Key Energy-Saving Projects," including: coal-fired industrial boiler retrofits, residual heat and pressure utilization, petroleum saving and substitution, motor system energy saving, and energy system optimization. The Plan set energy intensity targets for the years 2010 and 2020 for individual energy-intensive industries, including cement, steel, petrochemicals, oil refining, and electricity generation. The Plan also specified raising energy efficiency standards for major energy-using appliances to international levels by 2010. In 2007, many of the same targets, objectives, and policies appeared in both the *11th Five-Year Plan* and the *China National Climate Change Program.* The *12th Five Year Plan* (2011 to 2015) includes targets to reduce by 2015 energy intensity by 16 percent and carbon intensity by 17 percent from their levels in 2010.

In 2007, the National People's Congress passed an amended *Energy Conservation Law.* The 2007 Law includes a provision that the state "will implement a system of accountability for energy conservation targets and a system for energy evaluation whereby the fulfilment of energy conservation targets is taken as one part of the evaluation of

10 Crossley (2013a).

11 In the event, this goal was almost achieved with a 19.1 percent reduction in energy intensity over this period.

local people's governments and their responsible persons." The Law therefore makes achievement of energy intensity targets a component of the performance evaluation of local governments and their officials. Individual government officials may be subject to sanctions if energy intensity targets in their areas of responsibility are not met.

The 2007 Law requires reports to government by key energy-using entities to be made annually. In addition to the requirements under the 1997 Law, these reports must also contain information about whether the entity's energy intensity targets were achieved. The Law authorizes the imposition of penalties on key energy-using entities that fail to achieve targets or implement energy conservation measures; this covers more than 15,000 enterprises. The Law also authorizes the implementation of a system of differential electricity pricing whereby enterprises that are identified to have certain energy-inefficient production processes and/or equipment that the government requires to be limited or phased out can be charged higher prices.

The 2010 initiative to place an energy efficiency obligation on Chinese grid companies was a departure from the existing paradigm of government involvement in energy conservation that had commenced in the 1980s. Previous Government interventions were part of a "wide net" industrial policy aimed at technology upgrading, driven by government agencies. In contrast, the EEO is more focused and is implemented by the grid companies.

The EEO guidance document stated that DSM should be prioritised to meet electricity demand in the tight supply situation and power shortages that have occurred in most of China's central and southern provinces[12] (though these shortages may occur less frequently in the future). DSM was considered to be a mechanism that would help to deal with power shortages as well as long-term sustainability issues, such as:

- achieving end-use energy efficiency at lowest cost;
- reducing greenhouse gas emissions;
- improving environmental quality;
- integrating demand-side resources into energy, social, and economic planning; and
- enhancing grid security and reliability.

More recently, the Chinese central government has been concerned with reforming the power sector and particularly how the grid companies are governed and regulated. In March 2015, the government released *Deepening Reform of the Power Sector* (《关于进一步深化电力体制改革的若干意见（中发〔2015〕9号）文》全文),[13] a major policy document co-signed by the Central Committee of the Communist Party and the State Council. This policy statement and its several follow-on implementation documents signal significant changes to the regulation of the grid companies and to their business models, changes that should make it easier for the grid companies to implement demand-side management (DSM) and end-use energy efficiency programs.

12 China National Development and Reform Commission (2010a).

13 Central Committee of the Communist Party and State Council of China (2015).

3. The Energy Efficiency Obligation

3.1 Legal Authority

The 2010 guidance document that placed the EEO on the grid companies was issued by six central government agencies under the auspices of the State Council. The lead agency is NDRC which is designated as the responsible party for DSM in China. The other five agencies are to carry out DSM-related work within the scope of their existing general duties and responsibilities.[14]

At the central government level, NDRC is the main authority responsible for DSM short-term and long-term planning, strategic policy design, and electricity pricing regulation. The Ministry of Finance takes responsibility for DSM financing issues, such as funding, budget approval, and expense supervision. The role of the Ministry of Industry and Information Technology is to propose clean products and technologies, set up industrial plans, and promote the implementation of the EEO in industrial enterprises. The State-owned Assets Supervision and Administration Commission is responsible for overseeing public assets and evaluating the grid companies' performance in general. The National Energy Administration is nominally responsible for confirming that DSM is included as a resource in power generation, transmission, and distribution development, and that the grid companies produce good results in reducing electricity consumption and improving end-use energy efficiency. The National Energy Council is involved in energy policy design and coordination of the various central government agencies.

