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The Treatment of Renewable Energy Certificates, Emissions Allowances, and Green Power Programs in State Renewables Portfolio Standards

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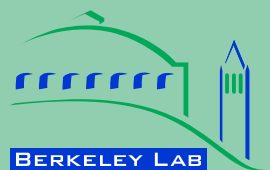
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# **The Treatment of Renewable Energy Certificates, Emissions Allowances, and Green Power Programs in State Renewables Portfolio Standards**

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**April 2007**

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Prepared for the

Permitting, Siting and Analysis Division  
Office of Electricity Delivery and Energy Reliability  
U.S. Department of Energy

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Office of Energy Efficiency and Renewable Energy  
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## Executive Summary

Twenty-one states and the District of Columbia have adopted mandatory renewables portfolio standards (RPS) over the last ten years. Renewable energy attributes—such as the energy source, conversion technology, plant location and vintage, and emissions—are usually required to verify compliance with these policies, sometimes through attributes bundled with electricity, and sometimes with the attributes unbundled from electricity and traded separately as renewable energy certificates (RECs).

This report summarizes the treatment of renewable energy attributes in state RPS rules. Its purpose is to provide a source of information for states considering RPS policies, and also to draw attention to certain policy issues that arise when renewable attributes and RECs are used for RPS compliance. Three specific issues are addressed: (1) the degree to which unbundled RECs are allowed under existing state RPS programs and the status of systems to track RECs and renewable energy attributes; (2) definitions of the renewable energy attributes that must be included in order to meet state RPS obligations, including the treatment of available emissions allowances; and (3) state policies on whether renewable energy or RECs sold through voluntary green power transactions may count towards RPS obligations.

The first section of the report addresses the use of unbundled RECs and how RPS compliance is verified. We find that 17 of 22 RPS policies currently allow unbundled RECs. Many of these states require that RECs used for compliance be accompanied by electricity delivered into the region. Some of these states accept both unbundled RECs and electricity bundled with renewable attributes. A few more states do not yet allow RECs pending the development of a suitable tracking system, and a few states do not recognize RECs for compliance at all.

Certificate tracking systems can play a significant role in providing the confidence state policy-makers need to allow RECs to satisfy RPS compliance. By “certificate tracking system,” we mean a web-based accounting database that supports multiple users and gives market participants the ability to manage their own certificate accounts. These tracking systems often serve multiple purposes, including verification of RPS compliance, support for environmental disclosure or electricity labeling, and substantiation of marketing claims for green products.

A number of states have supported the creation of certificate tracking systems. There are two regional tracking systems (NEPOOL GIS and PJM-EIS GATS) and three state tracking systems (Texas, Wisconsin and the New Jersey solar certificates program) in operation today. Two regional (WREGIS and M-RETS) and one state (New York) tracking system are currently in development, all of which are expected to be operational in 2007 or 2008. A few states currently track compliance with a manual system or review of utility-supplied documentation, sometimes pending the adoption of a web-based certificate tracking system.

The second section of this report addresses state renewable energy attribute definitions, and whether certain environmental attributes are required to remain bundled in RPS-eligible renewable energy transactions. Most RPS policies were adopted with an expectation that they would provide a range of benefits to the state, including environmental improvement. Despite this fact, states differ widely on which environmental attributes are required for RPS compliance,



and whether any available emissions allowances under cap-and-trade environmental regulations may be separated from (or must be retired with) RPS-eligible renewable energy transactions. In many cases, state RPS laws and regulations are simply ambiguous on how RECs are defined, and which specific environmental attributes must remain with renewable energy transactions for those transactions to count towards RPS compliance.

In particular, seven of the existing state RPS policies are specific about whether or not the attributes required for compliance include emissions reductions or allowances. Five of these states (Arizona, California, Colorado, New York and Washington) require that certain available emission reduction credits or allowances be retired for RPS compliance, while two states (Delaware and Pennsylvania, the latter in proposed rules) explicitly do not require that such credits or allowances be retired for RPS compliance.

Ambiguity reigns in most of the other states. This uncertainty has been created, in part, because the distinction between primary environmental attributes (the direct emissions of the generator) and derived environmental attributes (the resulting emissions benefits or allowances) has not always been acknowledged by state regulators and legislators. It is also a reflection of the fact that renewable energy generators have not, historically, been recipients of emissions credits or allowances, and that environmental regulators – not energy regulators – have domain over allowance distributions. At a minimum, definitional clarity should be sought.

The third section of this report reviews state policies regarding the use of renewable attributes for both RPS markets and voluntary markets for green power, and especially whether the same renewable attributes can be used for both purposes.

We find that 12 states and the District of Columbia prohibit the use of voluntary green power sales for RPS compliance, instead requiring that voluntary green power sales add to RPS-driven renewable energy requirements; a few of these states permit limited exceptions. Three states – Wisconsin, Arizona and Texas – permit voluntary sales of differentiated green power products to count towards their RPS requirements. In Wisconsin, however, investor-owned utilities, at least, are apparently voluntarily not counting green power sales towards their RPS obligations. In Texas, the interaction between voluntary sales and the RPS is the subject of much discussion, and regulatory rules have not yet been adopted. Six states – Connecticut, Delaware, Hawaii, Iowa, Pennsylvania and Rhode Island – have not yet addressed whether providers can count voluntary purchases of green power products towards their RPS obligations, though in at least four of these states such double use is effectively prohibited through the design of the regional certificate tracking system.

Overall, although the use of renewable energy attributes or certificates is widespread in state RPS policies, the definitions and treatment of these attributes and certificates vary by state. Where state intentions and requirements are unclear, policy-makers and regulators could remove ambiguity by revising current language and adopting more explicit language. Doing so will reduce uncertainty in the market, benefiting RPS-obligated entities, the renewable energy industry and consumers. In addition, at least when it comes to definitions of renewable energy attributes, it may be beneficial if states were able to further standardize their treatment of emissions allowances in order to encourage less fragmentation in the emerging RECs market.





## 1. Introduction

Twenty-one states and the District of Columbia have adopted mandatory renewables portfolio standards (RPS) over the last ten years. Renewable energy or renewable energy certificates are used to verify compliance with these requirements. Verification sometimes requires that renewable attributes remain bundled with the underlying electricity, but more often, an unbundling of the attributes from the underlying electricity is allowed. In the latter case, attributes may be separately traded as renewable energy certificates.

This report summarizes the treatment of renewable attributes in state RPS laws and regulations with the aim of providing an information source for states considering RPS policies, and also to draw attention to certain issues that arise in the use of renewable attributes and certificates for RPS compliance.

In this paper, we use the terms “renewable energy attributes” (attributes) and “renewable energy certificates” (RECs) to mean different things. Attributes are the characteristics of electricity supply, such as the energy source and emissions from a generator. Attributes are conveyed with electricity unless they are unbundled from the electricity and recorded in a certificate that may be traded separately from the electricity itself. RECs are the embodiment of one or more attributes of renewable electricity generation in an instrument that can be bought and sold separate from electricity, and that conveys a contractual right to claim those attributes.<sup>1</sup> We distinguish between attributes and RECs because state RPS policies vary between requiring renewable attributes to remain bundled with the underlying electricity, on the one hand, to allowing or requiring RECs for compliance, on the other.

Three specific issues associated with renewable energy attributes are addressed in this report:

1. The degree to which unbundled RECs are allowed under existing state RPS programs and the status of systems to track RECs and renewable energy attributes.
2. State definitions of the renewable energy attributes that must be included in order to meet state RPS obligations, including the treatment of available emissions allowances, and the implications of these definitional choices.
3. State policies on whether renewable energy or RECs sold through voluntary green power transactions may count towards RPS obligations.

Policies that address these three issues will have important implications for the fungibility and liquidity of the RECs market, as well as the location and number of renewable energy projects that are developed to serve RPS markets. They will impact the profitability of renewable projects, and may affect the degree to which an RPS policy brings near-term environmental gain. They can also influence market confidence in the voluntary green power market, and the ability of that market to support renewable energy deliveries that exceed state requirements. Finally, they will influence the ability of regulators to effectively track compliance with RPS obligations.

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<sup>1</sup> At least one state, Arizona, relies upon “RECs” to track RPS compliance, but expects those RECs to remain bundled with the underlying electricity. To categorize state practice, in this paper we define RECs to be attributes that may be unbundled from the underlying electricity; as such, using our terminology, Arizona does not allow (unbundled) RECs.

