Designing a Renewables Portfolio Standard: Principles, Design Options, and Implications for China

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I. INTRODUCTION

A renewables portfolio standard (RPS) is one of a number of policy mechanisms that might be used to help support increased development of renewable energy in China. The RPS has recently emerged as one of the leading market-based approaches to supporting renewable generation. While specific policies differ – sometimes substantially – an RPS has been adopted in a number of U.S. states and European nations, and is being considered by the U.S. Congress and additional countries around the world.

The hallmark of the RPS is a market-based standard for renewable energy supply. Policymakers set the standard, typically a renewables purchase requirement applied to retail electricity suppliers or electricity generators. The market then determines the most effective, least cost way of meeting the standard. As with any policy, there are numerous ways of structuring an RPS, depending on a country's policy goals, electricity industry structure, regulatory and enforcement capabilities, social and political context. On the other hand, certain fundamental policy design principles must be adhered to if an RPS is to function with maximum impact and effectiveness.

We begin in Section II of this paper by highlighting RPS design principles that must be adhered to to ensure an effective and low-cost RPS. In Section III, we relay a concise set of RPS development and design lessons that derive from the three RPS case studies of Maine, Texas, and Wisconsin, presented separately. Section IV describes in more detail certain RPS design choices that face policymakers, and summarizes the advantages and disadvantages of taking certain paths. Based on the previous discussion, Section V highlights a particular RPS design that might be used as a strawman proposal for considering an RPS approach in the Chinese context. Section VI identifies other RPS designs that might also be considered. We base this discussion on our experience with the development and design of RPS policies in the U.S and Europe, but with an eye on the applicability of these experiences for China. We do not mean to imply that an RPS is the only, or even the most appropriate, renewable energy policy for China. Given the variety of designs in other countries, however, as well as the advantages of an RPS, we do believe that an RPS is one of a handful of policy options that should be given careful consideration.

II. OVERALL RPS PRINCIPLES

The RPS is generally intended to create a stable and predictable market for renewable electricity that maximizes the benefits of renewable generation while minimizing costs through the use of market mechanisms. Though the RPS may be designed in many ways, as with any energy policy, certain fundamental design principles will need to be met if the RPS is to function at low cost and with maximum impact. Without these features, an RPS is unlikely to function effectively. Before addressing specific RPS design choices for China, it is therefore important to identify some of the more critical RPS design principles.

- ***The Purchase Obligations Should Drive Development of New Renewable Generation:*** The primary purpose of the RPS in the long term should be to increase the share of renewable electricity serving the grid. RPS purchase obligations should be carefully set to meet this objective. In particular, purchase requirements must be high enough to require new renewable generation development. As evidence from experience with the RPS in the United States (see the Maine case study), where this criterion is not met the RPS is unlikely to provide substantial public benefits.

- ***Resource Eligibility Decisions Should be Made With Care:*** Policymakers need to determine in advance of policy implementation which renewable generating sources should be eligible to meet the RPS obligations of utilities. Where resource eligibility is overly broad and eligible supply exceeds RPS-derived renewables demand (again, see the Maine case study), the RPS will be ineffectual. In general, eligibility should be restricted to those renewable technologies that provide substantial public benefits and that would not be developed at this time without public support.

- ***Purchase Obligations Should be Durable and Increase Gradually with Time:*** To maximize the impact of the RPS, reduce its costs, and ensure predictable, dependable growth in renewable generation, RPS purchase obligations must be in effect for the long-term and should increase in a predictable fashion. Short duration and politically unstable policies will create substantial volatility in the cost of RPS compliance and will not provide a favorable market for renewable development. Purchase obligations that do not increase in a predictable and gradual fashion may create damaging "boom and bust" cycles in renewables development. To ensure a durable RPS, two effective options can be used: (1) ending the policy 10 years after the last increase in the percentage purchase obligation; or (2) making the purchase obligation indefinite without a sunset. To ensure predictability, purchase obligations should increase regularly (annually or biannually) and should not increase dramatically from one year to the next.

- ***Purchase Obligations should be Placed Equally on All Retail Electricity Sellers, Generators, or Developers.*** To ensure competitive neutrality and fairness, the same percentage renewable purchase obligation should be imposed on all utilities, retail electricity suppliers, generators, or developers in a particular jurisdiction.

- ***Strong and Effective Enforcement:*** Without an effective penalty for non-compliance, electric utilities, retailers, generators, or developers will have little incentive to meet their RPS purchase obligations. Though multiple options exist in the design of a penalty system, several principles would ideally be met:
  - First, penalties must be sizable enough to ensure compliance with the RPS. An automatic financial penalty of several times the incremental cost of RPS compliance has been used effectively in the United States for both RPS and environmental credit trading policies.
  - Second, electric utilities, generators, or developers should be required to "make-up" any renewables purchase shortfall in one year with renewable energy purchases in the following year. Such a principle will assure renewable generators that a market exists for their output, and will not allow perpetual non-compliance by electric utilities and retailers.

- Third, penalties would ideally be imposed automatically and without excessive discretion to ensure that all utilities, generators, or developers are treated equally and to assure renewable generators and the financial community that a market will exist for their output.
- In China, the institutional relationship between SDPC, SETC, the State Power Corporation and local distribution companies may require other enforcement tools. This is discussed in Section III-G below.

III. RPS Policy Design in China: Implications from the U.S. Case Studies

In addition to the principles raised above, we believe that several important RPS design and implementation implications emerge from the three U.S. case studies (Maine, Texas, Wisconsin) presented separately. These implications are summarized below. We refer the reader to the case studies themselves for additional detail and context.