At the provincial government level, provinces are responsible for developing detailed implementation rules. In general, provincial Development and Reform Commissions or Economic and Information Commissions are responsible for implementing the EEO in their jurisdictions. Other provincial agencies assist in specific fields, including: DSM planning; setting annual DSM targets for provincial grid companies and reviewing their DSM implementation plans; and investigating the DSM resource potential in their respective provinces.

3.2 Fuel Coverage

The EEO placed on the grid companies covers electricity. In addition, energy savings from other fuel types may be converted to the equivalent electricity saving using standard coefficients published by the National Statistics Bureau and can then be counted toward the energy savings target.

3.3 Sector Coverage

The energy savings and demand reduction targets set by the obligation can be met with end-use energy savings from all economic sectors and from any facility. In addition, reduction of losses in transmission and distribution networks can also be used to meet part of the targets. There is no targeting of energy efficiency activities to particular sectors, nor are certain sectors excluded, as occurs in some EEO schemes in other countries.

3.4 Energy Savings Targets

The EEO requires the grid companies to produce energy savings equivalent to at least 0.3 percent of electricity sales in the previous year and to reduce load by at least 0.3 percent of maximum load in the previous year.

The EEO also establishes a sub-target that requires the installation of load monitoring equipment on 70 percent of the peak load, and load control equipment on 10 percent of the peak load, in any locality. This provides an opportunity for the implementation of demand response programs in China.

There are no other sub-targets relating to particular economic sectors nor to specific groups of end-users, as are included in some EEO schemes in other countries.

14 China National Development and Reform Commission (2010a).

3.5 Eligible Energy Savings Activities

In practice, there are five types of activities that grid companies can undertake to produce eligible energy savings that contribute to meeting their energy savings targets, subject to constraints specified in a *Compliance Evaluation Scheme* originally published by NDRC in 2011 as a trial version,[15] and updated in 2014:[16]

- directly implement energy efficiency projects in the grid company's own premises and in their end-use customers' premises;
- establish an energy services company (ESCO) affiliated with the grid company to implement energy efficiency projects;
- purchase energy savings by means of business transactions/trading[17] (not to exceed 40 percent of total eligible energy savings);
- promote energy efficiency to the grid company's end-use customers; and
- directly carry out grid system upgrades and operational management improvements that save energy and reduce losses in transmission and distribution networks.

As a further constraint, grid companies can claim 100 percent energy savings value only for those energy savings that are audited by a third party or recorded by online monitoring equipment; otherwise only 80 percent of the value can be claimed.

The EEO guidance document states that promoting energy efficiency to the grid company's end-use customers is an eligible energy efficiency measure. In response, the grid companies have implemented a range of marketing, education and outreach activities to contribute towards meeting their EEO targets.[18]

State Grid ESCOs have constructed an energy efficiency service platform where experts and energy users can get together to study energy efficiency policies and technologies and conduct energy audits. In June 2011, State Grid also launched a campaign to promote end-use energy efficiency. The campaign broadly disseminates information about energy efficiency and educates people to change to a high-efficiency and low-carbon lifestyle.[19]

Southern Grid provides energy audits to large end-users, and conducts energy efficiency demonstration projects in steelmaking, chemical, and non-ferrous metal industries.[20] Southern Grid has also developed an energy savings service platform "Nandudu."[21]

Three types of energy savings are identified as not eligible to contribute to meeting EEO targets:[22]

- energy savings from commercially-operated renewable energy projects;
- electricity savings that cannot be measured and verified; and
- electricity saved through implementing government policy on the orderly use of electricity.[23]

The grid companies also use their claimed eligible energy savings to calculate load reductions that contribute to meeting their load reduction targets. Load reductions are calculated as the annual eligible electricity savings (not including energy savings converted from other fuel types), divided by the average annual operating hours of electricity generation units.

Specific load-reduction activities by grid companies may include assisting customers to rearrange their production schedules, and using load shifting technologies and installing new equipment (such as heat pumps or reverse cycle air conditioners) to improve load factors at end-use customers' premises.