This report does not cover all of the issues that surround renewable energy attributes and certificate markets. An overview of RECs markets is provided by Holt and Bird (2005). Hamrin and Wingate (2003) describe regulatory policy issues and best practices relating to RECs. Ownership of RECs under different state policies and programs is discussed by Holt et al. (2006). Bluestein et al. (2006) and Bird et al. (2007) address issues relating to the use of renewable energy and RECs in emissions trading markets. For an in-depth treatment of trading RECs across geographic market boundaries, see Grace and Wiser (2002).

We begin in Chapter 2 by highlighting which states allow unbundled RECs in their RPS, and which do not. We also summarize the means by which states track renewable energy attributes and RECs for RPS compliance. Chapter 3 discusses the various state requirements for the specific renewable energy attributes that must be included in RPS-eligible renewable transactions, and specifically highlights the treatment of environmental attributes and emissions allowances. Chapter 4 turns to a different topic, and reviews state policies regarding the use of renewable attributes for both RPS markets and voluntary markets for green power; we pay special attention to whether the same renewable attributes can be used for both purposes. Chapter 5 summarizes our findings and conclusions.

## 2. Use of Renewable Attributes in State RPS Programs

Compliance with RPS mandates must be verified in some fashion. In this section we examine how states verify compliance, focusing on whether they rely upon renewable energy attributes bundled with electricity or renewable energy certificates unbundled from electricity.

Compliance verification is facilitated by a tracking system of some type, so we also highlight the means by which states track renewable energy attributes or certificates.

### 2.1 State Recognition of RECs

States that adopt RPS policies must specify how compliance with those policies will be verified.<sup>2</sup> One approach to verifying compliance is to examine the “chain of custody” in electricity contracts, relying on contracts for electricity (and bundled attributes) in which the generating units and their attributes are specified. A second approach is to unbundle the attributes from the underlying electricity and allow them to be traded as RECs. Verification of compliance can then take place by examining the number of RECs owned and retired by the obligated entities.

The use of unbundled and tradable RECs for RPS compliance has several possible advantages over requiring attributes to be bundled with electricity:

- Trading RECs is not as cumbersome or exacting as trading electricity.
- RECs may more easily seek the highest value, and more easily find buyers, than may bundled renewable electricity.
- RECs can usually be banked for a period of months or even years, thereby helping to avoid issues of generation intermittency and load-matching between the seller and the buyer.
- The use of RECs may reduce some transmission costs to the extent that they allow projects to avoid electricity delivery over constrained paths.
- Use of RECs may reduce RPS compliance costs by widening the geographic scope of eligible renewable energy projects.
- RECs can be more easily tracked for RPS compliance purposes.

Nevertheless, some states are reluctant to accept unbundled and tradable RECs for compliance. Preference for bundled electricity and attributes may be based on the following:

- Requiring bundled energy and attributes ensures that only generators in the region (or close enough to deliver energy into the region) can be used to meet the RPS, thereby protecting and promoting local generation.
- By virtue of the above, requiring bundled energy and attributes may provide greater assurance that economic development and environmental benefits will accrue to the state or region in which the RPS is established.
- Bundled energy and attributes may provide greater assurance that the price risk mitigation benefits of renewable energy are achieved than would unbundled REC sales.<sup>3</sup>

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<sup>2</sup> State policies that do not specify compliance methods usually fall into the category of voluntary state goals and are not classed as renewables portfolio standards in this paper.

<sup>3</sup> It should be noted, however, that these benefits can also be obtained by buying unbundled RECs whose price is indexed (inversely) to electricity prices, i.e., as a REC contract for differences.

- Creating a separate market for RECs may invite undesirable market manipulation, or may encourage reliance on short-term contracting, which will not necessarily meet the longer-term financing needs of renewable energy projects.
- Where wholesale electricity markets are not competitive, utilities might not purchase the electricity from the renewable energy facility if they only need RECs for compliance. This can be a particular concern for intermittent resources.

On balance, most states allow RECs for RPS compliance purposes, as shown in Table 1. Some of these states accept both RECs and electricity bundled with renewable attributes. Some states do not yet allow RECs pending the development of a suitable tracking system, and a few states do not currently recognize RECs for compliance at all. Many states that do use RECs address the preference for local benefits by requiring that imported RECs used for compliance have an equivalent amount of electricity delivered into the region to displace in-region generation, which is often fossil generation on the margin. To accommodate financing and contracting concerns, a number of states have established contracting standards that ensure that a minimum level of long-term contracting takes place.<sup>4</sup>

A number of the states listed in Table 1 do not merely allow RECs, but require them for RPS compliance demonstration. These states include Colorado, Connecticut, Delaware, Maryland, Massachusetts, Montana, New Jersey, New Mexico, Pennsylvania, Rhode Island, and the District of Columbia. In these cases, electricity suppliers may choose to purchase and sell these certificates on either an unbundled or bundled basis, but compliance demonstration is proven by virtue of REC ownership. Many of these states are served by regional certificate tracking systems in New England and the PJM region (see below for discussion of tracking). When additional regional tracking systems are adopted, more states will likely rely exclusively for compliance on RECs issued by those tracking systems.

Other states allow both RECs (bundled, or unbundled) and renewable attributes bundled with electricity for compliance demonstration purposes. For example, Maine allows documentation other than RECs for load-serving entities in the Maritimes Control Area, which is separate from the rest of New England and is not served by a regional tracking system.<sup>5</sup> Nevada's rules require each provider to comply with the RPS "by generating or acquiring electricity from renewable energy systems," but also that RECs "may be used to comply."<sup>6</sup> Texas requires RECs to meet its new renewables target, but requires electricity bundled with renewable attributes (which it calls "REC offsets") for existing renewable generation.<sup>7</sup> In Wisconsin, an electric provider only has access to tradable RECs once it exceeds its minimum percentage requirement for the RPS.<sup>8</sup>

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<sup>4</sup> For example, Colorado requires renewable energy contracts of 20 years, and California, Montana and Nevada require contract durations of a minimum of 10 years (California provides some leniency on this point). Other states require resource plans that encourage long-term contracts.

<sup>5</sup> Maine PUC, Docket No. 2002-494, Amendments to Eligible Resource Portfolio Requirement Rule (Chapter 311), Order Adopting Final Rule, June 18, 2003.

<sup>6</sup> Nevada Public Utilities Commission, Docket No. R115-03, effective February 18, 2004; entered as Nevada Administrative Code 704.8925.

<sup>7</sup> Texas Administrative Code, Title 16, Part II, Chapter 25.173(k)(1).

<sup>8</sup> Wisconsin Administrative Code PSC 118; consideration of revised rules may be tracked in Docket 1-AC-221.

**Table 1. REC Recognition and Renewable Attribute Tracking for State RPS Policies**

RPS State	Unbundled RECs Currently Allowed?	Attributes Tracking Currently Used	Comments
AZ	No*	manual	WREGIS expected operational in 2007
CA	No**	manual	May allow unbundled RECs after WREGIS is operational
CO	Yes (RECs required)	manual	WREGIS expected operational in 2007
CT	Yes (RECs required)	NEPOOL GIS	Electronic tracking system operational
DE	Yes (RECs required)	PJM-EIS GATS	Electronic tracking system operational
DC	Yes (RECs required)	PJM-EIS GATS	Electronic tracking system operational
HI	Not determined	manual	Rules not developed
IA	No	manual	RPS requirements completed
ME	Yes	NEPOOL GIS	Electronic tracking system operational
MD	Yes (RECs required)	PJM-EIS GATS	Electronic tracking system operational
MA	Yes (RECs required)	NEPOOL GIS	Electronic tracking system operational
MN	No	manual	New legislation calls for REC program by January 1, 2008
MT	Yes (RECs required)	manual	WREGIS expected operational in 2007
NV	Yes	manual	WREGIS expected operational in 2007
NJ	Yes (RECs required)	PJM-EIS GATS SREC	Electronic tracking system operational
NM	Yes (RECs required)	manual	Anticipates regional tracking system by 1/1/2009 at the latest (WREGIS)
NY	Yes	manual	Planning for new tracking system
PA	Yes (RECs required)	PJM-EIS GATS	Electronic tracking system operational
RI	Yes (RECs required)	NEPOOL GIS	Electronic tracking system operational
TX	Yes	ERCOT RECs Program	Electronic tracking system operational
WA	Yes	manual	WREGIS expected operational in 2007
WI	Yes	WIRRC	Electronic tracking system operational

\* By Arizona's definition, RECs bundled with electricity are required. By our definition of a REC that *may be* unbundled from electricity, Arizona does not allow RECs.