1. **Developing an RPS is Fundamentally a Political Process:** Designing an RPS unavoidably brings together interests that support and oppose the policy. In the case of Maine, the lack of a strong renewable energy lobby that supported the development of new renewable generation meant there was no force to push for or lobby decision-makers to strengthen the RPS. The result was that the political interests opposed to such a policy weakened Maine's RPS and limited its effectiveness in spurring new renewable energy development. In contrast, the presence and coordination of a strong renewable energy industry and lobbying organization in Texas helped create perhaps the most effective RPS in the country.

   In China, a well-developed private industry for renewable energy does not yet exist to counter the inevitable opposition from electric utilities and traditional generation developers and investors. Though there is a politically influential environmental voice, it is unclear whether they will put their support behind an RPS approach. This means that adoption and enforcement of an RPS may be more difficult in China than in the U.S. and Europe. (In the U.S., laws that are passed are often not enforced unless the environmental community continues to act as a "watch dog" monitoring the utility sector and the government's level of enforcement.)

   In China, SDPC will need to think about how to work through the political process to gain broad support for an RPS given these challenges. Another reason an RPS has a high probably of success in Texas is that, once RPS legislation was passed, a thorough stakeholder process involving utilities, environmental interests and renewable energy industry representatives helped create a consensus on how to implement the policy. Political consensus always makes decisions for decision-makers much easier. Such a national, consensus-building effort in China could help reduce opposition to the RPS. Though it may ultimately result in a slightly weaker standard, reduced opposition to the RPS may be worth the tradeoff.

2. **Uncertainty in Regulation:** In all three U.S. case studies, the legislation that established the

RPS provided only a fraction of the detail necessary to implement an effective RPS. Stable and certain regulatory involvement to design the operational details of the RPS was necessary in all cases. The U.S. RPS laws passed by the state legislatures clearly gave direction and authority to the state public utility commissions (PUC) to design the detail of the RPS. The PUC' are responsible for all matters related to utility regulation.

In China, it is going to be challenging to develop precise RPS implementation regulations and enforce those regulations once developed, given that the utility structure is in the midst of significant change. Again, SDPC and CRED will need to think about how to overcome this problem. The lack of a clear regulatory framework will make the development and enforcement of the RPS much more difficult. Initially, the only points of enforcement may be power plant licenses and tariffs. While these enforcement mechanisms are critical, SETC or other agencies may assert some kind regulatory authority for RPS policies later in the process as utility reforms are implemented that, unless carefully considered, could hinder the government's overall ability to enforce the standards.

3. **RPS in the Context of Restructuring:** In both the U.S. and Europe, RPS policies are being adopted for the most part in the context of a larger electricity restructuring program and were therefore viewed by many parties as just a small part of a much larger and more important package of energy policy reform measures. Having the RPS adopted in the context of China's restructuring may reduce opposition from the utility sector, which would be concerned about larger issues. On the other hand, involving the RPS policy in what is a slow, uncertain and piece-meal process may not lead to success either. If the RPS policy can stand on its own, that might be the best situation in China, though this has not been politically practicable in most western examples. The Wisconsin Case Study is an exceptional example of an RPS program being implemented within a traditional utility structure in advance of restructuring.

4. **Renewable Energy Credit Trading:** As demonstrated by the case studies, for renewable energy credit trading to work, there must be a central authority with the capacity to track energy and credits. Such an agency will need trained personnel. In addition, credit trading will require a well-developed contractual framework and a mechanism to resolve contract disputes in what is no doubt a complex field. Finally, credit trading generally results in a secondary market with brokers who are experienced and able to carry out trades effectively. Whether all of this is compatible with conditions in China at the moment and whether there are regulations now on the books that could hinder this trade are unclear. Without credit trading, it will be more difficult for the government to use an RPS to meet its economic development objectives for the north and western regions.

5. **Incorporating Solar Energy into the RPS:** None of the three RPS case studies contain specific mechanisms to help support solar power, though two U.S. states (Arizona and Nevada) have set out specific solar purchase requirements to ensure that solar fairs well under their RPS policies. In China there exist significant opportunities for the deployment of off-grid solar technologies. Adding an off-grid solar component to an RPS would add a level of complexity to the RPS standard, requiring additional levels of verification. However, it might go a long way in helping China accomplish its economic development goals, and the U.S. experience with the incorporation of solar into an RPS may provide some useful concepts. Under one design option, for example, the RPS could require that utilities or developers to satisfy a small portion of their renewables purchase requirement, say one percent for installing PV, solar cookers or solar hot water systems in areas not connected to the grid. This requirement could be either capacity- or energy-based and result in the installation of thousands of solar systems. Alternatively, given the verification and administration challenges of such a requirement in an RPS, China might consider other complementary policies to promote solar generation that are separate from the RPS.

IV. RPS DESIGN ISSUES AND OPTIONS

The discussion above provides some of the fundamental design principles that any RPS design should strive to meet, and preliminary design implications and issues raised by the three U.S. case studies. Nonetheless, policymakers have substantial leeway to craft an RPS to meet their own specific policy objectives. Some of the design features for which policy decisions must be made are discussed below. Based on this discussion, the Sections V and VI of this paper provide specific and complete RPS design options for China.