The EEO guidance document does not include provisions for approving eligible energy efficiency measures

15 China National Development and Reform Commission (2011a).

16 China National Development and Reform Commission (2014a).

17 A grid company may purchase energy savings from customers (or other ESCOs) if the grid company does not itself implement energy efficiency projects.

18 Grid companies may claim only ten percent of any energy savings made by customers as a result of energy efficiency promotions and these savings must not exceed five percent of total eligible energy savings.

19 State Grid Corporation of China (2011).

20 China Southern Grid Company (2010).

21 China Southern Grid Company (2014).

22 China National Development and Reform Commission (2011a).

23 Orderly use of electricity refers to involuntary supply curtailments that may be imposed by provincial governments on selected end-use customers during periods of supply shortages.

nor for deeming energy saving values for specific measures, as occurs in some EEO schemes in other countries. The guidance document does require each province to develop its own implementation rule that will identify provincial eligible energy efficiency measures based on best practices adapted to local situations.[24]

In the *Compliance Evaluation Scheme*, the NDRC recommends, but does not require, implementation of the following energy efficiency measures:[25]

- energy saving in transmission and distribution systems;
- energy efficient electric motors, energy efficient upgrade of boilers, using waste heat and pressure, installation of heat pumps;
- energy saving in buildings, green lighting; and electricity thermal (ice) storage and other energy management projects.

The NDRC also encourages grid companies to reduce transmission line losses at different voltage levels, to use efficient power transformers, to improve power supply coverage, and to enforce power factor correction at customers' premises.

3.6 Dealing with Peak Loads

Until recently, tight electricity supply situations and power shortages often occurred in most of China's central and southern provinces, particularly on hot days in summer.[26] While the guidance document for the grid company energy efficiency obligation states that grid company DSM activities should be prioritised to meet electricity demand during tight supply situations and power shortages, taking action to deal with these situations is the responsibility of provincial and local governments rather than the grid companies.

Electricity peak load problems are generally dealt with administratively through a planning and rationing process known as "orderly use of electricity."[27] Plans are prepared each year at provincial and local levels defining how to ration grid capacity under different degrees of expected shortage. These plans try to rely first on peak load shifting and peak load avoidance measures, but also provide for mandatory demand rationing and finally involuntary curtailment of supply, if needed. Some priority customers are provided with guaranteed ("firm") supply, while the others are ranked for involuntary rationing measures, with advanced warning if possible.

Provincial and local government power operation departments (or their counterparts) oversee the orderly use of electricity process. Individual end-users propose how much load reduction they can provide, if required. The order in which curtailments will be implemented is decided through a government-led process in conjunction with grid companies and end-users. When peak loads exceed available grid capacity and curtailments are necessary, government officials decide which end-users are going to be shut off at peak times, according to the predetermined order. Once the order of curtailments is decided, end-users' ability to negotiate whether they will be curtailed and the timing of actual curtailments is very limited.

3.7 Funding DSM and Energy Efficiency

The EEO guidance document states that DSM program implementation, management, and evaluation costs can be funded in four ways:[28]

- through a city utility surcharge (城市公共事业附加费), collected through electricity tariffs:[29]

24 China National Development and Reform Commission (2010a).

25 China National Development and Reform Commission (2011a).

26 It is possible that many of these provinces may experience supply-side overcapacity in the future, resulting from restructuring and lower growth in the Chinese economy, strong growth in renewable energy capacity, good energy efficiency performance, and continued rapid construction of coal-fired power stations.

27 China National Development and Reform Commission (2011b).

28 China National Development and Reform Commission (2010a).

29 This surcharge took effect in 1964 to support public utilities. Provincial governments set the surcharge amounts for each item (e.g., the industrial power use surcharge is five to ten percent of the electricity price).

- through revenues from differential electricity prices (差别电价), mainly through implementing differential prices for energy-intensive industries;[30, 31]
- through DSM special funds financed with surcharges on electricity prices imposed and managed by some provincial governments; these provincial special funds may provide subsidies for key energy efficiency projects, as well as communication, education, and evaluation of energy efficiency programs;[32]
- through other fiscal means, for example, an energy saving and emission reduction special fund (节能减排专项资金) established through the budgets of central and provincial governments.[33]

The EEO guidance document also states that reasonable DSM expenses incurred by grid companies can be recovered as part of power supply costs.[34] Currently, grid companies are recovering DSM costs by including all DSM expenses under a broad accounting category "power supply cost." There is no separate accounting category or reporting mechanism that enables grid companies to separately identify DSM expenses. However, grid companies will have to be able to separately identify DSM expenses if they are to be approved as allowed costs in the transmission and distribution pricing pilots being implemented in various regions.