\*\* California regulators may choose to allow unbundled RECs in the future, once a tracking system is operational. California's current RPS rules allow some flexibility in electricity delivery, and therefore do allow a certain amount of implicit use of RECs unbundling already.

California has been debating whether or not to allow unbundled and tradable RECs for some time, and under recent legislation the Public Utilities Commission is now explicitly allowed to



authorize the use of RECs once it has determined that a tracking system is operational.<sup>9</sup> Similarly, recent Minnesota legislation directs the Public Utilities Commission to establish a program for tradable RECs by January 1, 2008.<sup>10</sup> A regional tracking system is currently under development.

Iowa does not allow RECs for compliance. The state adopted a mandate to install renewable energy capacity before the idea of unbundling RECs arose, and that mandate has been met and is therefore no longer a factor in Iowa's renewable energy development. Hawaii's RPS makes no mention of RECs, and because regulatory rules have not yet been established, it remains unclear whether RECs will be allowed.

## 2.2 Tracking Renewable Attributes

Since some states track unbundled RECs for RPS compliance and others track bundled electricity/attributes, or a combination of the two, we turn now to how generation attributes are tracked.<sup>11</sup> State RPS administrators generally use one of two basic approaches to track compliance. About half of the RPS states rely on a web-based tracking system that supports multiple users and gives market participants the ability to manage their own accounts. The other RPS states currently rely on manual tracking systems (which we define as a database generally accessed only by the tracking system administrator), or simply require and examine defined documentation submitted by obligated entities. States using each approach are summarized in Table 1, where the named tracking systems all are web-based systems.

Web-based certificate tracking systems heavily influence the degree of confidence that state policy-makers have in allowing unbundled RECs to satisfy RPS compliance. A number of states have supported the creation of web-based tracking systems because they felt that REC compliance was more flexible and cost-effective than relying on tracking contracts for electricity bundled with renewable attributes. Other states have allowed RECs only if a web-based certificate tracking system was in operation. A few states that allow RECs track compliance with a manual system or review of utility-supplied documentation, often pending the adoption of a web-based certificate tracking system.

Manual systems can be satisfactory for verifying RPS compliance, especially if it serves only one state, if only a few utilities are obligated to comply and they remain regulated, or if there are few market participants. On the other hand, if several states in a region have adopted an RPS, and renewable energy generators within the region are eligible to satisfy RPS requirements in multiple states, then it may make sense to adopt a more sophisticated web-based approach. A web-based tracking system offers greater confidence that double-counting has not occurred, more transparency, greater flexibility to users, and may be more cost-effective if there are numerous market participants.

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<sup>9</sup> California Senate Bill 107 (approved by the Governor September 26, 2006) Sec. 19. Note that even under current state RPS rules, a certain amount of flexibility in electricity delivery is allowed. Implicitly, this flexibility already allows for a certain amount of manually-tracked RECs unbundled.

<sup>10</sup> Minnesota S.F. No. 4, 85th Legislative Session (2007-2008), signed February 22, 2007, <http://www.revisor.leg.state.mn.us/bin/bldbill.php?bill=S0004.1.html&session=ls85> (accessed March 16, 2007).

<sup>11</sup> Some tracking systems issue and track certificates for all generation; hence it is incorrect to say that they are REC tracking systems. For general information on tracking system issues, see Wingate and Holt (2004).

Of course, attribute tracking systems may have other applications in addition to supporting RPS compliance. Serving multiple purposes may help justify establishing a more sophisticated system. In New England, for example, the original impetus for the development of the NEPOOL Generation Information System (GIS) was a desire for a regional approach to verifying environmental disclosure or electricity labeling. Another potential application of tracking systems is to verify marketing claims for voluntary renewable energy sales, which increased by 60% in 2004 and nearly 40% in 2005 (Bird and Swezey 2006). Voluntary purchasers often buy RECs from outside their region, and want assurance that they have unique ownership of the attributes—assurance provided by larger regional tracking systems that can coordinate REC imports and exports with other tracking systems.<sup>12</sup> Finally, regions with abundant renewable resources may find it in their interests to adopt a tracking system that increases market credibility for REC exports.

### 2.3 Web-Based Certificate Tracking Systems

Table 1 identifies the web-based certificate tracking systems currently in use, by acronym; these systems are further described here. Figure 1 illustrates the regions with web-based tracking systems in operation or in development.

- NEPOOL GIS: The Generation Information System (GIS) is operated by the New England Power Pool (NEPOOL) for Connecticut, Massachusetts, New Hampshire, Rhode Island, Vermont and most of Maine, although only the four states with an RPS are listed in Table 1. The GIS issues certificates for all generation, not just renewable energy generation.<sup>13</sup>
- PJM-EIS GATS: The Generation Attributes Tracking System (GATS) is operated by PJM Environmental Information Systems (EIS), a for-profit affiliate of the PJM Interconnection. GATS covers the PJM regional transmission organization (RTO) footprint, which includes all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. Like the GIS, GATS issues and tracks certificates for all electricity generation reported to it (not just renewables).<sup>14</sup>
- Texas Renewable Energy Credits Program: The Electric Reliability Council of Texas (ERCOT) administers the Renewable Energy Credits Program and tracking system for the Public Utilities Commission of Texas.<sup>15</sup> The program tracks renewable energy generated within Texas in support of the Texas RPS.

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<sup>12</sup> In the future, state, regional or federal carbon regulations may require accounting for emissions allowances, and some have suggested that this function be supported by expanding the capability of certificate tracking systems, while others prefer that tracking certificates and allowances be kept separate and distinct. The use of certificate tracking systems for carbon regulation purposes may be especially useful under load-based cap and trade programs.

<sup>13</sup> See <http://www.nepoolgis.com/>

<sup>14</sup> See <http://www.pjm-eis.com/>

<sup>15</sup> See <http://www.texasrenewables.com/>

- WIRRC: The Wisconsin Renewable Resource Credit Tracking System (WIRRC) was established as a result of Wisconsin's 1999 RPS law.<sup>16</sup> Currently, it limits ownership of RECs to obligated utilities, but is likely to be expanded as part of the development of a new regional Midwest tracking system.
- New Jersey SREC Program: In addition to its participation in PJM-EIS GATS, New Jersey supports a separate tracking system for solar generation, the Solar Renewable Energy Credit (SREC) program.<sup>17</sup>

Other certificate tracking systems are in development. These include the Western Renewable Energy Generation Information System (WREGIS), the Midwest Renewable Energy Tracking System (M-RETS), and a New York tracking system.

- WREGIS: From a geographic standpoint, WREGIS will be the largest tracking system in the nation, covering the area of the Western Energy Coordinating Council.<sup>18</sup> It is expected to be in operation in 2007. WREGIS will issue and track certificates for renewable generation only.
- M-RETS: M-RETS includes the five states of Wisconsin, Minnesota, Iowa, North Dakota and South Dakota, and the province of Manitoba.<sup>19</sup> The Wisconsin PSC recently issued an RFP for M-RETS system development and administration, and expects M-RETS to begin operation in 2007. Like WREGIS, M-RETS will issue and track certificates for renewable generation only.
- New York: New York has had a manual tracking system for several years, but the Public Service Commission has requested the development of a tracking system compatible with New England and PJM.<sup>20</sup> This system should be ready for operation in 2008.

Manual tracking of unbundled RECs or bundled renewable electricity transactions is typically used by states without access to a web-based system. Several of the states listed in Table 1 as currently using a manual system will probably switch over to a web-based system when WREGIS, M-RETS, and the New York certificate tracking systems are operational. California, which has taken a lead role in the development of WREGIS, has indicated that it will adopt that system when it is operational. New Mexico will adopt a tracking system before 2009. Other western states have not yet indicated their intentions. Similarly, Minnesota will adopt a regional tracking system by January 1, 2008.

