CRS center for resource solutions

Overview of Renewable Portfolio Standard Design Options from the U.S. Experience

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Introduction

This report highlights the main principles and options that inform Renewable Portfolio Standard (RPS) program design based on experiences in the United States. Applicable examples are highlighted throughout the report, and an overview of implications for China is included at the end of the report.

1. Capacity—or Energy—Based Targets

Capacity-based RPS policies require that a certain number of megawatts (MWs) of eligible renewable energy generation facilities are installed and operating. The compliance obligation for these policies may be at the state level or placed on individual obligated load-serving entities (LSEs). LSEs may either own the generation capacity themselves or contract for the output of capacity from other generators.

Consumption-based RPSs require that a certain amount of eligible renewable electricity be delivered to (and consumed by) consumers by obligated LSEs. LSEs may be required to either deliver a certain number of megawatt hours (MWh) of renewables each year, or deliver a certain percentage of renewable electricity to their customers. Different customer types might be required to receive different amounts of renewable electricity in either case.

Capacity-based RPS policies may only require that the generation is installed and generating in the state, and not that any specific electricity user to consume the electricity. Consumption-based RPSs usually result in consumers claiming to use the renewable electricity delivered to them, to the exclusion of other customers. However, it should always be made clear in the RPS rules whether any particular electricity user type (such as commercial, industrial and/or residential) is meant to use the renewable electricity that is generated.

In the U.S., almost all RPS policies are consumption-based, defined in percentage terms, and with an equal allocation of the requirement across all customer classes. Good RPS design fairly allocates the requirement across all customers, and targets the intended attribute of renewable energy supply, not capacity. As one example, Oregon requires that obligated LSEs provide each customer with 25% renewable electricity by 2025. Renewable Energy Certificates (RECs), which are used as proof of renewable generation, are retired to show compliance with this RPS, as a percentage of each LSE's total retail load. There are only two examples of capacity-based RPS policies in the United States. And, in one of those states—Texas—the capacity-based RPS of 10,000 MW by 2025 has, in effect, been converted into a consumption-based requirement by the regulatory authority to ensure effective incentives for performance. In Texas, rather than reporting capacity built or under contract, each obligated LSE must retire enough RECs to equal a certain amount of capacity.

2. Point of Regulation

For RPS programs in the U.S., the point of regulation (the obligated entity) is the LSE or retail supplier of electricity. This can include investor-owned utilities, publicly owned or municipal utilities, cooperative utilities, competitive electricity suppliers (in deregulated states), and community choice aggregators, where permitted–or a subset of these. It is recommended to set an equal obligation on all chosen regulated entities to ensure competitive neutrality. Even in Texas and Iowa, the only two U.S. states that have set renewable energy requirements in terms of generation capacity instead of electricity sales to retail customers, the point of regulation is retail electric providers and utilities. In some cases, entities that would not otherwise be considered utilities are classified as retail electricity suppliers by the state and are therefore subject to the RPS as well. For example, Harvard University is a licensed retail supplier of electricity in Massachusetts and must comply with the state's RPS program.

Certain states, in particular Illinois and New York, either currently or have historically enforced RPS requirements through centralized procurement entities. In Illinois, large investor-owned utilities are subject to a centralized procurement process run by the Illinois Power Agency (IPA), which brokers all contracts between utilities and suppliers. Other utilities, in particular smaller multi-jurisdictional utilities, can request a procurement plan from the IPA. In New York, prior to the adoption of the current Clean Energy Standard (CES), the New York State Energy Research and Development Authority (NYSERDA) was the designated centralized procurement agency for the RPS program—which the state argued[1] was best suited to long-term contracting in the state's deregulated electricity marketplace. Though all retail LSEs now share the obligation of an RPS mandate, which they will meet with REC retirements in the New York Generation Attribute Tracking System (NYGATS), NYSERDA remains a centralized procurement agent for the state. LSEs may purchase qualifying RECs on their own, from NYSERDA, or develop their own renewable resources and keep the RECs.