Grid companies that establish ESCO subsidiaries to implement energy efficiency projects may be eligible for targeted ESCO funding from the central and provincial governments. In June 2010, the central government's Ministry of Finance and the NDRC released a new financial incentives policy for ESCOs carrying out projects under shared savings energy performance contracts (EPCs).[35] In October 2010, a further regulation[36] stipulated that financial incentives would be provided for projects involving boiler/furnace retrofitting, waste heat and waste pressure utilization, motor system energy conservation, energy system optimization, green lighting, and energy conservation in buildings. This regulation also listed categories of projects that are not eligible for funding, such as projects with the purpose of increasing production capacity, and projects involving solar, wind, biomass, and combined heat and power.

To receive the incentives, ESCOs are required to officially register with the NDRC and to have equipment and statistical systems in place to measure achieved energy savings. Under the policy, qualified EPC projects receive from the central government CNY240 per ton of standard coal equivalent (tce) energy saved and at least CNY60/tce from provincial and municipal governments, with some of these governments opting to pledge more. Grid company ESCOs that qualify to register with the NDRC are eligible to receive this funding.

Despite the various funding sources available, grid companies in China face significant costs in acquiring energy and demand savings. In addition, grid company revenues are reduced because they sell less electricity. At present, the regulatory regime in China does not compensate grid companies for this reduction in revenue. In common with electricity utilities in other jurisdictions, Chinese grid companies are concerned about both the

30 State Council of China (2006).

31 Differential electricity pricing is applied to energy-intensive enterprises in eight industries (electrolytic aluminium, ferroalloy, calcium carbide, caustic soda, cement, steel, yellow phosphorus, and zinc smelting). Enterprises are divided into three categories according to resource consumption and technology level. The three categories and their applicable prices are: "permit and promote" paying the standard provincial industrial power price; "restrict" paying a surcharge of CNY 0.05 to 0.1/kWh; and "eliminate" paying a surcharge of CNY 0.2 to 0.3/kWh in addition to the first class power price. New pricing mechanisms, such as time-of-use prices, inclining block tariffs, seasonal prices, and price discounts for interruptible loads, are only applied in some large cities in China.

32 For example, in Ningxia autonomous region and Jilin province, the surcharge for DSM special use is fixed at CNY 0.001/kWh.

33 The main objective of this fund is to encourage green production and environmental protection projects by giving subsidies, interest discounts, or other incentives. Local governments select projects based on proposals; the financial requirements and support amount vary among provinces. According to energy savings and emission reduction audits in 20 provinces, from 2007 to 2009, up to CNY 124 billion was allocated to support energy saving projects.

34 China National Development and Reform Commission (2010a).

35 China Ministry of Finance and National Development and Reform Commission (2010).

36 China National Development and Reform Commission (2010b).

costs involved and the revenue reduction that results from encouraging customers to use electricity more efficiently. This is exacerbated in China because the State-Owned Assets Supervision and Administration Commission evaluates grid company performance primarily on the revenue they earn and the profit they make. There are no performance metrics that recognize grid companies' achievements in acquiring energy savings. Grid company management are concerned that the performance of their companies may be downgraded because of the reduction in profit resulting from their implementation of energy efficiency projects in compliance with the EEO.[37]

In the future, grid companies may be able to access a new funding source for DSM and energy efficiency if DSM expenses are generally approved as allowed costs in setting retail prices for transmission and distribution.[38]

3.8 Evaluation, Measurement and Verification

The *Compliance Evaluation Scheme* for the grid company EEO was established by the NDRC in 2011 on a trial basis[39] and updated in 2014[40] (see Table 1, page 12). Evaluation of grid company performance in relation to the EEO is based on a scoring system that awards points for both energy savings achieved and implementation actions completed. The maximum achievable score is 100 points, with measures related to the EEO target receiving a maximum of 60 points and DSM implementation receiving a maximum of 40 points. There are four defined performance levels in the draft scheme: Excellent (>90 points), Good (80-90 points), Qualified (70-79 points), and Failed (<70 points).[41]

The 2014 update of the Compliance Evaluation Scheme was based on the grid companies' experience in achieving their EEO targets. There were some changes in the allocation of points to sub-categories, as shown in Table 1. Two new sub-categories were created that assigned points for grid companies achieving end-use energy savings (as distinct from supply-side savings such as reducing line losses) and for grid companies' progress in building data platforms to monitor energy savings.