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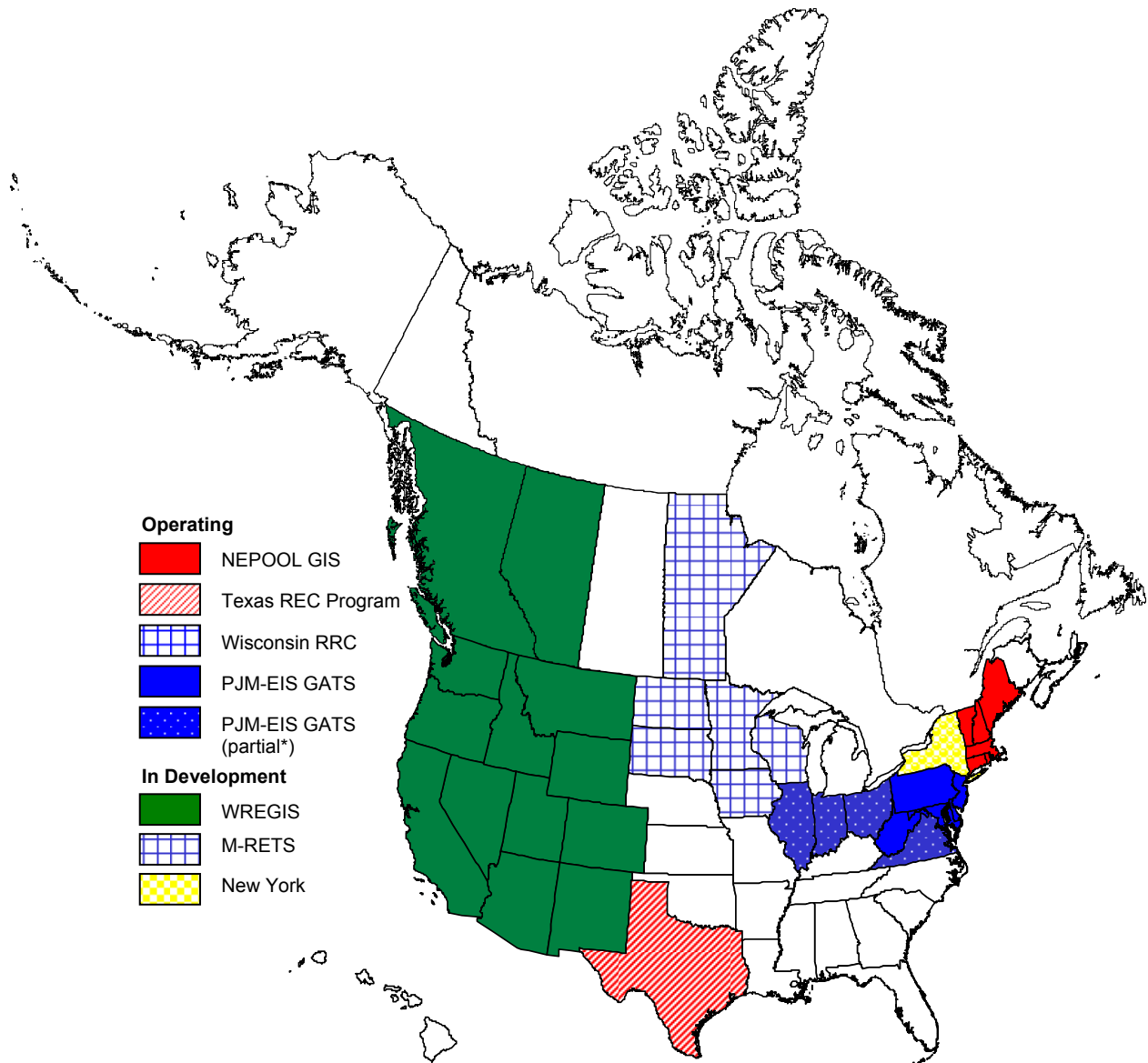
<sup>16</sup> See <https://www.wirrc.com/rrc/index.html>

<sup>17</sup> See <http://www.njcep.com/srec/index-primary.html>

<sup>18</sup> See <http://www.westgov.org/wieb/wregis/>

<sup>19</sup> See <http://mrets.net/>

<sup>20</sup> New York Public Service Commission, CASE 03-E-0188, Proceeding on Motion of the Commission Regarding Retail Renewable Portfolio Standard, Order Authorizing Additional Main Tier Solicitations and Directing Program Modifications, January 26, 2006; and Order Recognizing Environmental Attributes and Allowing Participation of Projects with Physical Bilateral Contracts, June 28, 2006.



\* GATS (partial) indicates that portions of these states, and others not similarly indicated, are within the PJM footprint.

\*\* New Jersey also supports a separate Solar RECs tracking system.

**Figure 1. Web-based Certificate Tracking Systems in North America**

### 3. Renewable Energy Attribute Definitions and the Treatment of Emissions Allowances Provided to Renewable Energy Generators

For several years, the relationship between renewable energy and environmental improvement—especially renewable energy generation’s effect on reducing air emissions—has been a source of discussion and debate. RPS policies reflect this debate to some extent. The debate has led to differences across states on which environmental attributes are to be retired to document RPS compliance, and it is this issue that is the topic of this chapter.<sup>21</sup>

#### 3.1 Renewable Energy and Emissions Allowances

Renewable energy is commonly understood to contribute to improved air quality and reduced greenhouse gas emissions. For this reason, many stakeholders argue that renewable attributes or RECs should include environmental attributes, as well as attributes identifying the resource type, location, vintage, and other salient characteristics of the generator. In describing environmental attributes, however, a critical distinction needs to be made. The direct air emissions from a renewable generator, often zero depending on the type of renewable resource, may be called the “primary” environmental attributes. “Derived” environmental attributes can be defined as the emissions *avoided* by virtue of renewable energy displacing conventional generation.

Regulators and legislators responsible for RPS enactment and administration have the clear authority to require that a generator’s *primary* environmental attributes follow the renewable energy attribute or REC transaction under a state RPS policy. In addition, in states where overall emissions levels are not capped under a cap-and-trade policy, *derived* emissions reductions (or the right to claim them) *might* (or might not) be considered part of the REC or renewable energy attribute; depending on delegated legislative authority, this decision may be made by energy or environmental regulators.

In states with emissions cap-and-trade programs, however, the treatment of *derived* emissions reductions is more complicated. These derived emissions reductions might (or might not) be eligible to earn emission allowances that could be traded, depending on the cap-and-trade program rules and whether renewable energy generators are granted emissions allowances.<sup>22</sup> Under the EPA’s Clean Air Interstate Rule (CAIR), 30 states are required to adopt rules for regulating SO<sub>2</sub> and NO<sub>x</sub>. States have some flexibility in how they do this, but most are expected to participate in a cap-and-trade program for emissions allowances. SO<sub>2</sub> markets are already established and allowance allocations have been made to emitting generators. NO<sub>x</sub> allowance allocations may be made to renewable generators; several states have already done so or have indicated their intent to do so. The other developing market of potential significance to renewable energy is carbon cap-and-trade. This market could be very large, but whether renewables will receive allowances is up to legislators and environmental regulators.

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<sup>21</sup> This is also an issue for voluntary markets for renewable energy and RECs. The arguments and conclusions may differ between RPS markets and voluntary markets, but the issue is fundamentally the same—what benefits are provided by the purchase and use of renewable energy? For more on voluntary market issues, see Bird et al. (2007).

<sup>22</sup> Whether renewable energy attributes include emission allowances depends in large part on whether the emission cap-and-trade rules make any provision for renewable energy generation to receive emission allowances. See Bluestein et al. (2006) and Bird et al. (2007).

Cap-and-trade rules are established by environmental regulators, not by energy regulators. In this instance, energy regulators and legislators responsible for RPS enactment and administration are, at most, able to direct whether any emissions allowances that *are* provided to renewable generators must be retired for RPS compliance purposes. Given that energy regulators are responsible for determining what attributes must be retired for RPS compliance, and that environmental regulators are responsible for determining whether renewable energy will receive allowances under cap-and-trade programs, ensuring consistent expectations calls for communication, cooperation and coordination between various levels of government and between energy and environmental regulators.

Clearly, the decisions of environmental regulators will affect the incremental emissions benefits provided by renewable energy markets relative to existing or planned cap-and-trade programs, but this paper is not about whether renewable energy generators *should* receive allowances.<sup>23</sup> Instead, our focus is on the environmental benefits expected from RPS policies and what can be done with emissions allowances or credits *if* they are granted to renewable generators; in other words, we are focused on the decisions of legislators and regulators responsible for RPS policy, not environmental policy more broadly.