3. Set the Obligation

In aiming to achieve a certain level of obligation by a set date, many states set benchmark targets at predetermined lower levels by earlier dates. For example, if the overall obligation is set at 25% by 2026, the state may commit to one benchmark of 20% by 2020 and a second benchmark of 23% by 2023 to help the state assess its progress to meeting the overall goal at certain points in time. As the obligation approaches fulfillment, many states choose to escalate the obligation to a higher percentage level. The experience of California[2] reflects a state that has been able to successfully meet and expand upon its initial obligations, starting with a commitment in 2002 of 20% by 2017 to the present obligation of 50% by 2030, agreed upon in 2016, when it was clear that earlier

1 See New York CES Order (August 1, 2016), p.10-11 and 41-42. Retrieved from http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b44C5D5B8-14C3-4F32-8399-F5487D6D8FE8%7d

2 Database of State Incentives for Renewables & Efficiency (DSIRE). Retrieved from http://programs.dsireusa.org/system/program/detail/840

obligations would indeed be met.

Each state has the flexibility to define a set of key characteristics or eligibility criteria that generation used to meet the obligation must possess. These characteristics can range from variables such as certain resource types or geographic locations, to issues such as cost effectiveness or whether RECs are delivered bundled with electricity. Generation can also be grouped into "tiers" based on these key characteristics, with the overall obligation met with certain percentages of each tier. Usually a main tier consists of more desired resource types such as wind and solar, while lower tiers contain more nuanced eligibility definitions for specific resource types. For example, the state of New Jersey[3] has its obligation currently divided to two tiers. The first is known as "Class I" and consists of solar, wind, certain low-impact hydropower facilities below 3 MW, wave or tidal, geothermal, fuel cells using renewable fuels, and certain biomass from its regional grid. The "Class II" tier consists of large hydropower and municipal solid waste from its regional grid. New Jersey requires that by 2021, 21.89 percent of its electricity use must come from Class I resources and 2.5 percent from Class II. Different tiers might also have different rules when it comes to geographic eligibility, Alternative Compliance Payments (ACP), or other enforcement mechanisms to encourage certain obligations to be met over others.

With all things being equal, fulfillment of RPS obligations usually will be achieved using the lowest cost, easiest to access resource type. To diversify the generation used to meet obligations, some states employ tools known as "carve outs" and "credit multipliers." A carve out is a way for a state to encourage certain resource types within a tier and is often applied to solar and/or distributed renewable energy, while credit multipliers give additional credit toward compliance for generation from certain types of facilities with the same resource type. The state of Colorado,[4] for example, has both a carve out and a credit multiplier. In Colorado, utilities must meet an overall RPS obligation of 30% by 2020. Colorado then layers on a solar carve out that requires 3% of the RPS obligation must come from on-site (including solar) distributed generation (DG) sources. Colorado then implements a series of credit multipliers – one example is a 300% credit toward meeting the obligation for the use of a MWh from a solar facility that came online before July 2015 – which further encourages the use of solar DG.

4. Eligible Resource Types

While each state is bound by geographic, resource-availability, and political constraints in allowing or encouraging one type of generation over another to meet an RPS obligation, many definitions of eligible resources are shared from state to state. One exception to this is hydropower: more than any other resource type, hydro is treated widely differently between the states. Many states, like California, only allow low-impact hydro facilities to be used as eligible generation, and have varying definitions of "low impact."[5] Other states establish size or operational thresholds, with only smaller or run-of-river hydropower plants being eligible. A few states like Maine do allow large hydro facilities to be considered eligible.[6] And other states such as New Jersey have more nuanced rules, allowing larger hydro facilities to be eligible but only as part of a lower tier.[7] A second point of difference among RPS policies relates to biomass generation, with varying rules established in some states regarding emissions and sustainability requirements that define which biomass plants will be eligible.

One challenge many states face is how to encourage diversity in resources used to meet the obligation, or the development of certain resource types over others. This can be achieved through a tiered system of obligation, tools like carve outs and credit multipliers, or by setting price caps or floors on certain resource types. This has the advantage of supporting a more robust and stable renewable energy market if mechanisms encouraging resource diversity are built into the design of the RPS itself.