Claimed energy savings were originally self-reported by the grid companies using their own EM&V methodologies, including deemed savings values developed for some energy efficiency measures by China Electric Power Research Institute, a subsidiary of State Grid. In early 2013, NDRC circulated a draft procedures manual for measurement, reporting, and verification of energy savings for trial by the grid companies and provincial governments that was largely based on EM&V practices in the United States. This methodology was subsequently revised based on experiences in the trial.

The EEO placed on grid companies also requires the installation of load monitoring equipment on 70 percent of the peak load. The energy use data being collected from this equipment and aggregated through data platforms will eventually form a valuable national resource that will provide a unique insight into how energy is being used in China.[42] These data will also open up major opportunities for the development and implementation of highly accurate EM&V of energy efficiency projects and programs.

3.9 Performance Incentives and Penalties

The *Compliance Evaluation Scheme*[43] states that the NDRC will reward those grid companies that achieve an "Excellent" result but there are no further details about how performance incentives will be provided. At present, no sanction is applied to grid companies that fail to meet their EEO targets, but details of non-compliance are published by the NDRC.

3.10 Grid Company Results

In 2012, 2013, and 2014, all grid companies exceeded their EEO energy savings and demand reduction targets, some by the barest margin of one GWh but others, particularly in provinces with low targets, by substantial margins. In 2013, total energy savings (on a first-year

37 Crossley (2014).

38 Crossley, Wang, and He (2014).

39 China National Development and Reform Commission (2011a).

40 China National Development and Reform Commission (2014a).

41 Grid companies that do not meet their targets for electricity consumption reduction or electricity load reduction are also considered to have failed.

42 Crossley (2013c).

43 China National Development and Reform Commission (2011a).

Table 1

Compliance Evaluation Scheme for the Grid Company Energy Efficiency Obligation in China[44, 45]

Criteria	Points 2011	Points 2014	Evaluation Standard (2014)
Electricity Savings (60 points)			
*Electricity consumption saving	30	20	Achieve 100% of target: 20 points Achieve 50%-90% of target: 10-18 points Achieve less than 50% target: 0 points
*Electricity load reduction	30	30	Achieve 100% of target: 30 points Achieve 50%-90% of target: 15-27 points Achieve less than 50% target: 0 points
End-use electricity savings		10	End-use savings contribute at least 10% of total electricity savings 2 points; 20% 5 points; 30% 8 points; 40% 10 points; less than 10% 0 points
DSM Implementation Performance (40 points)			
System design	3	3	Develop DSM regulation and policy: 1 point Develop DSM regulation working plan: 1 point Understand the compliance evaluation scheme, clarify rewards and punishment system: 1 point
Institutional management	2	4	Clarify DSM managers' responsibility, regularly hold working meetings:1 point Allocate DSM experts:1 point Accomplish annual evaluation on schedule: 2 points
Communication and training	3	4	Conduct at least four communication activities each year: 1 point Hold at least 2 training activities: 2 points Develop training plans for relevant employees: 1 point
Building data platforms		6	Establish and apply data platform: 3 points Achieve end-use customer on-line monitoring, provide energy services: 3 points
Technical assistance	5	2	Load monitoring capacity reaches 70% of peak load in the region: 1 point Load control capacity reaches 10% of peak load in the region: 1 point
Financial input	5	5	Establish and operate DSM special fund: 5 points
Implementation of DSM rules	6	6	Establish energy saving service organization and carry out energy contract management projects: 1 point Use pricing signal such as critical peak pricing, double storage pricing to help customers with DSM programs: 1 point Establish demand response new mechanism: 2 points Cooperate with financial institutes, build DSM financing new channels: 2 points
Key project results	6	5	Deduct 1 point if one key energy saving project fails according to the evaluation results
Other evaluation	10	5	These points may be allocated by provincial government agencies that manage electricity industry operations

** These are threshold criteria; grid companies that do not meet their targets for electricity consumption reduction or electricity load reduction are considered to have failed.*

44 China National Development and Reform Commission (2011a).

45 China National Development and Reform Commission (2014a).

savings basis) were 16.2 TWh, and the total load reduction was 3.44 GW. The 2014 results were lower with total energy savings of 13.1 TWh, and total load reduction of 2.95 GW. The lower results may be caused by the grid companies moving from finding relatively easy energy savings within their own operations to beginning to target end-use energy savings in customers' facilities.

