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Government Oversight of Grid Company Demand-Side Management Activities in China:

Recommendations from International Experience

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Several people were involved in developing this paper. John Plunkett from Green Energy Economics Group wrote the first draft which was then edited by Frederick Weston from RAP. David Crossley from RAP extensively revised the first draft and edited the final version for publication. Max Dupuy from RAP and Mona Yew from the Natural Resources Defense Council provided valuable comments, most of which were included in the paper. Wang Xuan from RAP worked hard to ensure that the Chinese version of the paper accurately conveyed the content of the English version. Camille Kadoch and Wang Xuan respectively shepherded the English and Chinese versions through the publication process.

Responsibility for any errors or omissions in the paper is taken by David Crossley.

Acronym List

DSM	Demand-Side Management
ESCO	Energy Service Company
GWh	Gigawatt-hour
LED	Light-emitting diode, an energy-efficient form of lighting
MoF	Ministry of Finance
MW	Megawatt
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NGO	Non-Government Organization
PBR	Performance-Based Regulation
RMB	Renminbi, official currency of China
SASAC	State-Owned Assets Supervision and Administration Commission
SERC	State Electricity Regulatory Commission
TOU	Time-of-Use
TRM	Technical Reference Manual

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Executive Summary

In November 2010, China issued a *DSM Implementation Measures* guidance document that places an obligation on grid companies that requires them to carry out demand side management (DSM) activities to achieve specified targets for reductions in electricity sales (GWh) and peak demand (MW).

This paper provides our ideas for government oversight of grid company DSM activities in China, based on international experience. Government oversight is important because, although the grid companies have the capability to be highly effective deliverers of energy efficiency, they have no track record and the electricity savings targets are not inherently consistent with grid company internal incentives.

The Chinese government has already begun developing a framework for evaluating grid company performance. To build on this work, and keeping in mind that every country is different and has to find specific solutions for particular local problems, we have several key recommendations. We group these recommendations based on three key questions faced by China and other countries with energy efficiency obligation schemes.

1. What information should government officials require from the grid companies?

In the course of their DSM work, the grid companies will potentially interact with millions of end-users and implement millions of individual DSM measures – and, in the process, generate reams of data and other information. Knowing what kind of aggregated information to require from the grid companies is the first challenge for government officials.

Recommendation #1: Each grid company should be required to regularly submit *DSM Portfolio Plans* outlining their proposed DSM activities, including:

- detailed descriptions of the DSM programs that the grid company intends to implement to achieve its annual electricity savings targets; and
- expected costs of implementing these programs.

Government officials can then scrutinize the plans and require appropriate changes ahead of DSM program implementation.

Recommendation #2: Each grid company should be required to follow up with regular *DSM Performance Reports* that detail the actual results of implementing DSM programs, including:

- detailed descriptions of actual electricity savings achieved;
- aggregate costs incurred, broken down by each DSM program; and
- comparison of the results with the grid company's approved DSM Portfolio Plan – and explanations for any deviation.

2. What should government officials do to verify the information received from the grid companies?

It is generally quite challenging to verify information provided by grid companies about DSM programs. These independent firms are large and have many more staff than the relevant government agencies. They also have better "on-the-ground" understanding of the DSM projects. As a result, government officials tend to struggle with verifying the information received. Approaches to verification will naturally vary depending on national legal and political structures. Our main idea in this area is that government officials should focus on the methodologies used by the grid companies in measuring the results from DSM projects and measures.

Recommendation #3: Each grid company should be required to prepare and submit a *Technical Reference Manual* (TRM) that specifies the methods used by the grid company to measure the results of their DSM activities carried out in specific facilities. Government officials can then scrutinize the TRM – with the help of expert consultants – and require changes as necessary.

Recommendation #4: Government officials should establish processes for carrying out *independent audits* of the measurement of electricity savings by the grid companies. Audits should be carried out on a random unscheduled basis.

3. What can government officials do with the information once it is received and verified?

The information provided by the grid companies about their DSM activities is valuable for ensuring that their electricity savings targets are met. Beyond this, government officials in many countries and regions use similar information provided by energy suppliers to assess the costs and benefits of DSM programs, particularly in comparison to traditional investments in generation, transmission, and distribution assets. This type of comparative analysis typically provides strong evidence that energy efficiency is a very attractive alternative when compared to traditional supply-side investments. The *DSM Implementation Measures* guidance document recognizes this by requiring grid companies to put energy efficiency first. Using the information provided by the grid companies to carry out cost-effectiveness analyses of their DSM programs will enable the most effective programs to be selected. Information provided by the grid companies about the costs of implementing DSM programs can be used to enable grid companies to treat these costs as investments, in accordance with the provisions of the guidance document.

Recommendation #5: Build on the requirement in the *DSM Implementation Measures* guidance document that prioritizes demand-side over supply-side investments by implementing *cost-effectiveness analyses* of grid company DSM programs, including calculating the benefits associated with reduced pollutant emissions. The analyses could be done by the grid companies (subject to government scrutiny and review), by independent consultants, or by government officials.

Recommendation #6: Build on the clause in the *DSM Implementation Measures* guidance document that allows grid companies to treat DSM investments in the same way as other investments. Allow grid companies to *recover the costs* of implementing DSM programs. More broadly, develop mechanisms to better align grid company incentives with China's DSM goals.

1. Introduction

In November 2010, China's National Development and Reform Commission (NDRC) issued the document *Demand-Side Management Implementation Measures* (发改运行 [2010] 2643号).[1] This guidance document requires grid companies in China to carry out demand-side management (DSM) activities, including both energy efficiency and load management, to achieve specified targets for reductions in electricity sales (GWh) and peak demand (MW).

By issuing the *DSM Implementation Measures* guidance document, China joins many other governments around the world that have established energy efficiency obligation schemes to require energy suppliers to achieve set levels of energy savings.[2] These governments have had to expend considerable effort to develop the capacity to oversee the activities undertaken by the energy suppliers to achieve their energy savings targets. It is not simple for government officials to make sure that the energy savings targets set by the government are actually achieved, and achieved cost effectively. Many governments have struggled with this problem, with varying degrees of success.

This paper provides our ideas for government oversight of grid company DSM activities in China, based on international experience. Government oversight is important because, although the grid companies have the capability to be highly effective deliverers of energy efficiency, they have no track record and the electricity savings targets are not inherently consistent with grid company internal incentives. Although the paper focuses on DSM programs managed by the grid companies, we believe most of the topics discussed here can also apply to other DSM programs, such as China's new "DSM Cities" initiative.

China has already taken significant steps in government oversight of grid company DSM activities. In 2011, NDRC issued the document *DSM Regulation Compliance Evaluation Scheme (Draft)* (发改委关于印发《电网企业实施电力需求侧管理目标考核方案》的通知 [发改运行 [2011] 2407号).[3] This guidance document includes a draft set of criteria for assessing grid company performance in relation to achieving the electricity savings targets. To build on this work and aid the efforts of the various Chinese government agencies that are involved with overseeing the grid companies, we identify several "international best practices" that may be useful in China.