5. Geographic Requirements and Restrictions

RPS laws are passed and implemented at the state level in the U.S., so they are written with the intent to provide local or regional benefits rather than focusing on national benefits. Some states, such as Texas,[8] require that any generation used to fulfill the RPS obligation be located either in-state or with a direct connection to the Texas state grid. The vast majority of states, however, take a more local approach. In regional markets, geographic requirements have the effect of creating a regional REC trading market. The state of Maryland,[9] for example, requires that the generation originate from a facility from the Mid-Atlantic electricity grid (known as the PJM Interconnection Region) or an adjacent electricity grid, provided the generation is being delivered into the PJM grid (except in the case of solar generation, which must be located in state). This means that obligated parties in Maryland can trade with neighboring states such as Pennsylvania and Delaware to procure generation that meets their obligation, and are free to trade with obligated parties in neighboring states to help those parties meet their own obligation. Finally, as the Maryland example shows, geographic requirements can be coupled with tools like carve outs and credit multipliers to help encourage certain types of generation over others. Maryland's solar carve out is coupled with the in-state solar geographic restriction, which effectively encourages the growth of Maryland's solar industry.

6. New Versus Existing Resources

RPS policies are typically implemented in order to cause more renewable electricity to be generated in the state. This can be

3 DSIRE. Retrieved from http://programs.dsireusa.org/system/program/detail/564

4 Solar Energy Industry Association. Retrieved from https://www.seia.org/sites/default/files/resources/RPS%20Solar%20Fact%20Sheet%20CO.pdf

5 DSIRE. Retrieved from http://programs.dsireusa.org/system/program/detail/840

6 DSIRE. Retrieved from http://programs.dsireusa.org/system/program/detail/452

7 DSIRE. Retrieved from http://programs.dsireusa.org/system/program/detail/564

8 DSIRE. Retrieved from http://programs.dsireusa.org/system/program/detail/182

9 DSIRE. Retrieved from http://programs.dsireusa.org/system/program/detail/1085

achieved in a few ways. An RPS can require that all generators be built during the compliance period or within a certain number of years prior. An RPS could require that the obligated entity only enter into long-term contracts with generators during the planning stage so that the generator is assured of long-term income prior to being built, allowing the facility to be completed. An RPS could also give the obligated entity more credit toward compliance when purchasing electricity from new generators. This is known as a multiplier, which can be used to promote the use of a particular type of renewables.

Generators that do not quality as "new" may be treated in a variety of ways by an RPS. These existing generators may simply be excluded from eligibility, or they could all be deemed eligible if the RPS is less concerned with the development of new renewables than ensuring that there is a certain amount of renewable generation or capacity of any type in the state, or if the RPS goals are sufficiently high that even with existing facilities there is still a strong signal requiring new facility construction. Alternatively, a tier system can be created with one tier of the RPS restricted to newer facilities and the other tier allowing older facilities.

As an example, Massachusetts requires that an annually increasing percentage of retail load is met with Class I renewables, which requires generators built after 1997. The state's Class II renewables come from generators that existed before 1998, and can be used for a small portion of the RPS obligation (2.6155% of load in 2018), to support existing renewable generators.

7. Energy Efficiency

With energy efficiency being an increasingly cost-effective way of reducing emissions, various states in the U.S. have started implementing energy-efficiency targets. Some states have included energy-efficiency measures into their RPS, while most have instead created a separate Energy Efficiency Resource Standard (EERS), which compliments the RPS. Nevada and North Carolina are among the few states to incorporate energy efficiency measures directly into their RPS, and consider energy efficiency measures an acceptable method to meet RPS requirements.[10] The Nevada RPS allows energy efficiency measures to comprise up to 20% of the renewables requirement through 2019, up to 10% between 2020-2024, and will phase out completely thereafter.[11] North Carolina's Renewable Energy and Energy Efficiency Portfolio Standard (REPS) allows energy efficiency measures to comprise 25% of the RPS requirement through 2021, but is increasing to up to 40% in 2022 and beyond.[12] Energy Efficiency Certificates (EECs), may be used for compliance with state RPS and EERS requirements. Similar to RECs, EECs generally represent 1MWh of energy saved, can be used for either compliance or voluntary markets, and their price is dependent on market value.