In 2013, under the *Compliance Evaluation Scheme*, all provincial grid companies, except for Tibet, passed the evaluation, with 17 assessed as Excellent, 12 Good, and one Qualified.[46] In 2014, performance levels for individual grid companies were not publicly released.

Table 2 shows the grid companies' detailed performance data by province in 2013 and 2014.

State Grid Corporation of China

In response to the EEO, State Grid created ESCOs in all 26 provinces within its service territory as subsidiaries of the State Grid-owned provincial grid companies, plus an additional ESCO at the corporate level. As of October

Table 2

Electricity Savings and Load Reductions Achieved by Grid Companies in China[47]

Region	Electricity Savings (GWh) 2013 Target	2013 Actual	2014 Target	2014 Actual	Load Reduction (MW) 2013 Target	2013 Actual	2014 Target	2014 Actual	Evaluation Level 2013	2014
Beijing	236	255	246	247	47.2	56.9	52.8	66.5	Excellent	N/A
Tianjin	182	194	195	207	34.9	37.2	39	40.9	Excellent	N/A
Hebei	785	1001	836	929	131.1	160.9	145	186.6	Excellent	N/A
Shanxi	384	646	407	576	66.5	114.4	76.6	131.2	Excellent	N/A
Inner Mongolia	299	342	324	410	40	49.4	67.3	71.7	Good	N/A
Shandong	403	1252	433	573	152.1	283.9	169.9	170.2	Excellent	N/A
Liaoning	449	582	482	848	71.5	144.3	73.2	188.5	Good	N/A
Jilin	107	175	110	183	29.2	47.6	27.6	37.6	Good	N/A
Heilongjiang	141	169	146	148	33.9	42.5	34.6	39.2	Excellent	N/A
Shanghai	329	490	351	420	78	99.2	88.2	92.6	Excellent	N/A
Jiangsu	1136	1190	1257	1352	205.7	238.1	233.3	286	Excellent	N/A
Zhejiang	327	384	353	416	155.2	199.2	163.9	180.1	Excellent	N/A
Anhui	317	782	354	428	68.1	148.9	79.7	80.5	Excellent	N/A
Fujian	165	432	407	413	76.1	120.4	76.6	82.9	Good	N/A
Hubei	349	604	385	460	70.7	155.4	80.2	108.6	Good	N/A
Hunan	358	668	289	353	105.6	190.4	65	100.9	Excellent	N/A
Henan	421	708	445	526	133.3	188.5	144	146.7	Excellent	N/A
Jiangxi	102	209	102	204	41.2	55	45	46.8	Excellent	N/A
Sichuan	438	1008	467	558	73.2	193.1	79.7	79.9	Good	N/A
Chongqing	160	249	180	208	35.7	59.3	42	48.3	Good	N/A
Guangdong	1226	1727	1275	1341	235.4	333.1	251.4	282.3	Excellent	N/A
Guangxi	212	259	223	232	40.7	49.9	41	44.6	Good	N/A
Guizhou	243	275	259	276	44.9	54.6	47.6	53.2	Good	N/A
Yunnan	271	271	294	339	44.7	73	45.9	97.2	Good	N/A
Hainan	47	52	52	75	8.4	11.3	9.5	15.2	Good	N/A
Shan'xi	191	367	199	260	46.4	75.8	49.5	53.4	Excellent	N/A
Gansu	210	506	228	396	37.5	83.2	43.6	81.9	Good	N/A
Qinghai	163	207	183	194	22.9	33.7	26.4	40.9	Excellent	N/A
Ningxia	185	311	202	266	29.1	58.9	33.8	55.9	Excellent	N/A
Xinjiang	161	923	210	296	41.1	77.8	36.8	39.2	Qualified	N/A