This paper is based on best practices employed by various governments around the world in overseeing DSM activities carried out by energy suppliers. It covers a range of issues relating to grid company DSM. The paper does not, however, go into the fullest detail on every issue. It is meant to introduce concepts and to assist the government agencies in China charged with overseeing grid company DSM activities[4] to identify and prioritize actions to be taken.

This paper is not a guide to implementing DSM. That is the subject of the recently published *DSM Program Procedures Manual* (电力需求侧管理项目实施指导手册

1 National Development and Reform Commission, *Demand-Side Management (DSM) Implementation Measures No. 2643* (发改运行 [2010] 2643号) issued on November 4, 2010, effective January 1, 2011.

2 For detailed descriptions of many of these energy efficiency obligation schemes see Crossley, D., Gerhard, J., Kadoch, C., Lees, E., Pike-Biegunska, E., Sommer, A., Wang, X., Wasserman, N., and Watson, E. (2012). *Best Practices in Designing and Implementing Energy Efficiency Obligation Schemes.* International Energy Agency Demand Side Management Programme, Task XXII Research Report. Montpelier, Vermont, The Regulatory Assistance Project. Available at: http://www.raponline.org/document/download/id/5003

3 National Development and Reform Commission. *DSM Regulation Compliance Evaluation Scheme (Draft) No. 2407* (发改委关于印发《电网企业实施电力需求侧管理目标考核方案》的通知 （发改运行 [2011] 2407号).

4 These agencies may include the State Electricity Regulatory Commission (SERC), the National Development and Reform Commission (NDRC), the State-owned Assets Supervision and Administration Commission (SASAC), the National Energy Administration (NEA), the Ministry of Finance (MoF), and other central government agencies, plus relevant provincial government agencies.

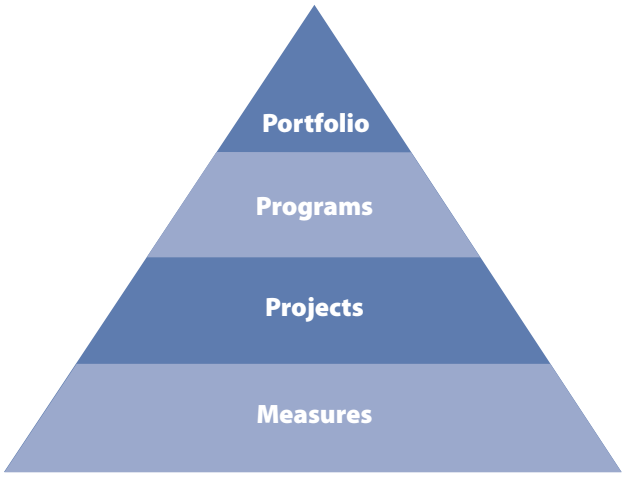
（工业篇）).[5] This paper refers frequently to those parts of the DSM Manual that relate specifically to the responsibilities of government officials.

1.1 DSM Activities

The essential "building blocks" of grid company DSM activities are identified in Figure 1.

Figure 1

Grid Company DSM Activities



The grid company **DSM portfolio** at the top of Figure 1 consists of a relatively small number of **DSM programs**, each of which comprises many **DSM projects**. Each DSM project implements one or more **DSM measures** shown at the base of the pyramid. For example, a grid company may have a DSM portfolio focusing on the industrial sector that might consist of several DSM programs, each directed to one type of industry, such as steelmaking, cement, petrochemicals, and so on.[6] Within each DSM program there will be a range of DSM projects carried out at individual industrial facilities, for example, factories or manufacturing plants. Each project may employ one or more DSM measures, such as installing energy-efficient motors, repairing compressed air leaks, upgrading lighting, and so forth.

1.2 Organization of this Paper

Four substantive sections make up the rest of this paper:

- *Section 2:* Grid Company DSM Planning and Reporting;
- *Section 3:* Verifying Electricity Savings;
- *Section 4:* Assessing the Cost-Effectiveness of DSM Activities; and
- *Section 5:* Other Areas for Action by Government Officials.

The sections are presented in order of priority. Before they can carry out any oversight of grid company DSM activities, government officials require information: Section 2 describes the kinds of information that responsible government agencies typically require. Section 3 outlines processes for verifying the accuracy of data on electricity savings provided by the grid companies. Section 4 introduces the various economic analyses that can be conducted with the data, which will reveal whether grid company DSM activities are cost-effective and whether changes are needed to improve their cost-effectiveness. Section 5 describes several complementary policies and actions aimed at assuring the highest levels of DSM performance by grid companies.

We do not expect government officials to take on this comprehensive set of responsibilities at the very start of grid company DSM in China. What works in other countries may not be suited for China; each step will involve learning and adjustment. Nevertheless, it is important for this paper to cover the broad range of potential actions by government officials, so that decisions can be made about the most appropriate actions to implement in China.

5 The *DSM Program Procedures Manual, Volume 1 – Industrial Energy Efficiency Program,* published in August 2008, was commissioned by the Natural Resources Defense Council (NDRC) and developed through a collaborative effort by the NRDC, the China-US Energy Efficiency Alliance, and the State Grid DSM Instruction Center in Nanjing. Note that there are significant differences between the Chinese and English language versions of this Manual. The Chinese language version (电力需求侧管理项目实施指导手册（工业篇）) is preferred for use in China and has been consulted during the preparation of this paper.

6 In North America, a DSM portfolio generally consists of a broader variety of programs designed to serve different markets and address specific barriers. For example, the programs may include incentive programs, financing programs, or direct installation and project implementation programs. Each program may also be designed to address specific technologies or market segments. There may also be technical assistance, energy audits, or other information programs that do not yield direct electricity savings but are complementary to those programs that do.

2. Grid Company DSM Planning And Reporting

A fundamental responsibility of grid companies is to report on the planned and actual results of their DSM activities. Overseeing DSM reporting by grid companies is an essential duty of government officials. Government officials are responsible for ensuring that reporting occurs, and that the grid companies submit timely, accurate, and complete reports on their DSM activities.

In China, DSM reporting enables government officials to determine the extent to which grid companies are meeting their DSM obligations, which are detailed in Article 14 of the *DSM Implementation Measures* guidance document:

> *Provincial power authorities together with other responsible bodies shall set local grid companies' power saving targets, and strengthen the assessment process. Power grid companies at provincial level shall achieve annual savings of at least 0.3% in sales volume and 0.3% in maximum sales load compared with the previous year through self-action or purchasing service.*

DSM reporting also allows government officials to evaluate contributions by grid company DSM activities toward meeting other government policy goals, for instance, the emissions reduction and productivity targets contained in the national Five-Year Plans and other decrees.[7]

2.1 Current DSM Planning and Reporting in China

In China, the *Compliance Evaluation Scheme* guidance document requires grid companies to plan and report on their DSM activities as follows:

1. Before the end of March each year, the provincial grid companies are to provide recommendations about annual savings targets and implementation measures to provincial government departments in charge of electric power operations. The government will seek comments from relevant departments and approve the targets and implementation measures by the end of April.