8. Verification and Enforcement

Naturally, an RPS obligation requires that there are mechanisms in place to ensure that the obligated party is in fact procuring and claiming the renewable generation that is required. States in the U.S. have the benefit of RECs being the standardized currency for renewable energy, so RECs are required for states to claim that renewable electricity is delivered to or generated on behalf of customers in that state due to the RPS. REC tracking systems provide the means to ensure and support the claims of obligated parties, as RECs are tracked between account holders of the tracking system and ultimately permanently retired or cancelled by the obligated party making the claim. With the backbone of RECs and tracking systems to rely on, state regulators such as the public utilities commission, the state energy commission and other bodies must define their additional regulatory roles. This includes providing obligated parties with a timeline and process under which failure to comply with the obligation is dealt with. Each state's public process ensures that the guidelines to determine compliance with the RPS by the obligated party are clearly understood, as is the process for official censure by the state if the obligation fails to be met.

The most common mechanism that states use to ensure obligations are enforced is the Alterative Compliance Payment (ACP). The ACP is a penalty payment made by the obligated party if the goal is not met. An ACP may be set at different levels for different generation tiers or resource types, but should be set high enough that it is not a viable alternative to procuring eligible generation. For example, the state of Massachusetts has an approach that features different ACP levels for each class or tier of generation under its obligation, and places a higher ACP on the more-valued tiers of generation (such as Class I, which is new build generation or the solar carve out tiers) than on lower value tiers (such as Class II, which is for facilities built before 1998).

9. Cost Containment

Though the cost of RPS compliance may sometimes place a financial burden on LSEs, many jurisdictions have implemented cost-containment mechanisms to limit the price of renewable generation and/or RECs. Some of these mechanisms include alternative compliance payments (ACPs), rate impact or revenue requirement caps, per-customer cost caps, and contract price caps. Cost-containment mechanisms are a way for states to limit the cost of renewables required by the RPS, and are designed to protect end-users from excessive energy prices.

As discussed in the previous section, ACPs are the most common tool for RPS enforcement, but they can also be used as an effective cost-containment mechanism by setting a maximum price for RECs. For example, the New Jersey solar carve-out requires suppliers to provide 4.1% of their supply from New Jersey solar

10 "Energy Efficiency Standards and Targets." Center for Climate and Energy Solutions, 26 Oct. 2017, www.c2es.org/document/energy-efficiency-standards-and-targets

11 "Energy Portfolio Standard-Nevada." DSIRE, 2016, programs, www.dsireusa.org/system/program/detail/373

12 "Renewable Energy and Energy Efficiency Portfolio Standard." DSIRE, 2017, programs. dsireusa.org/system/program/detail/2660.

generators by 2028[13] through its own Solar Renewable Energy Certificate (SREC) system. The price of SRECs, like any RECs, can vary greatly depending on supply and demand in the market, potentially causing an undue burden on LSEs from compliance costs, with those costs transferred to ratepayers. The ACP can be an effective tool to contain these costs, as the SREC prices generally hover around or below the solar alternative compliance payment (SACP) price, and do not exceed it.

However, when the price ceiling is too high and available supply is low, prices can be high and fluctuate greatly, creating volatility and uncertainty in the market. For example, from 2011-2012, the SACP was set at $658; on September 6, 2011 SRECs sold for $605, but by October 12, the price had decreased to $315.[14] These steep variations in SREC pricing were of significant concern to regulators, and in 2014 a plan was put in place to lower the price ceiling and gradually decrease the SACP for better cost containment, from its height at $711 in 2009 to $239 in 2028. For 2016-2017, the SACP was set at $315,[15] with actual SREC prices averaging $227.51 per SREC.[16] Revenues from the SACP in New Jersey go back to New Jersey Board of Public Utilities, which in 2010 allocated $47 million into solar rebate payments, and starting in 2011, a portion is also refunded to ratepayers.[17]

Several other forms of RPS cost-containment mechanisms are also employed in some states. A rate impact cap limits how much retail electricity rates can increase due to the RPS, contract price caps put a limit on the contract price an obligated entity can pay to purchase renewable energy from a generator, and per-customer cost caps limit the cost increase that may be charged to customers because of the RPS. How these policies are implemented vary across states. For example, Montana has had success implementing a contract price cap, which limits the cost of renewable energy contracts to 115% of any available alternative. This has succeeded in keeping the price of renewable energy down and keeping it reasonably cost competitive with fossil fuels.[18] Retail rate caps, where employed, have often been set at 1-4%.[19] No matter which mechanism is used to contain the cost of the RPS, each must be very carefully designed, as cost-containment mechanisms may interact with other RPS requirements in unintended ways.