This debate about what attributes are included with a renewable energy transaction bears on what environmental benefits a state may achieve with its RPS. If emissions allowances are issued to renewable energy generators and must be included for RPS compliance, then they are retired when renewable energy is used for that compliance. By requiring that allowances be retired (if available), states ensure that the RPS reduces emissions. States in this situation should also consider whether emission allowances retired for compliance with an RPS will be counted towards reducing emissions under the cap, or whether allowances retired for RPS compliance are intended to contribute to environmental improvements that exceed what is required under cap-and-trade emissions programs. In other words, can the same attributes (allowances) be used both for compliance with an environmental regulation and for compliance with an RPS?

On the other hand, even if emissions allowances are given to renewable generators, a state might still choose to exclude these derived environmental attributes from compliance if there is no intent that the RPS contribute to lowering emissions below a pre-established cap. In this case, the exclusion of emissions allowances from a REC and from RPS compliance frees them to be traded in cap-and-trade programs. This would have the effect of lowering the cost of cap-and-trade regulations because, by displacing emitting generation, fewer emissions allowances are needed in the cap-and-trade market. This approach would also provide additional revenue to the renewable generator because the generator could derive revenue from the RPS as well as from the cap-and-trade program. States taking this approach will have to address the question of what attributes to assign, for environmental disclosure or electricity labeling purposes, to the energy whose emissions attributes have been sold. For example, states could decide to assign the average emissions of the energy system mix to the energy whose derived attributes (avoided emissions or emission allowances) have been sold into the emissions market.

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<sup>23</sup> This is a matter for environmental regulators. For discussions of this issue, see AWEA (2005, 2006), Holt and Bird (2005), Leahy and Hathaway (2004), and comments on the Model Rule of the Regional Greenhouse Gas Initiative, at [http://www.rggi.org/stakeholder\\_comments\\_model\\_rule.htm](http://www.rggi.org/stakeholder_comments_model_rule.htm).

Finally, if renewable energy does not receive emissions allowances under cap-and-trade rules, then clearly its attributes will not include emissions allowances. Renewable energy used for RPS compliance will then have no incremental effect on reducing emissions below the cap, but will instead make achieving the cap simpler and cheaper.

However this issue is decided, states should be careful not to claim, under a cap-and-trade regime, that the RPS provides certain emissions reduction benefits unless emission allowances are retired to match RPS demand—either by retiring allowances with the renewable energy transaction or by lowering the emissions cap to take account of projected or actual RPS demand.

For insight into state positions on the intersection between renewable energy and environmental policy, we look first to what states are saying about environmental goals and expectations in their RPS policy statements. We then turn to state renewable energy attribute definitions, and to legislative or regulatory statements about emissions credits or allowances.

### **3.2 Stated Purposes of Existing State RPS Policies**

Both state legislation and regulatory rules address the goals of RPS policies.<sup>24</sup> Many policy statements mention environmental benefits from renewable energy in general terms, but are not specific, while others are very specific about an expectation of emission reductions. Still others do not mention expectations of environmental benefit at all. These various stated expectations are summarized in Table 2.

To be fair, whether legislators or regulators think to include the environment in their RPS goals statements varies with when they adopt the policies and in what context. Connecticut, Maine and Massachusetts, for example, do not mention the environment in their RPS legislation, but this may be because RPS policies in these states were adopted within much broader electricity restructuring legislation that did not spell out a specific purpose to each section. It is also possible, in other cases, that lawmakers were happy to include several rationales for their action without thinking too much about how these goals statements might be used or interpreted.

With these caveats in mind, the following excerpts are illustrative of the general environmental benefit expectations contained within some states' RPS policy statements:

- Arizona: “Environmental Portfolio Standard” targets “environmentally-friendly renewable electricity technologies.” (rules)
- Colorado: “...to improve the natural environment of the state.” (initiative)
- Hawaii: “...renewable energy resources offer Hawaii important job creation, environmental protection, and energy security benefits.” (legislation)
- Iowa: “...encourage the development of alternate energy production facilities and small hydro facilities in order to conserve our finite and expensive energy resources and to provide for their most efficient use.” (legislation)

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<sup>24</sup> Note that these goals apply to both RECs (where unbundled attributes are allowed) and to renewable electricity contracts that bundle the attributes with the energy.

- Montana: “Fuel diversity, economic, and environmental benefits from renewable energy production accrue to the public at large...” (legislation)
- New Mexico: “...generation of electricity through the use of renewable energy presents opportunities to promote energy self-sufficiency, preserve the state’s natural resources and pursue an improved environment in New Mexico.” (legislation)
- Pennsylvania: “An Act providing for the sale of electric energy generated from renewable and environmentally beneficial sources...” (legislation)
- Texas: “...to protect and enhance the quality of the environment in Texas through increased use of renewable resources...” (rules)
- Washington: “...will stabilize electricity prices...provide economic benefits...create high-quality jobs...provide opportunities for training apprentice workers...protect clean air and water...” (initiative)

It is unclear whether the general environmental expectations of these states imply anything about renewable energy attribute definitions or environmental attribute accounting.

Other states express more specific environmental expectations (*emphasis added*):

- California: “The development of renewable energy resources may *ameliorate air quality problems* throughout the state and improve public health by *reducing the burning of fossil fuels and the associated environmental impacts*.” (legislation)
- Delaware: “These benefits include *improved regional and local air quality, improved public health*, increased electric supply diversity, increased protection against price volatility and supply disruption, improved transmission and distribution performance, and new economic development opportunities.” (legislation)
- District of Columbia: “...the benefits of electricity from renewable energy resources, including *long-term decreased emissions* and reliance on and vulnerability from imported energy sources, increased energy security and economic development, and a healthier environment, accrue to the public at large.” (legislation)
- Maryland: “...the benefits of electricity from renewable energy resources, including *long-term decreased emissions*, a healthier environment, increased energy security, and decreased reliance on and vulnerability from imported energy sources, accrue to the public at large.” (legislation)
- Nevada: “...renewable energy systems...will *reduce environmental costs* in this State, including, without limitation: (1) *Air emissions*;” (rules)
- New Jersey: “...to encourage the development of renewable sources of electricity and new, cleaner generation technology; *minimize the environmental impact of air pollutant emissions* from electric generation; *reduce possible transport of emissions* and minimize any adverse environmental impact from deregulation of energy generation.” (rules)
- New York: “[The RPS] is expected to result in the *displacement of some existing fossil fuel-based generation supply*.” “Other essential considerations include...improving New York’s environment by *reducing air emissions and other adverse environmental impacts*;” (rules)
- Rhode Island: “Increased use of renewable energy can *reduce air pollution, including carbon dioxide emissions that adversely affect public health and contribute to global warming*.” (legislation)



**Table 2. Environmental Goals and Attribute Definitions for State RPS Policies**

State	Environmental Expectations	Attribute Description	Retirement of Emission Reduction Credits or Allowances
AZ	General benefits	Detailed definition	Required for RPS compliance
CA	Emissions benefits	Detailed definition	Required for RPS compliance in some circumstances; in other cases, allowed to trade separately
CO	General benefits	Detailed definition	Required for RPS compliance
CT	Environment not mentioned	All renewable and environmental attributes	Ambiguous
DE	Emissions benefits	Detailed definition	Not required for RPS compliance
DC	Emissions benefits	Unit of production	Ambiguous
HI	General benefits	Not Addressed	Not Addressed
IA	General benefits	Not Addressed	Not Addressed
ME	Environment not mentioned	Unspecified attributes	Ambiguous
MD	Emissions benefits	Unspecified attributes	Ambiguous
MA	Environment not mentioned	All renewable and environmental attributes	Ambiguous
MN	Environment not mentioned	Not Addressed	Not Addressed
MT	General benefits	All renewable and environmental attributes	Ambiguous
NV	Emissions benefits	Unit of production	Ambiguous
NJ	Emissions benefits	All renewable and environmental attributes	Ambiguous
NM	General benefits	All the environmental attributes	Ambiguous
NY	Emissions benefits	Detailed definition	Required for RPS compliance
PA	General benefits	Detailed definition*	Not required for RPS compliance*
RI	Emissions benefits	All renewable and environmental attributes	Ambiguous
TX	General benefits	All renewable and environmental attributes	Ambiguous
WA	General benefits	Detailed definition	Required for RPS compliance
WI	Environment not mentioned	Unit of production	Ambiguous

\*Proposed rules as of March 20, 2007.