2. Before the end of February each year, the provincial grid companies are to report the previous year's electricity savings and implementation measures to provincial government departments in charge of electric power operations. The government will, in concert with relevant departments, assess and supervise verification of the results, and submit an assessment report to the NDRC by the end of March.

3. Before the end of March each year, the national level grid companies, State Grid and China Southern Grid, will report on the previous year's electricity savings and implementation measures to the NDRC and relevant departments. The NDRC, along with relevant departments, will conduct an assessment and supervise verification of the results, and formulate an integrated assessment report that will be published and made available to the general public.

2.2 Improving DSM Planning and Reporting

The purpose of planning and reporting on grid company DSM activities is:

- to ensure electricity savings targets are met or exceeded, and any projected reductions in pollutant

7 China has set very ambitious energy intensity and carbon intensity reduction targets for 2020. The Twelfth Five-Year Plan (2011-2015) sets interim targets for these and other metrics.

emissions are delivered;
- to identify problems, thereby enabling mid-course adjustments to be made; and
- to guide the design of future DSM programs.

The role of government officials is to specify the content, timing, and frequency of planning and reporting on grid company DSM activities.

In China, the *Compliance Evaluation Scheme* guidance document has already established a process for planning and reporting on grid company DSM activities. This process provides an excellent starting point, but it could be improved by making the process multiyear, with sufficient lead time for government officials to review and approve grid company submissions before the implementation of each round of DSM programs begins. There should also be a process for ongoing review and adjustment of program plans, and collection of sufficient information to provide guidance for subsequent program planning and implementation.

Grid companies should submit information both prospectively (before program implementation) and retrospectively (after program implementation has begun). Government officials should establish processes through which they can consider and reach findings on the reasonableness of the reported information, and issue any decisions they deem necessary regarding future DSM activities.

The following sections of this paper present our ideas on how the existing compliance evaluation scheme in China could be improved.

2.3 Prospective DSM Portfolio Plans

Government officials should require grid companies to carry out a series of repeated planning stages culminating in the production of DSM Portfolio Plans that government officials then review and approve.

DSM Portfolio Plans state the electricity savings targets to be achieved and the grid company's expected costs, as well as providing other quantitative and qualitative information about the DSM programs designed to obtain the savings. This information is useful for government officials when they assess the economic merits of grid company DSM activities relative to the costs of electricity supply these activities avoid.

Each DSM Portfolio Plan should cover a multiyear planning period (typically three to five years) and describe how the grid company expects to achieve the annual electricity savings targets established by government officials. The Portfolio Plan should be submitted far enough in advance for government officials to review it, modify it if necessary, and finally approve it not less than three months before the proposed commencement of DSM program implementation.

2.3.1 Electricity Savings Targets

According to the *DSM Implementation Measures* guidance document, provincial level government officials are responsible for setting annual electricity savings targets for the grid companies. Each year, government officials must set current year electric energy (GWh) and peak demand (MW) savings targets of at least 0.3 percent of a grid company's previous-year actual annual sales and peak demand.[8] These targets should be included in each grid company's DSM Portfolio Plan.

In their Portfolio Plans, grid companies may also wish to nominate indicative multiyear annual electricity savings targets, in both GWh and MW, based on forecasts of sales and peak demand in future years. The *DSM Implementation Measures* guidance document does not require multiyear targets, but grid companies may find such indicative future targets useful for planning purposes.

2.3.2 DSM Programs

A key component of a grid company's DSM Portfolio Plan comprises detailed descriptions of the DSM programs that the grid company intends to implement to achieve its electricity savings targets. These descriptions should include for each planned DSM program:
- the market intervention strategies that the grid company will use to recruit electricity customers to participate in the program and to motivate program participants to install cost-effective DSM measures;
- the estimated number of customers expected to participate in the program;

8 The *DSM Implementation Measures* guidance document states that the annual electricity savings obligation is "at least 0.3%." Consequently, it should be possible for government officials in individual provinces to decide to set the level of the obligation higher than 0.3 percent.

- the expected costs of implementing DSM measures to be paid by the grid company or the grid company energy service company (ESCO);
- the expected costs to be paid by customers or other stakeholder (such as equipment suppliers or non-grid company ESCOs);
- the general plan and internal procedures that the grid company intends to use for measuring actual electricity savings; and
- the number of years over which electricity savings will be achieved, based on the expected lifetimes of individual DSM measures.

2.3.3 DSM Budgets

A DSM Portfolio Plan should also include a budget comprising estimates of the costs the grid company will incur to meet its electricity savings targets. Prior to the development of the Portfolio Plan, government officials should determine in detail which costs incurred by a grid company are allowable and consequently are to be included in the DSM budget.

In many countries and regions, government officials routinely review and approve (or modify) DSM budgets proposed by electricity suppliers. In China, the *DSM Implementation Measures* guidance document does not specifically require government officials to approve DSM budgets proposed by grid companies. However, establishing a process for reviewing and approving grid company DSM budgets will avoid surprises and disagreements during the later assessment of a grid company's actual costs.

To assist with this review and approval process, each budget should contain sufficient detail to enable government officials to judge the reasonableness of the proposed DSM expenditures in terms of the grid company's ability to achieve its electricity savings targets cost-effectively.[9] Chapter 3 (Articles 22 to 24) of the *DSM Implementation Measures* guidance document specifies possible funding sources for DSM programs as well as the types of DSM activities that can be funded. The guidance document also allows reasonable DSM expenditures to be treated in the same way as other grid company investments.

The timing and frequency of budget reviews and approvals is important. Annual budget approvals do not allow sufficient certainty for planning and implementation of DSM programs. In some countries and regions, a three-year time frame for approval of DSM budgets has been found to be most effective.

2.3.4 Additional Information

Government officials may also require grid companies to include additional information in their DSM Portfolio Plans, such as:

- projected reductions in pollutant emissions from electricity generation avoided by implementing DSM programs (e.g., reductions in sulfur, carbon and/or particulate emissions);
- projected non-electric energy savings or increased usage resulting from implementing DSM programs (e.g., savings or increased usage of coal, fuel oil, natural gas); and
- projected savings of non-energy resources from implementing DSM programs (e.g., water savings).

2.3.5 Subsequent DSM Portfolio Plans

A new multiyear DSM Portfolio Plan will be needed for the next planning period following the initial plan's timeframe. This new plan should be developed and submitted for review by government officials well in advance of the commencement of the next round of DSM program implementation. The new plan should reflect both the actual results achieved from implementing the previous round of DSM programs and updated expectations based on changing market and technologic opportunities. In other countries and regions, government officials typically require electricity suppliers to submit new DSM Portfolio Plans every three to five years.