46 China National Development and Reform Commission (2014b).

47 China National Development and Reform Commission (2014b).

2014, all of these ESCOs, except for Tibet, were registered with the NDRC and the Ministry of Finance. Their main roles are implementing energy efficiency projects, delivering specialised energy and consultancy services, and helping to organise workshops and seminars to better engage end-users in energy efficiency programs. By the end of 2014, State Grid had signed 433 energy saving program contracts, with a total investment of CNY 1.25 billion, which was estimated to generate 2.25 TWh annual savings.[48] State Grid has also built high-voltage DC transmission lines and reduced line losses. In addition, State Grid also strengthened its commitment to green procurement, promoting energy efficient products, high-efficiency electric motors, and other energy efficient equipment.[49]

China Southern Grid Company

Southern Grid established a single ESCO at the corporate level that covers all four provinces within the Southern Grid service territory. In 2007, Southern Grid commenced its "Green Action" program, which it is now using to meet its EEO targets. Under this program, Southern Grid has:[50]

- increased the efficiency of transmission and distribution networks by optimising grid structure, selecting energy efficient transformers, and introducing innovative transmission system designs. The line loss rate was reduced to 6.02% in 2013;
- implemented energy saving (environmental) dispatch by giving priority to renewables and more efficient coal-fired power plants;
- planned to save 27.2 TWh of electricity from 2010 to 2015 by building efficiency power plants[51] fully exploiting the energy efficiency potential in green lighting, high-efficiency electrical devices, and residential appliances; and
- emphasised energy services by changing from pure peak load management to end-use energy efficiency, and from concentrating on electricity consumption management to providing comprehensive energy services through the Southern Grid ESCO subsidiary. From 2010 to 2013, the ESCO successfully helped customers save 6 TWh of electricity;[52] and,
- disseminated energy saving concepts and technologies through a variety of communication channels.

3.11 Cost-Effectiveness

In China, there is no transparent well-designed framework for formally taking costs and benefits into account when designing energy efficiency programs, nor is there any definition of "reasonable costs," without which it is difficult to determine which costs should be included in a cost-effectiveness analysis.[53] Energy efficiency projects are usually implemented mainly to meet government energy efficiency targets, such as the grid company EEO, though a limited form of cost-effectiveness assessment may be carried out for individual projects. In particular, total resource costs and supply-side benefits are not taken into account, in contrast to the standard practice in other countries.

In the United States, utilities find that acquiring energy efficiency resources is often cheaper, and more economically efficient than generating or purchasing electricity. In China, the grid companies currently do not assess the cost-effectiveness of acquiring energy efficiency resources as compared with purchasing bulk electricity from generators. It is difficult for the grid companies to carry out this assessment because of the lack of a mechanism to separately account for DSM expenses, though such a mechanism may be developed in the future. Locating the acquisition of energy efficiency resources in ESCO subsidiaries outside grid companies' core businesses also makes cost-effectiveness assessment difficult.[54]

48 State Grid Corporation of China (2014).

49 State Grid Corporation of China (2011).

50 China Southern Grid Company (2010).

51 The term "efficiency power plant" (EPP) was first coined in China by the Regulatory Assistance Project in 2004 to describe a carefully selected portfolio of energy efficiency projects that provides a specified quantity of load reduction over a particular time period, with a level of reliability similar to the output from a conventional power plant (CPP). The EPP concept recognizes that CPPs have well defined planning and investment frameworks whereas energy efficiency currently does not, but could do so if the development of a portfolio of energy efficiency projects was carried out in a coordinated way.

52 China Southern Grid Company (2013).

53 An initial attempt to define "reasonable costs" is being made in the Shenzhen transmission and distribution pricing pilot project.

54 Crossley (2013b).

3.12 Overall Effectiveness

China's grid company energy efficiency obligation is relatively new and the grid companies have experienced some difficulties in changing their business models to achieve the EEO energy savings and load reduction targets. Both grid companies have chosen to establish subsidiary ESCOs to carry out energy efficiency projects. This use of ESCOs as the main delivery mechanism locates the acquisition of energy efficiency resources in a separate, subsidiary business unit outside the grid company core business rather than incorporating energy efficiency into the grid company business model.[55] This raises questions about the commitment of the grid companies to achieving the EEO targets and suggests that the EEO mechanism may not continue over the long term without further policy action by government. In addition, the levels of the two EEO targets are very low compared with targets for utility delivery of energy efficiency in other jurisdictions.[56] In 2013, the total energy savings (on a first-year savings basis) were 16.2 TWh, and the total load reduction was 3.44 GW. These savings are large in comparison to total annual energy savings in most other countries, but given China's size they are not particularly ambitious. While it is too soon to enable a robust assessment of the effectiveness of the grid company EEO in China, performance to date has not been outstanding.