A. **Capacity-based vs. Energy-based RPS:** The first design decision that must be made in creating the renewables purchase obligation is whether to base the standard on installed renewable capacity (MW) or renewable electricity generation (MWh). Most discussions surrounding the RPS have recognized that an energy-based (MWh) purchase obligation provides superior performance incentives to a capacity-based requirement and ensures that renewable facilities will operate at a reasonable level of performance. Although a capacity-based standard is much easier to monitor (no tracking of kWh), renewable generators may have a financial incentive to install renewable facilities that do not perform adequately in terms of electricity production. If a capacity-based system is used the requirement should be translated into an energy output, based on a reasonable capacity factor, or specific performance requirements developed for eligible renewable generation.

B. **New Versus Existing Renewables:** One design option for an RPS could be that the purchase obligation begin at approximately the level of existing renewable generation in China and grow over time, ensuring an increasing supply of new renewable generation. Existing and new renewables would compete to serve the RPS purchase obligations, and both existing and new renewable generators would receive financial support through the RPS.

   On the other hand, if existing renewable generation does not require or deserve additional policy support to continue operations, an RPS might be applied solely to renewable energy generators that begin operations after a particular date. Under this approach, only new renewable energy facilities would be eligible to meet the RPS requirements, with the purchase standard starting at a very low percentage and increasing gradually with time. The most effective RPS in the United States – Texas – uses a modified form of this approach.

Another variation of this latter option focusing exclusively on new renewable generation is to set the RPS as a percentage of new conventional generation. In other words, for every new fossil-fuel plant approved for construction, it would have to add 10 percent renewable capacity. If a utility needs an additional 500 megawatts of capacity, at least 50 megawatts would have to be from eligible renewable resources. India's RPS proposal is based on this concept.

C. Trading Renewable Energy Credits: An RPS policy can be based on one of two compliance tracking methods: either a tradable renewable energy credit (REC) system or a traditional electricity contract tracking system.

Under the "tracking" model, each electric utility or retail supplier would be required to purchase the requisite amount of eligible renewable energy to meet their RPS purchase obligations. They would do so by contracting with or purchasing the output from eligible renewable generators. The RPS administrator (eg: the government agency) would be required to track electricity transactions and contracts to verify that the RPS has been met by utilities and retail suppliers.

Under a REC system, on the other hand, individual obligations are effectively tradable, ensuring least cost compliance with the RPS. Such a system would work as follows:

1. The program administrator would register renewable generators that meet the eligibility requirement of the RPS.
2. Eligible renewable generators would be issued renewable energy credits (RECs) for each MWh of renewable generation in the previous month or quarter. Once created, the RECs are a separate, tradable product from the actual electricity generation.
3. Electric utilities and retail electric suppliers purchase RECs directly from the renewable generator or through a secondary market exchange or broker. REC prices are determined by the market, and will represent the "above-market" cost of renewable generation.
4. Electric utilities and retail electric suppliers annually submit their required number of RECs to the program administrator. If a purchase shortfall exists, penalties would be applied, as discussed above.

The advantages of credit trading can be significant. Perhaps most importantly, REC trading de-links actual electricity supply choices from the renewable energy purchases, allowing a utility in a renewables resource poor area to meet its RPS obligations from purchases of RECs from a renewable resource rich area. Not only does such a policy reduce overall compliance costs and increase compliance flexibility dramatically, but it may also serve as a useful mechanism for rural electric development in those areas with strong and sizable renewable resources.

Utilities are afforded maximum flexibility in meeting their renewable purchase requirements under a REC system, reducing transactions and contracting costs and increasing liquidity in the renewables market. A REC system can also easily incorporate off-grid and self-generation systems into an RPS. Finally, a REC system also operates as a straightforward RPS compliance process, allowing RPS administrators to more easily verify compliance with the RPS than if required to track and verify each and every power sales contract.

The REC approach is patterned off of other environmental credit and allowance trading markets, including the sulfur dioxide market in the U.S., which has demonstrated considerable success. Given the benefits raised above, it is no wonder that many U.S. states and European countries are exploring the use of tradable RECs to meet RPS. However, an important point to make is that such tradable commodity transactions require a stable regulatory framework and well-defined contractual and legal rules. What amount of time would be required to develop such a system in China is unclear. Moreover, given experience with international set-aside policies, it is evident that an RPS can operate effectively even without a credit trading element, though with some loss of efficiency.

D. Multi-Tiered RPS – Encouraging Resource Diversity: Under a single-tier RPS, those eligible renewable resources that have the lowest premium over the wholesale market price of electricity will in most cases be used to meet RPS purchase obligations. Under such an RPS, resource diversity within renewable technologies will be encouraged to the extent that some forms of renewable energy have similar cost characteristics (e.g., wind, landfill gas, geothermal, and biomass) or because resource constraints preclude a single energy source from meeting the entire RPS (e.g., landfill gas).

More expensive "emerging" technologies such as solar power, small wind, ocean thermal, wave and tidal energy are unlikely to be able to compete under these circumstances. This dynamic has raised concern by some that an RPS may not "adequately" promote resource diversity among all eligible renewable technologies, and has led to proposals in some jurisdictions for specific design options to encourage greater resource diversity.

Based on international experience and discussions, the following basic policy options have been proposed for further supporting resource diversity within the RPS:

- **Resource Bands or Tiers:** Most proposals to support diversity within the RPS have included explicit resource bands or tiers. Under this system, utilities and retail suppliers would be required not only to purchase a certain quantity of eligible renewable energy, but would be further required to purchase certain percentages of renewable energy from specific technologies or technology tiers. In this way, the renewables purchase requirement under the RPS is actually a series of smaller requirements for the purchase of individual renewable resources or tiers of resources. The British NFFO model also has tiers (called resource bands), requiring separate bids for wind, biomass, landfill gas, etc.