2.4 Retrospective Reports on Actual DSM Performance

Reviewing the results of DSM program implementation by the grid companies is a major responsibility of government officials. Periodic retrospective reporting by grid companies on actual DSM performance allows government officials to gauge progress toward annual and long-term electricity savings targets. It also enables

9 See section 4 (page 13) for information about the role of government officials in assessing the cost-effectiveness of grid company DSM activities.

government officials to determine the extent to which a DSM portfolio has been implemented as designed and planned by the grid company, and to make any changes required in the light of experience.

Government officials should require grid companies to submit annual DSM Performance Reports detailing the actual results from implementing DSM programs to achieve electricity savings targets. Grid companies should report results against the targets, estimates, and projections included in their DSM Portfolio Plans.

An annual DSM Performance Report should document the actual achievements of the grid company's DSM portfolio for the preceding year. It should also compare these achievements with the grid company's latest approved DSM Portfolio Plan and explain any significant variation between actual and planned performance indicators. The annual DSM Performance Report should also include any proposals by the grid company to change the approved DSM Portfolio Plan in the light of the achieved results.

Annual DSM Performance Reports should be submitted at the end of the first quarter of the year following the program reporting year. Government officials should then review the results and any changes proposed by the grid company and, if necessary, modify the company's approved DSM Portfolio Plan.

2.5 Measuring Electricity Savings

The *DSM Manual* provides extensive information on procedures for measuring and verifying electricity savings from DSM activities (see Section 5 of the Chinese language version of the Manual). These procedures invariably depend on estimating rather than directly measuring savings. The absence of electricity use – that is, electricity savings – can be estimated by comparing electricity use before and after implementation of a DSM measure. What happens before the measure is installed is known as the "efficiency baseline." For example, an LED lamp rated at 10 watts with the same light output as a 100-watt incandescent bulb saves 90 watts of demand against a 100-watt baseline. How much electricity the LED lamp saves depends on how much time it is on compared to how much time the 100-watt incandescent bulb it replaces would have been on.

There are two perspectives from which electricity savings can be estimated: ex ante (i.e., before they happen) and ex post (i.e., after they have taken place). The *DSM Manual* explains that ex ante estimates use engineering equations and apply assumed field conditions relating to high-efficiency and baseline equipment efficiency levels, hours of use, weather, and other variables that influence energy and peak demand savings. Ex post estimation of electricity savings is based on observations of installed equipment, actual recorded GWh energy consumption, and MW demand. Estimation of electricity savings may involve the use of statistical and computational techniques to adjust for variables beyond the control of the grid companies, such as weather.

To estimate electricity savings on an ex ante basis, grid companies need to develop and propose equations for calculating electric energy and peak demand savings from DSM projects involving combinations of energy-efficient technologies. Savings estimates may in some cases be simple point values for technologies that DSM programs install on a large scale, such as high-efficiency light bulbs. Typically methods and assumptions for estimating ex ante electricity savings are documented in what is generically referred to as a Technical Reference Manual (TRM), which is then reviewed by government officials.

From the results of ex ante and ex post estimations, grid companies should aggregate electricity savings from all DSM programs to calculate total program and portfolio results to be reported in annual DSM Performance Reports. Savings estimates should also include assumptions regarding peak coincidence factors to establish peak demand (MW) savings. For example, the 90 watts in nominal savings from an LED lamp may have a 90-percent likelihood of taking place during an afternoon system peak if the lamp is installed in a commercial building, but have only a 10-percent coincidence factor if it is installed in the home of someone who is away at work during the day.

2.6 Information Requirements

The information requirements for DSM reporting that China adopts should be determined by China's own objectives and capabilities. A common mistake that government officials in other countries and regions have made is to ask for more information than they really need. The purposes for which the information will be used should be the determining factor.

Early on in the process for overseeing grid company DSM activities, the primary need is to establish, broadly, that progress is being made and targets are being met. As both grid companies and government officials develop their requisite skills, it first makes sense to require only a minimum amount of information – for instance, aggregate electricity savings (annual and lifetime) and total expenditure on DSM activities. Later the categories of information can be expanded as experience allows.

2.7 Recommendations

Recommendation #1: Each grid company should be required to regularly submit *DSM Portfolio Plans* outlining their proposed DSM activities, including:

- detailed descriptions of the DSM programs that the grid company intends to implement to achieve its annual electricity savings targets; and
- expected costs of implementing these programs.

Government officials can then scrutinize the plans and require appropriate changes ahead of DSM program implementation.

Recommendation #2: Each grid company should be required to follow up with regular *DSM Performance Reports* that detail the actual results of implementing DSM programs, including:

- detailed descriptions of actual electricity savings achieved;
- aggregate costs incurred, broken down by each DSM program; and
- comparison of the results with the grid company's approved DSM Portfolio Plan – and explanations for any deviation.

3. Verifying Reported Electricity Savings

Establishing procedures for verifying electricity savings reported by grid companies is a major responsibility for government officials. Government officials typically care most about annual consumption of electricity and the rate of consumption during the time or times that the grid experiences its peak electricity demand. Annual consumption determines the total amount of electricity that must be generated during the year, and therefore fuel requirements and costs. Peak demand determines how much electricity generating capacity must be installed and available. Government officials thus are interested in verifying both reported annual MWh of electricity savings and reported MW of peak demand savings resulting from grid company DSM activities.

3.1 Reviewing and Auditing Methods for Measuring Electricity Savings

Government officials should ensure that the methods for measuring electricity savings used by the grid companies are free of bias (up or down) and are as precise as they need to be, given the purposes for which the results are going to be used.

Government officials should direct grid companies to document their methods and assumptions for ex ante estimation of electricity savings in a Technical Reference Manual (TRM). Government officials can then scrutinize the proposed TRM – with the help of expert consultants if necessary – and require changes as necessary. The TRM can be modified over time as market conditions and expectations change. It is important for government officials to review and update TRMs to account for changes in efficiency baselines. Changes in technology, market trends, and government efficiency codes and standards will change the market supply and demand for energy-efficient equipment.

Government officials may allow grid companies to also use a TRM to estimate electricity savings on an ex post basis. As discussed in the *DSM Manual,* impact evaluation studies can also be used to estimate actual savings by using statistical methods to analyze actual consumption histories among a sample of DSM program participants over a period of time before and after a DSM measure is installed. Government officials have the option of applying the results of impact evaluation studies to adjust ex post savings values.

Government officials should also establish processes for carrying out independent audits of the measurement of electricity savings by the grid companies. Audits should be carried out on a random unscheduled basis. If grid companies are aware that an audit may be carried out without notice at any time, they will ensure that their methods for measuring and monitoring electricity savings are precise and free of bias.

3.2 Allocating Responsibilities

Procedures for measuring, monitoring and verifying reported electricity savings from DSM activities include several different functions. Responsibility for carrying out each of these functions should be allocated to an appropriate entity. Candidates to carry out the functions include:

- grid companies;
- government officials;
- non-government organizations (NGOs), for example, universities; and
- private contractors.