55 Crossley (2013b).

56 Crossley et al. (2012).

4. Energy Efficiency As A Resource

In several jurisdictions around the world, electricity utilities employ end-use energy efficiency as a resource in meeting their customers' needs for energy services.[57] Energy efficiency is seen as a cost-effective alternative to investing in supply-side resources, such as building power plants and expanding the electricity grid. Used in this way, energy efficiency provides multiple benefits to the power system, to electricity customers, and to society as a whole.

In China, the March 2015 government policy statement *Deepening Reform of the Power Sector* (《关于进一步深化电力体制改革的若干意见（中发〔2015〕9号）文》全文)[58] commits to gradual national implementation of grid company regulation based on the principle of "Approved Costs + Reasonable Revenue." This regulatory reform will make it easier for grid companies implement cost effective energy efficiency and DSM and eventually move towards using energy efficiency as a power sector resource.

The *Deepening Reform* policy statement includes expanding several existing transmission and distribution pricing pilots to cover the entire country. These pricing pilots were first implemented in Shenzhen and Inner Mongolia in November 2014.[59] In May 2015, the central government announced that the regulatory principles implemented in the first pilots will be extended to Yunnan, Anhui, and Hubei provinces, and to Ningxia autonomous region.[60]

Depending on implementation details, the kind of pricing reform implemented in the pricing pilots may open up greater opportunities for grid companies to support energy efficiency and DSM by breaking the regulatory link between electricity sales and grid company revenues. Specifically, the revenue of each grid company involved in the pricing pilots is set for three-year periods at a particular level determined by the government.[61] While the primary objective of this pricing reform is to drive increased operational efficiency, it also has the added benefit of reducing the threat to grid company revenues that can accompany increased end-use energy efficiency. Capping grid company revenue reduces the "throughput effect," whereby grid companies rely on supplying increasing volumes of electricity to maintain their revenue and therefore profits. In this way, revenue capping "decouples" grid company revenue from sales volumes. Many U.S. states have used similar revenue-cap regulatory regimes to make it easier for electricity utilities to deliver energy efficiency to their end-use customers.[62]

While the pricing pilots were not introduced specifically with the intention of encouraging grid companies to implement DSM and end use energy efficiency, grid companies involved in the pilot projects should, in principle, be able to claim expenditure on implementing DSM and energy efficiency programs as "allowed costs" under the regulatory regime for the pricing pilots.[63] The EEO guidance document states that reasonable DSM expenses incurred by grid companies can be recovered as part of power supply costs.[64, 65]

New rules for the transmission and distribution pricing pilot in the western part of Inner Mongolia provide further support for grid company DSM because they call for the formulation of incentive mechanisms targeting

57 Crossley (2014).

58 Central Committee of the Communist Party and State Council of China (2015).

59 Crossley et al. (2014).

60 China National Development and Reform Commission (2015c)

61 China National Development and Reform Commission (2015a).

62 Migden-Ostrander, Watson, Lamont, and Sedano (2014).

63 Dupuy, Crossley, Kahrl, and Porter (2015).

64 China National Development and Reform Commission (2010a).

65 In mid-2015, there is some anecdotal evidence that DSM expenses are being treated as allowed costs.

various aspects of grid company service provision.[66] The rules specifically mention "strengthening DSM" as one of the aspects for which an incentive mechanism will be developed. This ruling should effectively create a performance incentives regime for grid company DSM in Inner Mongolia that could be replicated throughout China. In the United States, some states have established performance incentives for utility-delivery of end-use energy efficiency and some U.S. electricity utilities receive large financial payments if they meet pre-set energy efficiency targets.[67]

In China, careful attention to the details of implementing the government's planned reforms of grid company regulation will be necessary to lead the grid companies to seriously consider using energy efficiency as a power sector resource. The government must follow through with eliminating the throughput incentive and, in addition, create financial incentives for grid companies to deliver cost-effective DSM and end-use energy efficiency, building on the existing energy efficiency obligation.

66 China National Development and Reform Commission (2015b).

67 American Council for an Energy-Efficient Economy (2015).

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