Again, it is unclear, even from these more specific statements, whether policy-makers intended them to affect how environmental attributes are treated in renewable transactions, whether

renewable energy should be awarded emissions allowances (if emissions cap-and-trade programs are adopted), or whether any such allowance, if granted, should be retired for RPS compliance.

### **3.3 Attribute Definitions, Environmental Attributes, and Emissions Allowances**

Table 2 also summarizes the attributes that are required by each state for RPS compliance. In the table, the phrase “Detailed Definition” means just that, a clear and largely unambiguous statement of what attributes must, or may not, be included for RPS compliance, including whether any available emissions allowances may or may not be separately sold. “All Renewable and Environmental Attributes” requirements are also fairly comprehensive, but do not spell out specific intent with regard to whether emissions allowances or benefits are included with, or severable from, RPS-compliant purchases. This ambiguity is due, in part, to the fact that it is unclear, when renewable or environmental attributes are mentioned, whether state regulators and legislators intend to mean just *primary* attributes, or also *derived* attributes. The phrase “Unspecified Attributes” represents state rules that mention attributes in general but that provide little guidance as to meaning or intent, with the resultant same basic ambiguity as those states that use phrases such as “environmental attributes,” but that do not specifically refer to primary or derived attributes. Finally, some states do not mention attributes at all, but define a REC simply as a measurement of production. These states are also silent as to whether or not emissions benefits and allowances must be retired for RPS compliance. In Table 2, these states are labeled with the phrase “Unit of Production.”

One could argue that by not mentioning attributes at all, these state RPS rules imply that the emissions credits or allowances, if any, are free to be traded separately and not retired for RPS compliance. That logic, however, would then perhaps also imply that state rules that mention attributes intend that those attributes, and any derived benefits that come from them, must be included for RPS compliance. Neither argument should be pushed very hard because, in most of these instances, it is not clear whether legislators or regulators have even focused on this issue, or on the critical distinction between primary and derived attributes.

Overall, we find that seven states provide detailed definitions for the specific primary and derived attributes that must be included for RPS compliance purposes, including the treatment of any available emissions allowances. Nine states specify “all renewable and environmental attributes,” “all environmental attributes” or “unspecified attributes,” while three other states do not mention attributes at all (“unit of production”). As for the disposition of emission reductions credits or allowances (the derived attributes), five states require that any (or in the case of California, some) emission reduction credits or allowances, if they are available, be retired for RPS compliance. Two states are explicit that they do not require such derived attributes for compliance, and that emissions allowances may be sold separately, if they are available. Eleven states plus the District of Columbia, however, are ambiguous on this question, though the degree of ambiguity varies among states.

#### **3.3.1 Detailed Definitions**

Starting with the seven states with “Detailed Definitions” of attributes, five of these states (Arizona, California, Colorado, New York and Washington) explicitly include derived emissions benefits and allowances, if any, in the attributes that must be retired for RPS compliance.

- Arizona: The final rule uses a Unit of Production definition: “One Renewable Energy Credit shall be created to track kWh derived from an eligible resource,” but another part of the rule clarifies the rule’s intent: “If an Affected Utility acquires, trades, or sells environmental pollution reduction credits or any other environmental attributes associated with an Eligible Renewable Energy Resource, the Affected Utility may not apply Renewable Energy Credits derived from that resource to satisfy the requirements of these rules.”
- California: Attributes are specified in recently adopted legislation, Senate Bill 107. “‘Renewable energy credit’ includes all renewable and environmental attributes associated with the production of electricity from the eligible renewable energy resource, except for an emissions reduction credit issued pursuant to Section 40409 of the Health and Safety Code and any credits or payments associated with the reduction of solid waste and treatment benefits created by the utilization of biomass or biogas fuels.” As such, some emissions allowances and credits are allowed to trade separately from renewable energy transactions used to meet RPS obligations, while others must be included. A rulemaking is in process at the California PUC to incorporate SB 107 changes into standard terms and conditions for RPS contracts.
- Colorado: “A contractual right to the full set of non-energy attributes, including any and all credits, benefits, emissions reductions, offsets, and allowances, howsoever entitled, directly attributable to a specific amount of electric energy generated from an Eligible Renewable Energy Resource. One REC results from one megawatt-hour of electric energy generated from an Eligible Renewable Energy Resource.” Colorado rules also state that when contracting for renewable energy and RECs and determining their cost and value, a utility may take into consideration “environmental impacts including tradable emissions allowances savings,” among other factors.
- New York: The requirement is from NYSERDA’s 2006 solicitation for RPS attributes. These attributes must include “the exclusive rights to claim...that New York State and/or the RPS Program is responsible for the reductions in emissions and/or other pollution resulting from the generation of the Bid Facility’s energy and its delivery into the NYCA.” If the Bidder must apply, under any emission trading regime, for title to credits or allowances for which they are eligible, then the Bidder “shall (i) take all actions necessary to apply for and secure such Title, to the maximum extent to which Bidder...is entitled, (ii) provide NYSERDA with evidence of taking such action; and (iii) convey such Title to NYSERDA whenever so secured.”
- Washington: State law requires the inclusion of all the non-power attributes, which are defined as “all environmentally related characteristics, exclusive of energy, capacity reliability, and other electrical power service attributes, that are associated with the generation of electricity from a renewable resource, including but not limited to the facility’s fuel type, geographic location, vintage, qualification as an eligible renewable resource, and avoided emissions of pollutants to the air, soil, or water, and avoided emissions of carbon dioxide and other greenhouse gases.” Rules are currently under development.

Detailed specifications are also provided by Delaware and Pennsylvania, which are clear that they do not require derived emissions benefits or allowances to be retired for compliance.

- Delaware: Based on the definition of “Generation Attribute” as “a non-price characteristic of the electrical energy output of a Generation Unit including, but not limited to, the Unit’s fuel type, geographic location, emissions, vintage, and RPS eligibility,” Delaware would fall into the category of “All Renewable and Environmental Attributes.” A further statement clarifies the state’s intent, however: “Renewable Energy Credit” means “a tradable instrument comprised of all the Generation Attributes equal to 1 megawatt-hour of electricity derived from Eligible Energy Resources and that is used to track and verify compliance with the provisions of this Regulation. A REC does not include emission reduction credits and/or allowances encumbered or used by a Generation Unit for compliance with local, state, or federal operating and/or air quality permits associated with the 1 megawatt-hour of electricity.” This definition was written to allow any attribute representing emissions reduction credits or allowances to be sold separately from a REC (Bloom 2006).
- Pennsylvania: Legislative language is minimal: “Alternative Energy Credit is a tradable instrument that is used to establish, verify and monitor compliance with this act.” The implementing rule proposed on July 20, 2006, however, states, “An alternative energy credit represents the attributes of 1 MWh of electric generation that may be used to satisfy the requirements of § 75.51...A certified alternative energy credit does not automatically include environmental, emissions or other attributes associated with 1 MWh of electric generation. Parties may bundle the attributes unrelated to compliance with § 75.51 with an alternative energy credit, or, alternatively, sell, assign, or trade them separately.”<sup>25</sup> The proposed rule has not been made final as of this writing.

Among the seven states with a detailed enumeration of attributes, New York expects its RPS to provide incremental derived emissions benefits, and follows through by requiring that emissions reductions/allowances, if any are available, be retired with the REC for RPS compliance. If a generator must file an application to receive allowances, New York also requires that the generator submit that application so that an allowance retirement can take place. California also apparently expects its RPS to create incremental emissions benefits, but provides exceptions that allow certain allowances and credits to be severed from RPS-compliant renewable energy transactions. Arizona, Colorado and Washington cite only general environmental benefits, but by requiring emissions reductions as an attribute of a REC, their rules make clear that specific incremental emissions reductions are desired. On the other hand, Pennsylvania cites only general environmental benefits and does not (in its proposed rule) require derived emissions reductions and allowances to be retired for its portfolio standard; instead, these attributes may trade separately. Delaware appears to expect its RPS to provide emission reductions, but nonetheless, does not require such derived attributes and allowances to be retired for the purpose of RPS compliance.