In general, grid companies may be allocated responsibility for measuring and monitoring electricity savings but should not be responsible for verification functions, such as inspection of records, reviewing calculations for compliance with savings measurement protocols, and carrying out audits. Verification functions

should be carried out by government officials or by independent entities engaged by the government. Government officials should maintain general oversight over all the procedures for measuring, monitoring and verifying electricity savings.

3.3 Timing and Application

Government officials should formulate plans for staging and sequencing over time the measurement and verification of electricity savings. Planning should start before the launch of DSM programs and should span several years of program implementation. Government officials should also seek to coordinate measurement and verification activities with the planning and reporting requirements covered in Section 2 of this paper (page 6). In this way, government officials can ensure that measurement and verification activities are conducted to support continuous improvement in DSM program design, planning, and implementation by the grid companies.

In developing a measurement and verification plan, the first priority for government officials should be to require grid companies to document their methods and assumptions for estimating electricity savings in TRMs for review and approval. Government officials should work with the grid companies to formulate the scope of measurement and verification activities before the launch of each DSM program, with the aim of establishing data collection requirements in advance.

Government officials should decide when and how to apply the results of measurement and verification activities to modify grid company DSM Portfolio Plans if required. Government officials may also choose to use measurement and verification results to reward grid companies for successful DSM performance or penalize them for unsatisfactory performance.

3.4 Recommendations

Recommendation #3: Each grid company should be required to prepare and submit a Technical Reference Manual (TRM) that specifies the methods used by the grid company to measure the results of their DSM activities carried out in specific facilities. Government officials can then scrutinize the TRM – with the help of expert consultants – and require changes as necessary.

Recommendation #4: Government officials should establish processes for carrying out independent audits of the measurement of electricity savings by the grid companies. Audits should be carried out on a random, unscheduled basis.

4. Assessing the Cost-Effectiveness of DSM Activities

This section of the paper starts from the premise that grid companies will respond to their obligations under the *DSM Implementation Measures* guidance document by making direct investments in DSM or by facilitating investments by other stakeholders. In China, these investments are likely to include:

- project investments by grid companies and their ESCOs;
- investments by electricity customers participating in DSM programs;
- investments by other stakeholders, including equipment suppliers and non-grid company ESCOs; and
- financial support and incentives provided by the central or provincial governments.

As with all investments, decisions about grid company DSM activities should be based on sound investment criteria. Cost-effectiveness analysis of DSM programs can help decision-makers in the power sector easily compare the costs of energy efficiency to the costs of constructing new power plants and transmission and distribution lines. Most countries and regions that conduct this type of analysis find that investment in energy efficiency is typically less expensive than traditional supply-side investments. In China, such findings would support the requirement in Article 4 of the *DSM Implementation Measures* guidance document that prioritizes demand-side over supply-side investments.

In many countries and regions, one of the most important responsibilities of government officials is to ensure that DSM investments by electricity suppliers are based on robust financial analysis and, above all, that the funds are spent cost-effectively to achieve maximum electricity savings with minimum cost. In China, the *DSM Implementation Measures* guidance document does not specifically allocate this responsibility to government officials. The guidance document does state, however, that reasonable costs incurred by grid companies in implementing DSM programs can be treated in the same way as other grid company investments. These costs will eventually have an impact on the prices charged to customers. Government officials therefore should ensure that DSM programs are implemented cost-effectively by the grid companies.

Section 6 of the Chinese language version of the *DSM Manual* provides detailed guidance for assessing the cost-effectiveness of grid company DSM investments. Typically this analytical work is performed by the grid company or a third party, and is then reviewed by government officials. This section of the paper focuses on those aspects of the analysis that government officials need to review when assessing DSM cost-effectiveness.

4.1 Methods for Comparing Benefits and Costs

In North America, the principle underlying methods for comparing the benefits and costs of DSM activities is that society will be best off if it acquires all the economically achievable electricity savings available. That is, the optimal allocation of resources will be attained by acquiring all electricity savings that can be achieved for less than the cost of supplying an equivalent quantity of electricity (the "avoided supply cost"). The indicator most often used for assessing the cost-effectiveness of a DSM activity is whether the activity can achieve electricity savings for less than the avoided supply cost.

The first step government officials take in overseeing DSM cost-effectiveness analysis is to specify the cost-effectiveness test that will apply. As explained in the *DSM*

Manual, the cost-effectiveness test most commonly applied in North America is known as the Total Resource Cost Test.

The Total Resource Cost Test calculates the benefit/cost ratio of a DSM program based on the total costs of the program, rather than the costs incurred by only some of the stakeholders. In China, the total costs of a DSM program include: the grid company's costs, the costs paid by program participants, and the costs paid by other stakeholders. The benefit/cost ratio equals the benefits of the program, in terms of the value of electric energy and demand saved, divided by the total program costs. This ratio is usually calculated on a life-cycle basis considering savings and costs that accrue over the lifetimes of installed DSM measures. If the ratio is greater than 1.0, then the DSM program is considered to be cost-effective.

4.2 Parameters for Cost-Effectiveness Analysis

Four key parameters are involved in the cost-effectiveness analysis of DSM investments:

- the scope of the analysis;
- the discount rate used;
- system loss factors; and
- capacity reserve margins.

4.2.1 Scope of the Analysis

Determining the scope of the cost-effectiveness analysis involves making decisions about both the scale of DSM activities the analysis will cover and the period of time over which the analysis will be carried out.

Grid company DSM investments involve many DSM measures implemented in a range of DSM projects – far too many measures and projects for government officials to pay close attention to each one. Government officials should focus attention on DSM investment where it matters most. When government officials review the costs proposed in grid company DSM budgets, overall DSM portfolio results should be the top priority. For government officials, individual DSM program outcomes are less significant than are overall portfolio outcomes. Likewise, individual DSM project outcomes are subsidiary to the outcomes of each DSM program as a whole.

This is why, in many countries and regions, government officials rarely get involved in assessing the cost-effectiveness of individual DSM projects, but rather allow electricity suppliers flexibility to assess each DSM project individually in terms of the total cost of the electricity savings achieved. Government officials can reserve the right to assess individual DSM projects if and when the size of project expenditures involved is large in proportion to the budget of the relevant DSM program.

Cost-effectiveness analysis must also recognize that DSM investments typically achieve electricity savings for years into the future, depending on the useful life of the electricity-using equipment involved. Thus, the *DSM Manual* explains that cost-effectiveness analysis should use the estimated lifetimes of electricity savings included in a DSM portfolio. DSM measures in the commercial and industrial sectors, for example, can produce savings for 15 to 20 years.

DSM portfolio investments also take place over a number of years. Accordingly, DSM cost-effectiveness analysis should account for the multiyear nature of the investment. The highest priority for government officials should be the economic performance of the overall DSM portfolio over the entire investment period; the performance in individual years is of secondary importance.