- **Maximum or Minimum Contribution Limits:** Similar to resource bands or tiers, contribution limits impose additional purchase requirements on the basic RPS, but in a slightly more flexible manner than explicit bands or tiers. Under this approach, higher-cost renewable technologies or technology classes might be given minimum purchase floors (e.g., utilities and retail suppliers must, as part of their RPS, purchase at least 5% of the renewable requirement from solar technologies). In addition, lower-cost technologies could be given purchase ceilings (e.g., small hydro and biomass must together contribute not more than 80% of a retail suppliers purchase requirement).

- **Credit Multipliers:** Credit multipliers would provide certain higher-cost renewable resources multiple “compliance credits” per kWh, relative to other renewable resources. For example, each MWh of solar output might be “worth” 10 MWh of RPS credit, while each MWh from a lower cost technology would only receive one MWh of RPS credit. For trading purposes, a higher level of credit could be awarded for emerging technologies.

The principal substantive advantage of the additional mechanisms listed above is that they would encourage an added measure of diversity within the renewable resources developed under an RPS policy. Absent such mechanisms, an RPS is likely to primarily encourage the lowest-cost renewable technologies such as small hydro and landfill gas. Solar, small wind, wave, tidal, and ocean thermal technologies will receive less support, and to the extent that these technologies are viewed as promising future sources of electricity, the RPS will do little to encourage them.

Yet, there are also several disadvantages to pursuing these explicit approaches to resource diversification:

- The creation of resource bands, credit multipliers, or minimum or maximum contribution limits will increase the cost of RPS compliance. They may also mute the competitive pressures faced by individual renewable technologies.

- Any subdivision of the market into finer resolution in this fashion reduces the depth and liquidity of the market for any particular resource type. This will also tend to have an upward effect on price.

- The development of these mechanisms will increase the complexity of RPS administration, reporting, contracting, and compliance demonstration procedures.

- The creation of bands or multipliers may require significant readjustment over time to ensure that continued diversification is achieved as some technologies come down their cost curves at a faster rate than others, adding to the administrative complexity and regulatory uncertainty of the RPS.

- By trying to encourage a wide range of renewable technologies, the RPS may not provide sufficient support to any one technology to significantly drive its costs down over time.

- These points lead us to suggest that other policy mechanisms may be more appropriate for the promotion of higher-cost, emerging renewable energy technologies, with the RPS focusing on lower cost renewable energy options.

E. Treatment of Hydropower: Because hydropower is a mature generation technology whose public benefits are sometime questioned, there are conflicting opinions about how one should treat hydro under an RPS. The treatment of hydropower differs substantially across RPS requirements in the United States. Some states allow only new hydropower development to qualify (e.g., Texas). Others establish size limits on eligible hydropower (e.g., Wisconsin sets a 60 MW hydro limit), and still others allow existing hydro to qualify but only in a 2-tiered RPS where the new renewables tier excludes hydropower (e.g., Massachusetts, Connecticut, New Jersey). Some states exclude hydropower altogether (e.g., Nevada).

Proponents for including hydro claim that hydropower provides public benefits like other renewable energy sources, and that some forms of hydro are in need of additional public policy support. Opponents contend that hydro is a mature, low cost technology whose public benefits are questionable.

One thing is clear: if hydro is to be included, it is essential that the RPS be designed to handle fluctuations in hydro availability. Because hydro generation is driven by natural resource flows (precipitation), it is not uncommon for annual hydro generation to vary substantially from one year to the next. With a fixed renewables purchase obligation, and fluctuations in resource eligibility, if not designed appropriately it is possible that compliance with an RPS could be costly – if not impossible – in low hydro years. Accordingly, to mitigate these concerns, the eligibility of hydro should generally be restricted in one of several possible ways:

- size limited - e.g., a 30 MW limit
- contribution limited - allowed to contribute only a certain percentage of the annual renewables purchase obligation (e.g., hydro could only meet 50% of the overall RPS requirement),
- walled off – allowed only to contribute towards an "existing" tier of a 2-tiered RPS.

F. Enforcement: As discussed earlier, strong and effective enforcement is one of the hallmarks of a well-functioning RPS. Potential renewable energy investors will naturally hesitate to enter a market if the revenue generated by the RPS is unreliable. Such unreliability can come from persistent non-compliance with the RPS on behalf of utilities and other retail suppliers. Such non-compliance can derive from: 1) non-compliance sanctions that are weak, and 2) a verification system that is unable to identify those that are out of compliance. We discussed verification options earlier; here we stress the need for a strong sanctioning system.

Both sizable financial penalties for non-compliance with the RPS purchase obligations and a requirement to make up purchase shortfalls in the subsequent compliance year are useful elements of a well-functioning penalty system. Another option is to revoke the license of the electric service provider (if and where that is feasible) or to refuse license for new power plants. In general, any financial penalty should apply only to the renewables purchase shortfall, and should be denominated in $/MWh of shortfall. To ensure compliance, a penalty level of 2-5 times the expected cost of RPS compliance might be used.

Other effective penalty mechanisms most certainly can be designed depending on the institutional context, but the underlying principle of making the penalty sizable and certainto be imposed to assure compliance is essential. Policymakers must also ensure that renewable generators or utilities that falsely report electricity production or supply be sanctioned appropriately.

In the case of China, having one government agency (SDPC or SETC) penalize another government agency (the State Power Corporation) may be difficult. However, because SDPC has enforcement power over power plant siting and tariffs, it could refuse tariff increases or plant licenses if the utility has not complied with the RPS. More creative enforcement tools may be appropriate in the Chinese context.