10. Procurement Options

RPS policies may offer a variety of ways for an obligated entity to procure renewables to meet its obligation. Obligated entities may seek and develop contracts directly with generators or REC sellers. Long-term purchase contracts can offer a predictable cost to the obligated entity, but there is some risk of "over-procurement" if the LSE's retail load shrinks in the future. Buying RECs short-term on the spot market helps resolve this risk, but provides no long-term price certainty.

Obligated entities often procure supply through auctions, where private developers bid to provide supply to the entity and the lowest bid is typically accepted. Factors other than price might influence bid selection, such as development timing or resource type. Obligated entities might also choose to build or own the generator themselves rather than only contract for the output.

Experience from the U.S. demonstrates that RPS programs are most effective if the primary form of compliance is via long-term contract for bundled electricity and RECs, typically procured through auction. Short-term REC trade is a useful supplemental balancing mechanism to give LSEs flexibility in their procurement options given uncertainty in their load and therefore RPS obligations. Where short-term REC trading has been the primary compliance mechanism, the cost of RPS policies has tended to be very high—partly because it is difficult for renewable energy projects to obtain low-cost finance based on uncertain and fluctuating REC prices. In fact, in many states, regulators have over time created new long term contracting requirements and mechanisms to ensure that auctions of long-term contracts are a primary means of RPS compliance.

For example, California's Renewable Auction Mechanism (RAM) allows obligated entities to conduct auctions for contracts with solar generators that can be built within 3 years. To streamline the process, standard contracts are used and the regulatory review process is expedited for winning projects.

11. Flexibility

Many RPS policies contain flexibility mechanisms, which can reduce the cost of compliance. A common mechanism is banking REC purchases for a future compliance period. RECs from a particular generation year, or "vintage," may be allowed for compliance in the following year, or a more distant compliance period. This way, obligated entities can make fewer, larger purchases and spend less time each year seeking supply. However, many RPSs that allow banking will also force a REC's eligibility to expire after a period of time, to encourage the development of new generators and to maintain demand for RECs.

Multi-year compliance periods and expanded geographic eligibility are also common flexibility mechanisms. Allowing a compliance period of greater than one year gives obligated entities more time to find good prices for renewables and requires less administrative burden for both the obligated entities and the RPS administrators. For example, Maine allows up to one-third of certain obligations to be met with RECs generated in the prior year, as long as those RECs are in excess of what was claimed toward that prior year's compliance obligation. In nearly all states, renewables from outside of the state are typically allowed as a means of flexible

13 http://programs.dsireusa.org/system/program/detail/5687

14 http://njcleanenergy.com/renewable-energy/project-activity-reports/srec-pricing/srec-pricing-archive

15 http://programs.dsireusa.org/system/program/detail/5687

16 http://www.njcleanenergy.com/renewable-energy/project-activity-reports/srec-pricing/srec-pricing

17 https://www.nrc.gov/docs/ML1322/ML13226A126.pdf

18 Pierpont, Brendan. "RPS Webinar: RPS and Cost Containment Options." Clean Energy States Alliance Clean Energy. Let's Make More., 2012, www.cesa.org/webinars/rps-webinar-rps-and-cost-containment-options/?date=2012-04-24.

19 Bird, Lori. "Renewable Portfolio Standards: Costs and Benefits." National Renewable Energy Laboratory (NREL), Dec. 2014.

compliance and cost mitigation.

12. Timeline

States define a compliance period for obligated parties to report to regulators their progress in meeting their benchmarks. These periods can vary from a standard calendar year like the state of Connecticut,[20] a different 12-month period of time like New Jersey's June – May so-called "Energy Year,"[21] or a multi-year period like California,[22] which sets its benchmarks based on a 2-year compliance period. A goal of state regulators is to keep the overall compliance process as predictable as possible. Compliance periods can help to do that by providing a set boundary. This provides the structure that obligated parties and other market participants need to successfully navigate the compliance market. Coupled with clear enforcement processes, compliance periods can help to give overall regulatory certainty and can help foster overall price stability.