4.2.2 Discount Rate

Any investment decision involves making tradeoffs among different expected future returns from an expenditure incurred in the present. A discount rate is used to calculate the present value of a future benefit or cost to compare it with the current value of the underlying investment. The discount rate is the rate of return on the investment that could be realized by committing the money instead to competing investment opportunities.

Government officials in China should consider using a societal discount rate for valuing the benefits and costs of future electricity savings. This is the rate of return that could be made on competing investments that will benefit society, such as public infrastructure projects that benefit China's economy. In other countries and regions, government officials typically use a "real" societal discount rate on the order of three percent (i.e., three percent above the expected rate of general price inflation).

4.2.3 System Loss Factors

DSM investments save electricity at the point of end use. Electricity is lost as it is transported through the transmission and distribution system from the point of

generation to the point of end use. DSM investments avoid these system losses and this should be accounted for in the estimation of electricity savings from DSM activities and in the cost-effectiveness analysis. System loss factors are expressed as a percentage of electric load. For example, if the energy loss factor is ten percent of load, every kilowatt-hour saved by DSM activities translates to 1.1 kilowatt-hours of savings, including the losses.

System losses vary as a function of resistance and voltage. According to Ohm's Law, resistance increases with the square of load. Peak demand loss factors thus are generally higher than energy loss factors. Resistance is also a function of ambient temperature. Consequently the marginal losses avoided by DSM activities will deviate from the average system losses at any given time. Particularly, during high-load periods, marginal losses will be higher than average losses.

Government officials should require grid companies to report their estimated marginal and average energy and peak demand loss factors and state how these have been applied in DSM cost-effectiveness calculations.

4.2.4 Capacity Reserve Margins

The amount of installed electricity generation capacity is generally maintained above the forecast level of peak demand. This reserve capacity is intended to meet load in the case of failure of one or more power stations or in the event of unanticipated deviations in forecast peak demand. Although grid companies in China do not own electricity generation facilities, they plan on a set level of reserve generation capacity being available – this is known as the "capacity reserve margin."

A peak demand reduction achieved through DSM activities translates to a larger amount of avoided generating capacity when the capacity reserve margin is included. For example, if the reserve margin is 20 percent of peak demand, every kilowatt of peak demand reduction from DSM activities translates to 1.2 kilowatts of generation capacity, including the reserve margin.

Capacity reserve margins and peak demand loss factors apply multiplicatively. For example, if the capacity reserve margin and the peak demand loss factor are both 20 percent, each kilowatt of peak load reduction from DSM is worth 1.44 kilowatts. Put simply, peak demand savings from DSM activities can be extremely valuable.

Government officials should require grid companies to report the capacity reserve margins they establish for planning purposes and state how these have been applied in DSM cost-effectiveness calculations.

4.3 DSM Program Benefits

4.3.1 Avoided Supply Costs

DSM programs produce electricity savings that reduce the quantity of electricity that must be supplied to meet demand, resulting in cost savings that are termed "avoided supply costs."

Avoided supply costs comprise both avoided energy costs and avoided peak capacity costs. Avoided energy costs are the marginal costs of generating electric energy to serve end uses, including system losses. Avoided energy costs are expressed in RMB per kilowatt-hour. Peak capacity is required to generate or deliver electric energy for a short period of time when demand for electricity reaches its peak. Consequently there are two types of peak capacity: peak generation capacity and peak grid capacity. Avoided peak capacity costs are expressed in RMB per kilowatt per year.

Avoided energy costs consist of variable and fixed components. Variable energy costs are mostly the cost of fuel for electricity generation, but also include operations and maintenance costs. Fixed energy costs include the capital costs of new generation facilities, minus the capital costs of peak generation facilities. In many systems around the world, peak generation capacity is supplied by combustion turbines fueled by oil or natural gas. In China, however, the dominant fuel is coal and the daily peak extends for longer than in other countries. Consequently virtually all electricity generation capacity in China exists to serve overall electricity demand, not peak, and thus all generation capacity costs can be assigned to avoided energy costs.

Because grid companies in China do not own electricity generation facilities, the costs grid companies incur in purchasing electricity from generation companies can be used as a proxy for avoided energy costs (and also avoided peak generation costs, if applicable).

The cost of peak grid capacity comprises the marginal cost of building transmission and distribution infrastructure to deliver electricity at the time of the system peak. Government officials may consider directing grid companies to target DSM activities to load centers where

load is expected to grow beyond the existing capacity of the transmission and/or distribution infrastructure. In such cases, DSM activities can postpone the need for investment in reinforcement or augmentation of grid infrastructure. The value of this deferral can be substantial, because each year of deferral avoids the annual fixed costs of the investment (debt service, return on equity, depreciation, and operations and maintenance).

Because electricity savings may be produced for periods ranging from 5 to 20 years or more, the calculation of avoided supply costs requires estimates of the future marginal costs of electricity supply. Consequently government officials need grid companies to provide and document their projections of future long-run marginal costs of electricity supply for each year over the lifetime of each DSM activity.

To calculate the benefits of DSM investments, the annual marginal supply costs are multiplied by the annual electricity savings expected from each DSM activity, and the results of these calculations are discounted to their present values. The sum of the annual discounted avoided costs is the total supply cost avoided by the DSM activity (i.e., the DSM benefit).

4.3.2 Value of Non-Electric Resource Savings

DSM programs often save resources in addition to electricity. For example, some DSM measures lower cooling and heating requirements in buildings and can result in savings of fossil fuels (coal, natural gas, oil). Water is the other principal non-electric resource saved by some DSM measures.

Savings of non-electric resources must be counted in the Total Resource Cost Test analysis of grid company DSM investment. Failing to account for these savings would understate benefits, leading to a false conclusion that some DSM investments are not cost-effective.

Some DSM measures can increase fossil fuel consumption. For example, it may be societally cost-effective to convert electric water heating to oil or natural gas. The cost of increased fossil fuel consumption must be counted in the analysis to determine whether a DSM investment would be cost-effective.

To carry out comprehensive cost-effective analyses of DSM investments, government officials will need estimates of market prices for fossil fuels saved or consumed by DSM activities, including forecast of future prices. Government officials may want to prepare independent estimates of these prices or have grid companies develop them for their review and approval.

4.3.3 Reduced Externalities

DSM programs that reduce the quantity of electricity that must be supplied to meet demand also reduce the pollutants emitted by electricity generation. The environmental costs of these pollutants (also called "externalities") are usually not reflected in electricity prices but are nonetheless real. In China, avoided sulfur dioxide, nitrogen oxides, mercury, particulate matter, and carbon emissions are among the environmental externalities that should be accounted for in the cost-effectiveness analysis of DSM investments. Another externality often ignored is water. Thermal power generation uses vast amounts of water. DSM not only avoids air pollutants, it saves water, too.