G. Cost Containment – helping to overcome political opposition: One disadvantage of the RPS is that under its traditional design, its cost cannot be predicted in advance with precision. In some circumstances, policymakers may demand a guarantee that costs not rise above certain levels. There are ways to cap the overall cost of the RPS, but such mechanisms must be very carefully designed. Such a cost cap has been proposed in the U.S. Congress as an element of certain national RPS proposals.

One type of cost cap would work as follows (assuming a REC system is used):

- An upper limit on the price that utilities and retail suppliers are expected to pay for RECs would be established (e.g. 3 cents/kWh).
- If, in shopping for RECs, a utility is unable to purchase its required number of credits at the cap price or below, then the administering agency sells "proxy" credits to the utility at the cap price, ensuring that the utility is in compliance with the RPS.
- The administrator uses the funds collected from the "proxy" credit sales to either purchase true RECs on the market or to support renewable energy in other ways.

Under such a system, the maximum incremental cost of the RPS would equal the cap price multiplied by the overall renewables purchase obligation. Another approach to cost containment would be to periodically review the workings of the RPS and reduce the rate of increase in the RPS purchase requirements prospectively if the cost of the RPS rises to unexpected levels.

The advantages of some form of cost containment include:

- potentially lower overall compliance costs;
- lower variability in compliance costs from year to year; and
- reduced political risk of RPS repeal if renewable energy costs rise.

The disadvantages include:

- the risk that policy targets for renewable energy are not met; and
- the administrative burden of collecting and spending cost cap funds.

Importantly, for a cost cap to work effectively the cap level must be set sufficiently high to preserve a true RPS mechanism. A low cap price would undermine the RPS by creating significant uncertainty in the demand for renewable electricity.

H. Other Flexibility Mechanisms: In part because of natural resource variability for renewable energy resources, RPS compliance costs will vary from year to year. If the RPS is overly rigid and inflexible, the cost of compliance could be particularly high and variable. By the same token, if compliance with the RPS is overly flexible and lenient, the likelihood of gaming and non-compliance could increase and administration of the RPS would become more complex.

To maximize the flexibility of the policy and to lower the costs of compliance, while not unduly influencing its basic mechanics and credibility, several policy designs should be considered. These include:

- ***Reconciliation Period:*** A three month reconciliation period may be provided at the end of each year in which any renewable energy purchase shortfalls could be remedied. This would allow renewable energy generated in the first quarter of year 2010 to qualify for meeting a utility's 2009 RPS obligations, therefore lessening the risk of non-compliance and evening out resource availability and compliance costs.

- ***REC Banking.*** Unused RECs from one year might be "banked" to a following year for RPS compliance use. Such a system would further smooth the costs of RPS compliance and maximize the flexibility provided to in meeting RPS obligations. It would also smooth out the year to year variability in renewable resources. Such banking might be limited (e.g., RECs may only be valid for 3 years) or indefinite (e.g., RECs are valid forever until used).

- ***Force Majeure.*** Under extreme events (e.g., natural disasters), an extended reconciliation period might be provided within which to meet renewables purchase obligations.

Providing RECs to renewable energy generators that are developed in advance of the RPS targets might also be considered. Finally, RPS obligations should be met over the course of a 1-year compliance period. Shorter compliance periods will overly constrain compliance flexibility, especially for renewable resources whose output varies considerably throughout the year. As an RPS policy is designed, including these and other flexibility mechanisms may be essential in building support for the policy and maximizing its flexibility.

E. Competition/Reverse Auction: The RPS could establish a system where the utility or government agency bids new renewable energy projects to developers who offer the lowest price. The British NFFO system competitively bid out a certain level of megawatts within several technology bands, and as a result, the cost of wind, landfill gas and other renewable resources in the U.K. on a per kilowatt-hour basis was reduced by as much as 75 percent. To cite one example, the cost of wind power went from 10 pents/kWh to 2.88 p/kWh in about seven years (1.08 yuan/kWh to .376 yuan/kWh). The decline in price occurred simply because contracts were generally awarded to lower bidders, which provided an incentive for renewable energy developers to find ways to lower costs. The disadvantage of this strategy was that the renewable facilities were not always constructed where the bid price was proven to be infeasible. Further, low bids may sometimes have been used to block competition.

The state of California does not have an RPS but does have a subsidy program in which projects are bid out based on the subsidy that is required to keep the power at a competitive price. Renewable energy projects that are the least expensive and therefore require the lowest subsidy per kilowatt-hour – but still meet the minimum criteria – are granted the project awards. In this case, the incremental subsidy came from a systems benefit charge (SBC), which was levied on all consumers.

It is important to point out that neither the California model not the NFFO are RPS policies in the traditional sense. Both were financed through taxation programs where consumers paid a small and explicit fee, which went into a central fund managed by the government. These funds were used to subsidize renewable energy generators, so their electricity could compete in what was becoming a competitive market. An SBC might not be politically feasible in China. Even in the absence of these fees, however, a utility meeting its RPS requirement could hold a competitive bid for projects in order to lower costs. In this instance, two issues need to be considered:

- China may want to ensure that an indigenous renewable energy industry is created in the country. That has not been the result of the U.K. policy. Although prices have decreased dramatically in the U.K., the primary suppliers have been foreign and the result did not contribute to development of a U.K. renewable energy industry. This could also be the case in China: if there is no indigenous industry to bid on projects, the only competition will come from foreign suppliers. The lack of choices in the market may mean that prices will not go down as much and China's renewable industry will not develop as quickly. Additional policies to promote domestic industry development may be required to counteract this effect.