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<sup>25</sup> Pennsylvania Bulletin, Vol. 36, No. 41, October 14, 2006, p. 6299. §75.54 (g) of proposed rule.

### 3.3.2 Less Precise Definitions

Nine states refer to renewable attributes, renewable and environmental attributes, non-price attributes or generation attributes, without specifying with precision whether derived emissions reductions, credits or allowances, if any, are excluded or must be included. Without such specificity, the resulting ambiguity leaves generators uncertain of what they can or should do. Generators would presumably like to sell emission allowances, if any are available, for the additional revenue they might provide. If RPS rules require that emission reduction attributes not be sold separately, generators (assuming they are eligible) might not bother applying for emission credits or allowances unless, as in New York, they are required to do so. In any event, because these nine states do not provide specific guidance, it is unclear what is or is not allowed. Moreover, because the current certificate tracking systems do not track individual attributes that have been separated from certificates, or were never included in those certificates, it is unclear whether generators in these states are currently selling allowances separately from RECs. Presumably, with rules unclear, generators may feel welcome to sell emissions allowances separately, and the authors are aware of instances in which this is the case.

- Connecticut: Connecticut’s rules state: “Renewable Energy Trading Program Emissions Attributes. Any electric supplier that seeks to demonstrate renewable energy portfolio standard compliance by participating in a renewable energy trading program shall have exclusive ownership of all renewable energy and environmental attributes from such trading program that are associated with its renewable energy sources.” Based on this language, it seems clear that environmental attributes may not be traded separately, and therefore must be retired for RPS compliance, but it is not clear what is encompassed by “environmental attributes.” Do they include only the direct emissions characteristics, which we have called primary attributes, or do they include also the emissions reductions or allowances, which we have called derived attributes? Until this is clarified, the treatment of emissions allowances remains ambiguous.
- Massachusetts: “Generation Attribute. A non-price characteristic of the electrical energy output of a Generation Unit including, but not limited to, the Unit’s fuel type, emissions, vintage and RPS eligibility.” Also, “NE-GIS Certificate. A document produced by the NE-GIS that identifies the relevant Generation Attributes of each MWh accounted for in the NE-GIS.” Because this definition does not specifically call out avoided emissions or emissions allowances, and the NE-GIS does not require that allowances be bundled with RECs, one might interpret the definition to allow derived benefits/allowances to be sold separately. Though we imagine that generators are doing just that, it is nonetheless somewhat unclear whether the distinction between primary and derived attributes was even strongly recognized in the RPS rulemaking process. As such, a certain amount of ambiguity remains.
- Montana: “Renewable energy credit” means “a tradable certificate of proof of 1 megawatt hour of electricity generated by an eligible renewable resource that is tracked and verified by the commission and includes all of the environmental attributes associated with that 1 megawatt-hour unit of electricity production.” As with Connecticut, further clarification of whether “environmental attributes” includes derived emission allowances would be helpful.

- New Jersey: “‘Renewable Energy Certificate’ or ‘REC’ means a certificate representing the environmental benefits or attributes of one megawatt-hour of generation from a generating facility that meets the requirements of this subchapter... ‘Attribute’ means a characteristic associated with electricity, such as its generation date, facility geographic location, unit vintage, emissions output, fuel, state program eligibility, or other characteristic that can be identified, accounted, and tracked.” Though this definition seemingly focuses on primary emissions attributes, not derived attributes and allowances (and may therefore be interpreted as allowing allowances to trade separately), the treatment of derived emissions allowances remains somewhat uncertain because the rule itself does not explicitly reference the important distinction between primary and derived attributes.
- New Mexico: Legislation passed in March 2007 defines a renewable energy certificate as “a certificate or other record...that represents all the environmental attributes from one kilowatt-hour of electricity generation from a renewable energy resource.” These environmental attributes are not further defined in law, though perhaps the Public Regulation Commission will add detail to the statute in the months to come.
- Rhode Island: “Generation Attributes: means the non-price characteristics of the electrical energy output of a generation unit including, but not limited to, the unit’s location, fuel type, actual emissions, vintage and policy eligibility. The Commission may modify this list as appropriate.” “NEPOOL GIS Certificate: means an electronic record produced by the NEPOOL GIS that identifies certain of the Generation Attributes of each megawatt-hour of electrical energy accounted for in the NEPOOL GIS.” The level and type of ambiguity here is similar to that in New Jersey, but with some further indication that allowances could be traded separately from the REC. In particular, a separate PUC report that accompanied the regulatory order adopting the RPS rules stated the PUC’s commitment to work with environmental regulators to figure out what to do, when and if CO2 regulation is adopted.
- Texas: The PUC regulatory rules state that “An REC represents one megawatt hour of renewable energy that is physically metered and verified in Texas,” while ERCOT’s rules note that “A Renewable Energy Credit is a tradable instrument that represents all of the renewable attributes associated with one MWh of production from a certified renewable generator.” And “ERCOT shall post on the MIS a table containing CO2, SO2, NOx, and particulate matter emissions data on an MWh basis for each certified REC generating Facility.” Some parties in Texas interpret this as requiring derived emissions attributes for compliance, while others see no such requirement.

Two of the nine states simply make a vague reference to attributes:

- Maine: “‘GIS certificates’ mean certificates created pursuant to the NEPOOL Generation Information System that represent attributes of electric power and that may be traded separately from the energy commodity.”
- Maryland: “‘Renewable energy credit’ or ‘credit’ means a credit equal to the generation attributes of 1 megawatt-hour of electricity...”

In both of these final cases, one might interpret them to include only primary attributes in RPS-eligible renewable energy transactions, allowing derived attributes to trade separately. Again, however, by not explicitly saying as much, a certain degree of uncertainty remains.

### 3.3.3 No Regulatory Guidance

Two states—Nevada and Wisconsin—and the District of Columbia define a REC minimally, as evidence of a MWh or kWh of energy generated from a renewable facility. It is not clear if such definitions are intended to exclude all attributes, including emission reductions or allowances, or if the states saw no need to be more specific. Though the rules are somewhat ambiguous on the treatment of emissions allowances in these cases, presumably with rules this unclear, generators may feel welcome to sell emissions allowances separately.

The RPS rules in Hawaii, Iowa and Minnesota also do not address what attributes, if any, must be present for RPS compliance.

As with policy goals, it is risky to impute too much to the intent of these general regulatory definitions. They may be general because the drafters did not see an issue and a need for greater clarity, and did not recognize the distinction between primary and derived attributes. On the other hand, definitions might be intentionally general, meaning that regulators intended for environmental attributes to be free of RPS constraints. It is only with more specific language, however, that intent may be truly said to be revealed. For this reason, in the future, states would ideally explicitly state whether derived emission reductions benefits, credits or allowances, if the renewable generator is eligible for them, must be retired for RPS compliance.

## 3.4 The Role of Tracking Systems

Certificate tracking systems could, in theory, help ensure that all primary and/or secondary attributes are included in RPS-eligible transactions. GATS, WREGIS and M-RETS, for example, all include in their operating rules the following definition:

Whole / Whole Certificate: A “Whole Certificate” is one where none of the renewable attributes have been separately sold, given, or otherwise transferred to another party by a deliberate act of the Certificate owner. Renewable attributes shall include the environmental attributes that are defined as any and all credits, benefits, emissions reductions, offsets, and allowances, howsoever entitled, directly attributable to the generation from the generation unit(s).<sup>26</sup>

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<sup>26</sup> See “Generation Attribute Tracking System (GATS) Operating Rules,” Revision 4, May 10, 2006. <http://www.pjm-eis.com/documents/downloads/gats-operating-rules.pdf> (accessed February 12, 2007); “WREGIS Interim Operating Rules: Functional Requirements,” Final WREGIS Operational Rules Committee Recommendations, July 15, 2004. <http://www.westgov.org/wieb/wregis/reports/InOpRulesfn17-15-04.pdf> (accessed February 12, 2007); “Midwest Renewable Energy Tracking System Operating Procedures,” December 6, 2006. [http://www.gpisd.net/mrets/documents/RFP/M-RETS\\_Operating\\_Procedures120606.pdf](http://www.gpisd.net/mrets/documents/RFP/M-RETS_Operating_Procedures120606.pdf) (accessed February 9, 2007).