The *DSM Manual* explains that the Total Resource Cost Test does not include externalities. However, a variant of Total Resource Cost Test called the Societal Cost Test does include externalities (and also uses a societal discount rate). Government officials in China should decide whether to include externalities in the cost-effectiveness analysis of DSM investments. If externalities are included, government officials will need to establish or approve estimates of the environmental externalities they deem significant. Grid companies will need to provide government officials with estimates of marginal emissions factors for the generation facilities from which they purchase electricity so that electricity savings can be converted to quantities of emissions reductions.

4.4 DSM Program Costs

There are two main types of DSM program costs:

- the incremental capital costs of procuring and installing energy-efficient equipment or other measures that reduce electricity consumption; and
- grid company administrative costs.

Incremental capital costs may be just the cost difference between energy-efficient and standard technology, or they could be the whole cost of the equipment, depending on the situation. Incremental capital costs should be calculated on a project-by-project basis to account for different

situations among projects.

Grid company administrative costs comprise the costs of designing, planning, marketing, technical assistance, and managing the overall portfolio of programs, and the costs of measuring electricity savings and reporting program results. These administrative costs are largely fixed with respect to each type of DSM program.

Government officials should require grid companies to report proposed and actual DSM program costs. This will enable government officials to hold grid companies accountable for how they spend money that government officials have previously approved for achieving annual electricity savings targets.

4.5 Calculating DSM Cost-Effectiveness

Government officials in China have an opportunity to take responsibility for deciding whether grid company expenditures on DSM activities to meet annual electricity savings targets are reasonable. Cost-effectiveness analysis will indicate whether and to what extent DSM investments are worthwhile. The Total Resource Cost Test analysis combines all the components of benefits and costs of a DSM program, discounts them back to the present, and calculates a benefit/cost ratio. If the ratio is greater than 1.0, then the DSM program is considered to be cost-effective.

In absolute terms, a single investment of any size is cost-effective if its net benefits are positive (i.e., the benefit/cost ratio is greater than 1.0). In relative terms, however, more is better and the size of the investment and of the resulting net benefits matters most. Calculating the benefit/cost ratio for DSM investments thus is not decisive for judging the economic merits of competing investments. Government officials in other countries and regions require DSM cost-effectiveness analyses to present both benefit/cost ratios and net benefits, and ultimately judge DSM cost-effectiveness on the size of the net benefits.

In China, government officials can (1) perform cost-effectiveness analyses themselves using inputs submitted by grid companies for DSM program benefits and costs, (2) commission independent consultants to carry out the analyses, or (3) direct grid companies to carry out the analyses and submit them for review and approval.

4.6 Timing of DSM Cost-Effectiveness Assessment

Government officials in China can take responsibility for assessing cost-effectiveness both before and after grid companies make DSM investments. Cost-effectiveness analysis should be timed accordingly. Government officials should synchronize DSM cost-effectiveness analysis with the DSM planning and reporting process discussed in Section 2 of this paper (page 6).

When the time comes for government officials to review, ex ante, the cost-effectiveness of a proposed portfolio of DSM programs, it will be best to begin by first setting the parameters for analysis, estimating avoided electric and non-electric costs, and specifying the reporting of DSM program costs in grid company DSM budgets. The analysis itself can then be performed as soon as grid company DSM Portfolio Plans are submitted with the information detailed in Section 2.

Likewise, government officials will need to retrospectively (ex post) review the cost-effectiveness of actual DSM investments and their outcomes reported in grid company annual DSM Performance Reports. Government officials and grid companies then will be in a position to combine historical information about the actual cost-effectiveness of implemented DSM programs with new information about future prospects for DSM activities to assess the next generation of grid company DSM Portfolio Plans.

4.7 Recommendation

Recommendation #5: Build on the requirement in the *DSM Implementation Measures* guidance document that prioritizes demand-side over supply-side investments by implementing *cost-effectiveness analyses* of grid company DSM programs, including calculating the benefits associated with reduced pollutant emissions. The analyses could be done by the grid companies (subject to government scrutiny and review), by independent consultants, or by government officials.

5. Other Areas for Action by Government Officials

In the three decades since electricity suppliers in many countries and regions around the world commenced implementing DSM, much has been learned about how to design, deliver, and improve the performance of DSM programs. The literature on these topics is extensive and widely available. But 30 years' experience has also taught other, related lessons. In response, decision-makers and government officials have developed a variety of complementary policy tools to support and enhance DSM, primarily by addressing the very real barriers (disincentives) to DSM experienced by electricity suppliers. These barriers have largely to do with how electricity suppliers make money, but also with how they plan their systems for the long term and the extent to which they do so with an eye to minimizing the total costs of supplying electricity and achieving other public policy objectives, such as environmental protection. In this section of the paper, we briefly describe the issues and proven approaches for addressing barriers related to:

- DSM cost recovery and performance incentives; and
- integrating DSM with supply planning.

5.1 DSM Cost Recovery and Performance Incentives

The fundamental barrier to grid company DSM is financial; it's a matter of how grid companies make money. It is important, therefore, that China adopts practices that align financial incentives for grid companies with their DSM obligations.[10] This has two parts:

- recovery of DSM-related costs; and
- the adoption of regulatory methods that do not reward companies for increases, or penalize them for decreases, in sales.

5.1.1 DSM Cost Recovery

Under current practices in China, a grid company is allowed to include the cost of power purchases in the prices it charges electricity customers. In addition, Chapter 3 (Articles 22 to 24) of the *DSM Implementation Measures* guidance document specifies possible funding sources for grid company DSM programs as well as the types of DSM activities that can be funded. The guidance document also allows reasonable DSM expenditures to be treated in the same way as other grid company investments.

Like all such charges, DSM cost recovery must be approved by the government before going into effect. The rules for making these decisions should be straightforward. First, the costs incurred by a grid company in implementing all cost-effective DSM (i.e., where the DSM investment replaces more costly supply options) should be recoverable by the company. Second, where these costs cannot be fully covered by the funding sources identified in the *DSM Implementation Measures* guidance document, the balance of DSM costs should be treated like any other grid company cost and recovered in the prices paid by electricity customers.

10 The grid companies are government-owned monopolies. Ordinarily the lack of private ownership would suggest that cost-recovery, performance-based regulation, and financial incentives would be less important than direct government direction. In China's socialist market economy, however, the distinction between government-owned and investor-owned companies is not as great as it may be elsewhere. The grid companies are expected to be profitable, and management's performance is judged on profitability and quality of services. Grid company representatives have repeatedly identified the lack of DSM cost recovery, DSM-related revenue losses, and revenue losses from implementation of time-of-use (TOU) prices as key barriers to DSM in China.

In calculating any changes to electricity prices caused by DSM cost recovery, government officials will need to determine over what period of time DSM costs should be recovered. In North America, practices vary. In New York, California, and some other states, regulators treat DSM costs like the costs of other longer-lived investments (such as new electricity generation capacity and grid infrastructure) and require that they be recovered over several years, roughly matching but generally shorter than the life of the investment. In contrast, in Massachusetts regulators allow the full costs of DSM investments to be recovered within one year.