13. RPS in the Context of Restructuring

Moving from a regulated electricity market—in which a monopoly utility owns and/or controls all generation and transmission infrastructure, as well as delivers electricity to customers—to a restructured electricity market can present its own set of policy challenges. Wholesale market restructuring has allowed independent power producers to sell into the wholesale market, increasing competition and decreasing costs that are ultimately passed to consumers. Access to transmission lines in restructured markets is often overseen by independent system operators or regional transmission operators. Moreover, of the 29 states with an RPS, 18 have deregulated retail electricity markets or are in the process of deregulation.[23] With U.S. policymakers tailoring the RPS to fit the specific objectives of their respective states, various policy options emerged as a result, providing a unique lens with which to view a number of successful and unsuccessful RPS policies in restructured states.

Retail choice is a key component within deregulated states. Generators can sell to the wholesale market and retail energy suppliers may then purchase the electricity to sell to consumers, who can choose which retail supplier to buy from. Alternatively, retail suppliers can also enter into bilateral agreements with generators for supply. The competition of retail suppliers, which is absent from regulated markets, typically decreases prices and increases options, including options for increased renewable energy. To ensure policy objectives, all retail suppliers in RPS states are subject to RPS requirements.

One key challenge of RPS implementation in markets with retail choice is that competitive retail providers have uncertainty in their future load and therefore RPS obligations. This tends to lead to a substantial amount of shorter-term REC purchasing for compliance purposes and, in the U.S., has sometimes led to higher costs given the challenge of financing renewable energy projects based on this model. In response, a number of states in the Northeast have established longer-term contracting mechanisms, either doing so through a government-run procurement body (e.g., NYSERDA, in New York) or by requiring the still-regulated distribution utilities to conduct longer-term auctions for renewable energy contracts.

14. Voluntary Market Implications

Many electricity users want more renewable electricity than their state's RPS provides. In the U.S., "voluntary" renewable electricity purchasers who enroll in optional green-power programs offered by their electricity providers or purchase RECs on their own compete with RPS obligated entities for renewables, increasing overall demand for renewable generation and accelerating renewable capacity development. If an RPS allows voluntary renewable electricity purchases to be counted toward RPS compliance, then these MWhs are double counted—once for the RPS and once for the consumer—and this can result in less renewable electricity development than policymakers likely intended. Therefore, RPS design that prohibits double counting is important for voluntary market participants, because RPS policies should not credit voluntary renewable electricity purchasing towards the RPS compliance obligation.

Vibrant voluntary renewable electricity markets can, and typically do, exist alongside vibrant RPS markets, and the markets can be mutually beneficial. To meet increased voluntary market demand, generators that are intended for RPS compliance can be sized larger or can be brought online before the compliance period, and the extra generation can be sold to the voluntary market. In this way, the generator produces more renewable electricity than it would have without voluntary demand, preventing carbon dioxide emissions sooner than the RPS would have required.

Figure 1 shows the relative volumes of voluntary purchasing, compliance purchasing of renewables from "new" generators, and compliance purchasing of "existing" renewables from 2010-2016 in the U.S.