- There also needs to be stability in the contracting process, or financiers will require very strict terms, high interest rates and investment returns. The best way to do this is to offer long-term contracts of about 15 years. This will lock the utility into a long-term contract but will help mitigate the risk to developers and financiers and therefore reduce the overall costs. Overly short contract periods in the early years of the U.K's NFFO are known to have inflated prices significantly.

Summary of RPS Design Options – The Potential and the Challenges

Option	Example	Advantages	Disadvantages
Capacity-based vs. energy based RPS	Capacity RPS: Require overall MW without regard to actual generation performance.	Capacity RPS is easier to monitor since no tracking of kilowatt-hours are required. Capacity credits, rather than energy credits, may still be tracked.	Low capacity factor/higher cost of many RE technologies mean that renewables can be put into the ground and rarely used to generate electricity – goals of RPS are lost.
New vs. Existing	Start with existing RE only, to practice trading. Then require new.	Existing allows smoother transition to new requirements and supports present RE, which may not be competitive.	Creates a general delay in installation of new renewables and development of commercial RE technologies.
Trading	Utility buys RECs from renewable generators to meet its RPS requirement; brokers buy and sell credits like commodities on a secondary market.	Greatly increases flexibility and therefore can reduce costs; encourages economic development in poorer areas with strong RE resources.	Requires effective government monitoring, firm contractual regulations and enforcement, which may not exist in China today. Also increases administrative burden on enforcement agency and makes the RPS policy much more complex.
Multiple Tiers	40% of RPS requirement must be met through higher cost technologies like solar, emerging biogass technologies, etc.; 60% can be met through lower cost biomass, small hydro and landfill gas.	Ensures resource diversity, which can help commercialize emerging technologies in China, such as solar and new biogas technologies. Ensures that new resources are developed in the areas where they are most plentiful.	Tiers increase the cost of RPS compliance and can mute the competitive pressures faced by individual renewable technologies; each sub-division of the RE market reduces economies of scale, with upward effect on price. Tiers increase the complexity of RPS administration, reporting, contracting, and compliance demonstration procedures.
Auction	Develop a reverse auction that bids out projects to RE developers with the lowest cost (needs domestic industry and stable contracts -- 15 yrs or so).	Creates downward pressure on price which reduces the cost of renewables – demonstrated with the British NFFO.	Promotes only the lowest cost renewables, which need the least amount of support. Encourages developers to bid so low that they cannot build a projectand may prevent competitors from winning bids.
Hydropower	Allow hydropower for RPS, but only below 10-50 MW.	Promotes a technology with public benefits (but many environmental costs); may help lower costs/increase flexibility.	Can reduce development of other RE technologies and create problems with variance in resource during times of drought.
Cost Containment	Cap the total cost of RPS through policy mechanisms. May be best if used in conjunction with other flexibility policies. (See text)	Potentially lower overall compliance costs; lower variability in compliance costs from year to year; less political risk of RPS repeal if renewable energy costs rise.	Risk that policy targets for renewable energy are not met; administrative burden of collecting and spending cost cap funds.

V. A Strawman RPS for China

Given the discussion above on the principles, design options, and challenges faced by an RPS, as well as the electricity industry and regulatory structure in China, how might China design their RPS policy? In this section a strawman RPS proposal is described for consideration in China. This design largely meets the RPS principles identified earlier, and may fit within the current regulatory and industry structure in the country as it evolves over time. The next and final section of this paper identifies other possible design options that SDPC may want to consider.

Under any RPS design, we believe that it will take at least one or two years for initial RPS implementation. Likewise, given the changes currently occurring in the Chinese energy sector, it may be prudent to think of renewables policy design in different phases. The RPS design presented here includes three phases, each building off of the previous phase as the electricity industry in China evolves, the regulatory system clarifies, and experience is gained with the RPS mechanisms.

Phase I: (Phase I of this RPS scenario would not begin until the moratorium on new power plant construction is over in 2002.)

RPS Standard: Phase I would require that SDPC approve no new power plant licenses unless 10 percent of the electricity production from new planned capacity is obtained from eligible renewable resources. Thus, if SPC or a regional utility plans to add 500,000 annual MWh of generation, at least 50,000 MWh annually must be from renewable energy. This would put the burden on the utility or developer (if it is not the utility itself) to partner with a renewable energy generator or build the required renewable generation themselves. The renewable power may be sold to the same distribution utility that buys the output from the traditional power plant. The power may also be sold at the average commodity price to the local distribution utility where the generation is located with the primary developer paying the incremental difference in cost out of the total project revenue.

Under Phase I, at least half of the 10% renewables purchase requirement must come from new renewable generation (in this case 25,000 MWh). The other half could come from either existing or new renewables, whichever is more cost effective. This way, while still ensuring that new renewables plants are developed, existing renewable energy generators could benefit from developers looking to build new fossil fuel plants, thus supporting the existing renewables base. The existing base, however, would compete with new renewables because the utility will purchase whichever is lower cost. This arrangement could result in reducing the cost burden of existing projects on local jurisdictions by providing an additional source of revenue for the incremental cost of the renewable power.

To ensure the new renewable capacity is not sub-standard and actually generates substantial amounts of electricity, the RPS requirement would apply to electricity generation rather than capacity. The utility would not be required to actually purchase the renewable generation, but would have to demonstrate that it constructed or supported the generation of the requisite quantity of renewable energy. The utility would also have to show it has a contract to serve that generation to Chinese customers. This would allow urban utilities to meet their RPS requirements cost effectively by supporting renewables development in rural areas (where the renewable resource potential is large and costs are lower).