The decision on the duration of DSM cost-recovery will be influenced by various factors including, among others, the total amount of costs in question, equity among customers, the relative price impacts of differing durations, and the impacts of additional borrowing on a grid company's balance sheet.[11]

5.1.2 Revenue-Capped Performance-Based Regulation

Allowing a grid company to recover its DSM costs is not enough to ensure that the company will deliver cost-effective DSM programs to the greatest extent possible. Unlike supply-side investments, DSM, although cost-effective, poses a unique difficulty for the grid company and government officials. The challenge has been to find ways to align the grid company's financial interest with the public interest.

When a grid company implements DSM activities that reduce electricity use by its customers, the grid company incurs the DSM program costs and also foregoes the revenue that it would have obtained by selling a larger quantity of electricity to the participating customers. From the perspective of society as a whole, the revenue foregone by grid companies is regarded as a transfer payment within society and therefore it is not included in the Total Resource Cost Test cost-effectiveness analysis. From the perspective of a grid company, however, revenue foregone as a result of implementing DSM activities can have a significant effect on the company's financial position.

In many countries and regions, policymakers have turned to alternative methods, broadly referred to as "performance-based regulation" (PBR), that remove this financial disincentive to DSM.

One approach used successfully in Australia, the United Kingdom, South Africa, and parts of the United States is a form of PBR that sets a cap, or ceiling, on the revenues that an electricity supplier can retain. Revenue caps remove the incentive to increase sales, because the electricity supplier will not be allowed to keep the additional revenues that it receives from incremental sales. Conversely if its revenues are less than the cap, then the electricity supplier will be allowed to collect the shortfall. This means that the electricity supplier's total revenues are independent of sales volume – they are "decoupled" – and thus it has a very strong incentive to improve its profitability by cutting costs. One of the best ways to cut costs is to reduce its customers' consumption of electricity. Under revenue caps, there are no financial losses to the electricity supplier from reduced sales.[12]

There are several variations of revenue-based regulation. Some cap total revenue and allow revenue to increase based on inflation or other factors. Another variation sets initial-year revenue and allows revenues in subsequent years to grow in proportion to the growth in the number of customers served. The latter approach is called per-customer revenue caps.

The logic of per-customer revenue caps recognizes that, over the long run, demand for electricity drives the need for investment in new electricity generation capacity and grid infrastructure. In the short run, however, changes in an electricity supplier's investments and other costs are more closely correlated to changes in the number of customers it serves rather than to changes in its overall level of electricity sales. It thus makes sense to cap the electricity supplier's revenues on a per-customer basis.

11 The impacts on a grid company's balance sheet may be less of a concern at this time in China, where the grid companies are government-owned. Generally the more quickly costs are recovered, the less borrowing is required to fund the investments. If, for example, the full costs of an investment are included in the prices paid by electricity customers in the year the investment is made, much (if not all) of the investment can be paid for out of cash flow. Faster cost recovery gives greater certainty to the grid company, but it must be balanced against likely increases in the price of electricity.

12 For further information see Lazar, J., Weston, F., and Shirley, W. (2011). *Revenue Regulation and Decoupling: A Guide to Theory and Application.* Montpelier, VT, The Regulatory Assistance Project. Available at: www.raponline.org/document/download/id/902

Doing so retains the incentive for the electricity supplier to make sure its customers use electricity as efficiently as possible while simultaneously giving the electricity supplier some measure of revenue protection against changes in its costs associated with changes in the number of customers it serves.

We recognize that, in China, government-owned grid companies do not necessarily have the same profit motives that privately owned electricity suppliers have and that the government will remain the majority owner of the grid companies for the foreseeable future. Even so, Chinese grid companies are expected to operate on a sound financial basis, and the policy of "corporatizing" the companies (separating their historic government functions from their business functions) is in part a reflection of that policy. Giving the grid companies strong financial incentives to act in ways that promote stated public policies (such as lower costs, reduced environmental impacts, and system expansion) makes good sense regardless of their ownership structure, particularly if the performance of grid company management is measured by its success or failure in achieving those targets.

5.2 Integrating DSM with Supply Planning

To take full economic advantage of demand-side resources, grid companies need to properly integrate DSM into their long-term supply planning and investment decision-making. Government officials have an interest in making sure that grid companies properly account for DSM in the long-range electricity demand forecasts that they use to determine how much electricity the companies need to purchase in the future. It is in the best interest of electricity users for government officials to encourage grid companies to acquire as much cost-effective electricity savings as possible, while correspondingly reducing their purchases from generation companies.

China has already taken a big step in this direction. Article 4 of the *DSM Implementation Measures* guidance document states:

> *"In order to meet electric power demand, both conservation and development should be taken into consideration, but conservation should come first. While increasing power supply, DSM measures should be considered and given priority."*

A grid company's long-range forecast of electricity demand is the foundation for its supply plan. DSM represents a reduction in that forecast. DSM reduces the quantity of electricity that must be purchased at any point in time, or postpones the date by which these purchases will be required. For proper resource integration, it is therefore vital that grid companies' DSM Portfolio Plans and demand forecasts be consistent.

Demonstrating consistency between the estimates of future electricity savings in a grid company's DSM Portfolio Plan and its electricity demand forecasts is problematic. There is a fundamental difference in approach between estimating future electricity savings and forecasting future electricity requirements. Electricity savings are estimated using engineering methods involving the physical characteristics of energy-using equipment. In contrast, electricity demand forecasts usually extrapolate relationships observed between past customer electricity demand and other variables such as economic activity. Such econometric forecasting methods tend to ignore the impact of market intervention in the form of DSM or other policy instruments, such as mandatory building and equipment efficiency codes and standards.

Government officials in China will need to pay attention to how grid companies forecast future electricity requirements. They will need to identify areas of potential conflict between the efficiency baseline assumptions used to estimate electricity savings and the assumptions implicit in the grid companies' forecasts of electricity demand. It may be necessary for government officials to direct grid companies to make adjustments to their demand forecasts in order to make them consistent with the efficiency baseline assumptions built into their DSM Portfolio Plans.

5.3 Recommendation

Recommendation #6: Build on the clause in the *DSM Implementation Measures* guidance document that allows grid companies to treat DSM investments in the same way as other investments. Allow grid companies to *recover the costs* of implementing DSM programs. More broadly, develop mechanisms to better align grid company incentives with China's DSM goals.

6. Conclusion

By requiring grid companies to carry out DSM activities to achieve reductions in electricity sales and peak demand, China has enabled a new delivery mechanism for implementing energy efficiency. This mechanism joins the already successful system of establishing energy efficiency targets to be met by all levels of government and by selected individual enterprises.

Grid company delivery of energy efficiency has the potential to be as successful as the existing target-based system. However, for this potential to be realized, it is important for China to establish robust procedures for government oversight of grid company DSM activities. The recommendations in this paper are intended to assist in establishing such procedures.

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