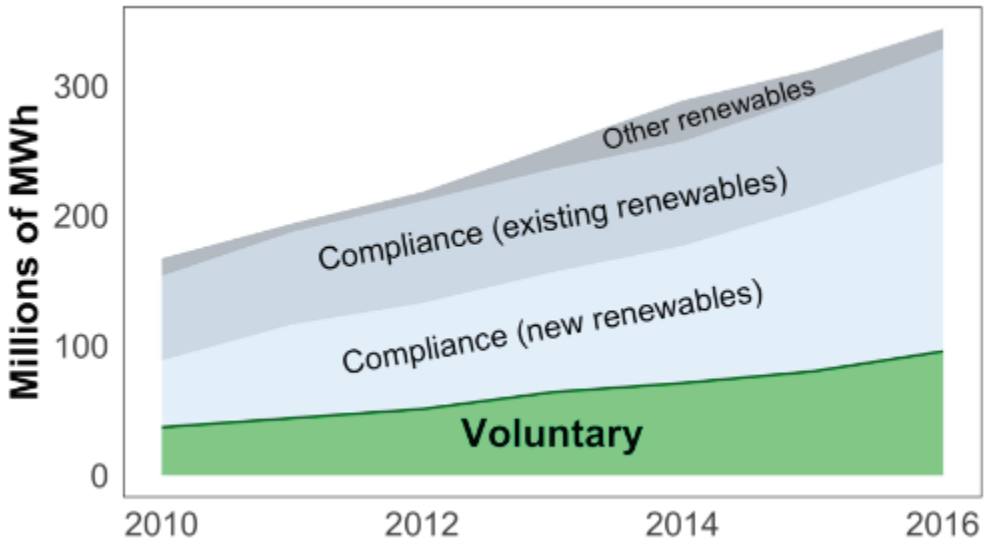
For example, because compliance for the Texas RPS is REC-based, it is easy to avoid double counting, and voluntary sales of Texas RECs help support generation beyond the RPS, resulting in extra environmental benefits in a state that has good wind resources. In comparison, Hawaii's RPS counts all in-state generation toward its targets, and so voluntary purchase of RECs is not possible since it would always cause a double claim.

15. Carbon Policy and RPS

Interaction between renewable energy and greenhouse gas policy in the power sector depends on how the policies are structured and administered. First, it is important to note that where RPS programs are intended to achieve greenhouse gas reductions,

20 DSIRE. Retrieved from http://programs.dsireusa.org/system/program/detail/195
21 DSIRE. Retrieved from http://programs.dsireusa.org/system/program/detail/564
22 DSIRE. Retrieved from http://programs.dsireusa.org/system/program/detail/840
23 Electric Choice. Retrieved from https://www.electricchoice.com/map-deregulated-energy-markets/

Figure 1



Source: "Status and Trends in the U.S. Voluntary Green Power Market (2016 Data)" National Renewable Energy Laboratory. Based on data from the Energy Information Administration 2017 and Lawrence Berkeley National Laboratory 2017

RECs (or other RPS compliance instruments) must include the greenhouse gas benefits of clean energy production and represent the only means to transact and document ownership of those attributes by or on behalf of consumers. If not, those benefits could be captured in other programs or instruments and exported or double counted, making the goals harder to meet. Second, where emissions attributes are attached to renewable energy compliance instruments, they may also be used as an instrument to assist in compliance with greenhouse gas regulation. But there is risk of double counting in this case if accounting is not harmonized between the two programs.

Double counting between these greenhouse gas policies and RPS can occur if best practices are not followed. These are many important design decisions for carbon and RPS policy that require careful evaluation in order to maintain policy goals and prevent double counting. For example:

- ETS Systems: If the RPS compliance instruments (e.g., RECs) are used to reduce greenhouse gas compliance obligations (either representing a quantity of emissions reductions or avoided grid emissions, or representing a quantity of renewable energy generation to reduce a carbon compliance obligation under an ETS), there is double counting since the RECs are functioning as emission reduction instruments issued within a capped sector. The same reduction in grid emissions due to renewable energy will be counted under the cap and then counted and used for compliance again as an emission reduction.

- Carbon Offsets: If the RPS is consumption-based and the compliance instrument or REC includes the avoided grid emissions attribute of renewable energy generation (which is the case in all but one RPS in the U.S.[24]) and reduction credits (or carbon offsets) are issued for the same generation that is delivered to customers through the RPS, then both the REC and the offset can convey the same avoided emissions attribute to different consumers and there can be double counting. RPS administrators should coordinate with carbon offset certifiers to prevent double counting of carbon attributes of clean power.

Beyond double counting, there can be renewable energy market integrity and/or demand issues that arise at the intersection of greenhouse gas and RPS policies where the effects of policy can have negative market, price, or policy effects on the other.