Eligible Renewables: The renewable resources eligible for the RPS would include: All types of biomass, geothermal, small hydro (<10 MW), solar electric, ocean technologies, and wind. A special band of 5% of the RPS standard (0.5% of the total proposed non-renewable capacity) might be set aside for non-grid connected solar (including water heating, stoves, etc.), small biomass applications (cooking fuel, greenhouses, etc) and small wind technologies.

Verification: Verification of the grid-connected renewable energy will be provided through: 1) a copy of the power purchase agreement for renewable power from a distribution company; and 2) an annual report by the utility purchasing the renewable energy from the designated renewable generator over the past year. Annual verification is required for 15 years.

If there is a requirement for installing non-grid connected renewables (See Section II-5), the developer would only need to verify that it has contributed sufficient funds for the requisite amount of off-grid capacity. This money would be put in a central fund for disbursement for specific off-grid projects. (A per kilowatt fee representing the average installed cost of a range of technology applications could be standardized for this use.)

Enforcement: Failure to meet the RPS requirements could result in the loss of the license to operate the primary generating facility (if the company significantly fails to perform) or a fine (based on four times the renewable kWh cost indicated in the original project proposal) per kWh of renewable energy shortfall.

Rationale: The rationale behind the Phase I approach is to use the enforcement mechanism available now (e.g. the SDPC new facility approval process) and apply it to a limited number of actors (those companies/joint venture partners proposing new generating facilities). The cost of compliance should be modest. The primary responsibility for compliance is on the developers who may not get project approval, or may loose their project license if they do not comply. This approach offers maximum leverage and reduces implementation costs since it will only apply to a relatively small number of participants. It also allows SDPC staff to gain increased knowledge of renewable energy costs and operational characteristics as well as offering a fund of money to use for non-grid connected renewables.

Phase II: Phase II introduces certificate trading. This phase is triggered by the identification of a trading administrator with the ability to track and verify renewable energy credits (RECs). Trading will also require a supportive legal structure to oversee trading with the ability to impose civil penalties for non-compliance or fraud.

In this phase, the RPS obligation is still placed on the developer of new capacity. The same RPS targets and enforcement mechanisms are in effect. The difference is that verification for the grid-connected power is accomplished through tradable RECs. These credits are generated by each eligible renewable energy generator consistent with the kWhs they generate. The credits indicate the type of resource used, (e.g. biomass, geothermal, small hydro, solar, wind, ocean) and whether they are from new or existing generation. Credits will also need unique identification, such as a serial number, so they can be easily tracked. Annual compliance by the project developer is verified by possession of the appropriate number of certificates.

Rationale: This phase allows both government and the electricity industry to gain experience with the needs and characteristics of renewable certificate trading while there are only a few participants to monitor.

Increased RPS Standard: The 10 percent standard will be increased to 12.5 percent after five years and 15 percent after ten years or until Phase III is implemented.

Phase III. This phase represents a shift in the requirement from the renewable energy developer to the retail electricity supplier. This shift assumes that an independent regulatory agency is developed to ensure that RPS requirements can be enforced. The standard would be a percent of each sellers retail sales, and would begin at approximately the existing percentage of renewable energy in the resource mix at that time. The standard would then increase by some small increment (e.g. 1% every two years).

Rationale: By Phase III there should have been a year or more of experience with renewable certificate trading to aid in verification. Experience with the cost and performance characteristics of renewable projects will also provide the government with necessary information to apply a cost cap or adjust the eligible renewable definition as appropriate. Moving to a full RPS program in a step-wise progression allows the effort to build on past successes and to proceed in concert with electricity sector reforms. The phased program provides a signal from government that it has a long-term renewable energy strategy without rushing into policies in advance of the institutional structures required to support them. The initial period can be used to revise current renewable energy policies (e.g. tax, tariffs, concessions, etc.) to be consistent with this phased approach and to provide a consistent framework.

VI. Other Potential RPS Options for China

Given the regulatory, political, and institutional context of China, the previous proposal represents our best efforts to identify a strawman RPS policy for broader consideration. That said, there are numerous other possible RPS designs that might also be considered. Here are a few of these additional RPS designs. These designs are all energy based with the percentages a portion of existing supply rather than a portion of new capacity additions.

One of the most challenging decision comes in determining the magnitude of the renewables purchase obligation. As discussed earlier, the standard should be set initially to support only a modest increment to current renewable generation levels, increasing gradually and predictable over a period of years. To ensure adequate time for resource prospecting and project development, requirements for new renewable generation should begin at least two years after all regulations are final. The ultimate standard level should be set with reference to overall policy objectives, renewable resource quality, and political realities in mind. The several RPS options identified below each treat the nature and magnitude of the RPS purchase requirement differently.

Option I: Start with existing renewables, then build gradually, incorporating new renewable resources over time.

- 2001: RPS of 5 percent, allow existing renewables (using same eligible renewables as in the strawman proposal -- no net increase in renewables yet – 90 percent of current capacity is small-hydro).
- Includes Renewable Energy Certificate trading. Enables time to practice renewable energy trading between renewable rich and renewable poor regions.
- 2005: RPS of 7 percent (in capacity terms, 2% of existing total 277,000 MW capacity equals 5,540 MW of new renewables). No technology bands.
- 2008: RPS of 10 percent (an additional 8310 MW of new renewables – based on capacity level in 2000). No technology bands.

Pros and Cons: This RPS option provides maximum flexibility but does not encourage resource diversity. It will encourage the lowest cost renewables and may not therefore meet other policy objectives such as commercialization of a domestic wind and biomass industries. Credit trading could be implemented through pilot projects and phased in over time. On the plus side, this option would be the easiest to enforce and be the least complex administratively. Nonetheless, it would still be difficult to devise a successful verification and enforcement scheme given the current institutional structure in China.

Option II: Encourage Some Additional Resource Diversity

A variation on this option would be to create tiers for newer or higher cost technologies to ensure additional resource diversity.

- 2001: RPS of 5 percent, allow existing renewables (no net increase in renewables yet)
- Includes Renewable Energy Certificate Trading.
- 2005: RPS of 7 percent. For new renewables, create two tiers. Tier I would include wind, solar, biomass, geothermal. Tier II would include hydropower under 35 MW. Thirty percent of the RPS resources must come from new generation with 70 percent of all new renewables from Tier I, with 30 percent coming from Tier II. If a utility wants to buy RECs to satisfy the new requirement, it must be linked directly to new renewables.
- 2008: RPS of 10 percent. Same percentage of Tier I/Tier II new renewables.

Pros and Cons: This option may be more costly, but will encourage fuel diversity and help encourage the growth of other renewable industries.

Option III. RPS Eligibility Restricted to New Renewable Generation

Another variation to Option 1 would be to establish the renewables purchase requirement for new renewable generation only. Such a variation would exclude existing resources from eligibility, and simply require that two percent of energy supply come from new renewables by 2005 and that five percent come from new renewables by 2008. This option would further ease administration and significantly lower the cost of the RPS. The new requirement would start in 2002 to allow time to develop the new renewable energy projects.

Option IV. RPS Designed to Maximize Resource Diversity: The NFFO Approach

Capacity based figures below are similar to the British Non-Fossil Fuel Obligation (NFFO), but could be converted to energy-based numbers.

2001: RPS of 5 percent, allow existing renewables (no net increase in renewables yet)
2005: RPS of 7 percent – total of 5,540 MW of new capacity. Again, trading would require contractual links to each specific resources:

- 2,800 MW of RPS requirement must be met from wind, including small-scale (51 percent)
- 180 MW from solar, including off-grid (3 percent)
- 1,100 MW from small hydro (20 percent)
- 1,050 MW from biomass (19 percent)[1]
- 410 MW from geothermal (7 percent)

Each province would be allocated a certain percentage based on the resource availability in each region. For example, the desert regions might have a slightly higher solar component and a lower biomass component. Utilize reverse auctions for resources where enough of an industry exists to create competition among project developers (e.g., perhaps wind). In this case, the provincial utilities would bid out the new projects with oversight from SDPC and/or SETC. Contracts are for 15 years from the time the generators go on-line.

2008: RPS of 10 percent, and an additional 8310 MW of capacity. Percentages in each technology band revised consistent with the new target.

Pros and Cons: Most costly and least flexible, but would maximize fuel diversity and bring emerging technologies, such as solar closer to commercialization in China. Combined with other incentives, this could make China an exporter of small-scale PV technologies to other developing

[1]/ Currently, 90 percent of the renewable base is small hydro. If this model were used, by 2008, 60 percent of renewables are small hydro and 40 percent are other resources. If small hydro is not eligible as new renewable, then by 2008, it would account for 45 percent of the total renewable base.

countries. However, this level of RPS may be too complicated and difficult to enforce. At a minimum, it would be much more complex administratively.

Option V: RPS Designed to Maximize Resource Diversity: A Multi-tiered RPS

Option IV is not a standard RPS but is more similar to the NFFO. An RPS with multiple tiers would not set MW-level requirements but would have percentage requirements. For example:

2005: RPS of 2 percent, allow only new renewables:

Tier One:
Eligible renewable resources: wind, geothermal or biomass: 55 percent of total new generation must come from Tier One.

Tier Two:
Eligible resources: small hydro (under 30 MW): 40 percent must come from Tier Two.

**This option could also include a separate requirement that the remaining 5 percent come from solar resources (see Section II-5).

2008: RPS of 7 percent. Tiers could be the same or they could be amended based on experience up to that point.

Option VI: A Systems-Benefit Charge

Instead of utilities charging extra for the premium costs of meeting an RPS requirement, China may want to consider a systems benefit charge mechanism, such as that developed in California and the U.K.

2001: Require that utilities collect on their customers' bills a small (3 percent or so) charge to finance renewable energy.

2005 and 2008: Keep the same percentages as described in Option 1 and require the utilities to purchase power from renewable generators. However, the utilities will not be paying higher costs because the proceeds from the central fund will subsidize the premium so the costs of purchasing renewable electricity will be the same. The subsidy can be used to reimburse the utilities for their higher costs of meeting the RPS requirement.

The government will issue competitive awards based on the lowest price per kilowatt-hour, which will require the lowest level of subsidy (tiers can be arranged to ensure resource diversity). Trading will increase the geographical distribution of projects. Once the projects are developed, the government will use the central fund to pay out subsidies for a period of time. The levels of subsidies will decrease as economies of scale reduce the cost of renewables over time. As with all other renewable energy policies, this will need to be in force for a long period of time to ensure market stability.

Pros and Cons: This type of system will reduce political opposition from the utilities because their costs will not be affected. However, there may be political opposition against levying another charge, no matter how small, on consumers. In addition, this arrangement will create a large administrative burden in terms of collecting the money, issuing requests for proposals, evaluating them, awarding the contracts for renewable projects and monitoring the progress. This approach will require the greatest level of public-sector involvement.