Implications for China

China is unique, and the experience with RPS programs in the U.S. may not be fully relevant. Nonetheless, some possible implications are as follows:

- **Be Careful in the Transition: New Renewable Energy Programs Are Hard to Design, and It Is Important to Not Disrupt China's Already-Successful Renewable Energy Policies.** China has assumed a world-leading position in renewable energy development, and care should be taken to design an RPS that contributes to this success. Experience on a worldwide basis demonstrates that RPS programs are not easy to design. The ongoing transformation of the electricity market in China is complex, and great care should be given to RPS policy design in China, in part to ensure a smooth transition from the current policy environment.

- **Be Clear on Objectives and Design the RPS Policy Accordingly, but Don't Expect that RPS Policies Can Solve All Problems.** RPS policy design can be tailored to meet certain objectives, and so being clear on the objectives of the policy is a critical first step to effective program development. However, RPS policies simply cannot meet all objectives. Perhaps most importantly, grid-integration challenges will not be

24 North Carolina allows the avoided emissions attribute to be traded separately from the REC for RPS compliance.

Table 1. Types of greenhouse gas policies for the power sector

Type No.	Name	Description
1	Emissions regulations	This is mass-based regulation of emissions from the power sector with source-based accounting of emissions. It is also sometimes called an emissions trading scheme (ETS) or cap-and-trade program. These programs can be voluntary or mandatory, and there are various options in terms of who the compliance entities are and trading of emissions or allowances/permits.
2	Emissions reduction markets	These are also called carbon offset markets, and they can be voluntary or mandatory.
3	Emissions intensity regulations	This is rate-based regulation of emissions in the power sector. These can be consumption-based (the intensity of the electricity consumed in a region is regulated) or generation-based (the intensity of electricity generated in a region is regulated). They can also be voluntary or mandatory, and there are various options in terms of trading rate-based instruments.
4	Tax	One example of this is a greenhouse gas "adder" or charge in wholesale power rates.
5	Emissions reporting	Emissions reporting, often through a central inventory system or registry, can be either voluntary or mandatory and can include direct and/or indirect emissions.
6	Goal	This is a goal or target in terms of emissions or emissions reductions in the power sector.

solved by RPS programs, neither can RPS programs eliminate the above-market cost of renewable energy.

- **Design RPS Programs around a Set of Best Practices:** Though policy stability is important, China should be ready to adjust the targets if renewable energy supply expands more rapidly than anticipated. Various RPS tiers or carve-outs should also be considered to ensure a level of resource diversity. Compliance should be enforced, with clear penalties in the case of non-compliance, but also with some level of flexibility to help enable cost-effective compliance. REC tracking systems serve as an important underpinning to track renewable energy trade and RPS compliance. Various forms of cost-containment mechanisms can be used to help ensure that costs do not exceed threshold levels.

- **Ensure that Auctions for Long Term Contracts Are the Primary Means of Compliance, because Renewable Energy Investors Need Pricing and Market Stability:** Short-term trade in RECs is a useful supplemental compliance option, and RECs are an essential compliance tracking mechanism, but short-term REC trading should not be the primary form of compliance if cost reduction is the goal. Long-term contracting should be encouraged or required. Other mechanisms for ensuring pricing and market stability include: REC pricing floors or bands, government long-term contracting for RECs, requirements for government-approved compliance and procurement plans, and ensuring policy design clarity and stability.

- **Who Is Obligated to Meet RPS Requirements Is Critical, and the Range of Options Should Be Narrowed based on Considerations of Market Stability and Cost Recovery.** In the U.S., retail electricity suppliers—or LSEs—are always the obligated party. The reason is simple: these are the entities that are responsible for developing a supply portfolio to meet customer demand, and so are the natural party to be obliged to purchase renewable energy. Other obligated parties are under consideration in China. Regardless of what entities are chosen, it is essential that: (1) obligated parties are able to enter into long-term contracts for renewable energy, and (2) obligated parties have an opportunity to recover the costs of RPS compliance from end-use customers.

- **Careful Attention to Coordination among Supporting Policies and Efforts Is Essential: No Single Policy Will Do.** Carefully designed RPS programs can be effective, but are not a sufficient means to cost-effectively support renewable energy supply and grid integration. Careful coordination among different policy mechanisms is essential—including voluntary green power markets, carbon cap-and-trade programs, electricity market design and grid integration efforts, and others. It is important to ensure that such policies are complementary to one another, and do not conflict.

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