Each of these three tracking systems further states that its certificates are “whole certificates.” By signing an agreement with these tracking systems, participants presumably bind themselves legally not to sell derived emissions attributes or allowances separately from the REC.

There are, however, at least three issues that deserve note here:

- First, tracking systems have sometimes gone out of their way to be “policy neutral,” but by specifying the types of certificates that may be traded, one might argue that the three systems noted above have made an exception from this goal. The other tracking systems have no such requirement.
- Second, and related, state RPS legislation and regulation in the regions covered by GATS and WREGIS have, as discussed above, allowed certain derived emissions allowances to be traded separately from RPS-compliant transactions. This is the case in, at a minimum, California, Delaware, and Pennsylvania. In these instances, state laws and regulations that allow such derived attributes to be separated from the RPS-eligible renewable transaction contradict what is claimed to be allowable by tracking system operating rules.
- And finally, how these conflicts are resolved in practice is unclear. Although most tracking systems can record information about emissions or emission allowances, they are not set up to track whether or not an individual derived attribute has been sold separately. As such, for all practical purposes, the tracking systems cannot verify that all required attributes are in fact present.



## **4. Relationship between State RPS Policies and Voluntary Green Power Sales**

States that adopt RPS requirements generally expect that such requirements will lead to the development and generation of additional renewable electricity. To this end, most state rules require that energy or certificates used for RPS compliance not be used for compliance with renewable energy obligations in another state. Using the same REC to comply with an RPS in more than one state would dilute the benefits of these policies because the requirement would not result in additional renewable generation for one of the states.<sup>27</sup>

A similar result could occur if an electricity provider were to sell renewable energy or RECs as part of a differentiated green product to a retail consumer, and claim the same renewable energy or RECs for RPS compliance. Consumers presumably expect that their voluntary green power purchases will lead to more renewable energy generation than is already required by law. According to the U.S. Environmental Protection Agency (EPA), for example, “It is this ‘additionality’ that gives voluntary green power purchases their environmental integrity and marketability and, thus, underpins an effective voluntary market.”<sup>28</sup> The treatment of green power sales in state RPS policies is the subject of this chapter.

### **4.1 Arguments for and Against the Use of Green Power Sales in State RPS Policies**

Generally, arguments against allowing voluntary green power sales to count towards RPS compliance include:

- Consumers who voluntarily pay more for renewable energy expect to promote additional renewables development above and beyond what is already required by law. Because of this expectation, use of voluntary renewable energy sales for RPS compliance should be forbidden as a matter of consumer protection.
- If consumers understand that the renewable energy they are buying is required by law and would be generated even without their contributions, voluntary demand will decline or cease.
- Allowing voluntary renewable energy sales to count towards an RPS would shift the cost of RPS compliance to those willing to pay more; if a public policy such as an RPS is beneficial to society, then all energy users should pay proportionately.

On the other hand, arguments in favor of allowing voluntary renewable energy sales to be counted towards RPS obligations include the following:

- Promoting differentiated green power products is merely another way for a utility or marketer to achieve the same portfolio goal, and is not a separate program per se.
- If some customers are willing to pay more for renewable energy, and the same sales can be counted towards the RPS obligation, it will lower the cost of RPS compliance to other ratepayers.

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<sup>27</sup> This is often referred to as “double-counting” or “double use.” For a more complete discussion, see Hamrin and Wingate (2003).

<sup>28</sup> U.S. EPA, “Comments of the U.S. Environmental Protection Agency,” in Project No. 31852, Rulemaking Relating to Renewable Energy Amendments, Public Utility Commission of Texas.



current rules state, “The Commission shall, in another proceeding, further define how RECs from Green Power products...are to be tracked and utilized for compliance in the RPS.” The treatment of green power sales in the RPS policies of Hawaii and Iowa are not clear.

#### 4.2.2 States that Do Not Allow Green Power Sales to Count Towards RPS Requirements

Twelve states and the District of Columbia disallow the use of the same certificates for RPS compliance and voluntary renewable energy products, but some permit limited exceptions. Below, we highlight the exceptions before providing language from states that appear to prohibit double use entirely.

##### *States prohibiting use of voluntary green power sales for RPS compliance, with exceptions*

- Colorado prohibits RECs sold through a green pricing program from being counted towards compliance with the RPS unless it is expressly authorized by the PUC, but a utility must apply to the PUC to do so.<sup>29</sup> None have done so to date.
- Maine, with a flat 30% RPS, does not allow voluntary demand in excess of the requirement to be used to satisfy the RPS obligation, but voluntary demand up to the level of the RPS may be counted towards RPS compliance. In a green power product with 50% renewable energy, for example, 30% may count towards the RPS. The customer is really creating a 20% benefit above the RPS.
- Maryland rules do not allow voluntary purchases to count towards the RPS. “A supplier shall retire one renewable energy credit for each megawatt-hour of retail sales of electricity marketed as having characteristics of a Tier 1 renewable source or a Tier 2 renewable source.” But, the supplier must exclude any voluntary, differentiated renewable energy sales from the baseline to which RPS percentages apply. This exclusion applies until 2019. Until then, suppliers can reduce their absolute RPS obligation by increasing voluntary sales.

##### *States prohibiting use of voluntary green power sales for RPS compliance, without exceptions*

- New York has split its 25% RPS into two components: a 24% mandatory RPS and a 1% voluntary goal. The accounting for these is separate so that the same REC may not be used to satisfy both components.
- Current California regulations are not explicit about accounting for voluntary sales of green power, but the recently adopted SB 107 takes care of that: “A renewable energy credit shall

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<sup>29</sup> Colorado also anticipates the possible adoption of a federal RPS by noting that RECs used for compliance with the state RPS may also be used for compliance with a federal renewable energy standard. The question of counting a state RPS obligation towards a federal RPS obligation is separate and different from the issue we have been discussing here. First, a state and federal RPS (if one is adopted) are both regulatory requirements, rather than an overlap of regulatory and voluntary demand. Second, it is unlikely that federal RPS legislation would seek to impose such a requirement in addition to an RPS that a state already has in place, as long as the state requirement is at least as strong as the federal mandate.

be counted only once for compliance with the renewables portfolio standard of this state or any other state, or for verifying retail product claims in this state or any other state.”

- The District of Columbia’s rule is simple and direct: “An Electricity Supplier shall not apply any surplus Renewable Energy Credits derived from voluntary purchases of energy from qualified renewable sources toward its mandatory compliance requirements.” Although the term “surplus” is unclear, the adoption of the rules is clear as to intent, in part because of a dissenting opinion on this issue.
- Massachusetts also offers a general ban on a double use of RECs: “A Retail Electricity Supplier shall demonstrate...that New Renewable Generation Attributes used for compliance have not otherwise been, nor will be, sold, retired, claimed or represented as part of electrical energy output or sales, or used to satisfy obligations in jurisdictions other than Massachusetts.”
- Minnesota law requires utilities to offer green pricing programs. Initially, the Public Utilities Commission allowed voluntary sales to count towards the state’s RPS, but the PUC soon reversed itself: “In meeting their renewable energy objectives, utilities shall not include generation purchased under green pricing programs established under Minn. Stat. § 169.”
- Montana legislation stated the policy: “A public utility may not resell renewable energy credits and count those sold credits against the public utility’s obligation to meet the standards...”
- Nevada intent also appears to be to prevent the use of a REC for both a voluntary differentiated product and the RPS obligation. If a utility does not own the generator, the generator owner must attest that the qualifying energy “(a) Has not been and will not be sold or otherwise exchanged for compensation or used for credit in any other state or jurisdiction; and (b) Has not been and will not be included within a blended energy product certified to include a fixed percentage of renewable energy in any other state or jurisdiction.” While this speaks to non-utility generation, the rules do not address the situation of utility-owned generation or utility use of purchased RECs.
- In New Jersey, the same renewable energy shall not be used for more than one of the following: “(1) Creation of a solar REC under N.J.A.C. 14:8-2.9; (2) Creation of a REC under N.J.A.C. 14:8-2.8 or 2.9; or (3) Creation of a REC, or of any other type of attribute or credit, under authority other than N.J.A.C. 14:8-2.9 such as another state's renewable energy standards or any voluntary clean electricity market or voluntary clean electricity program.”
- New Mexico rules state: “...renewable energy sold to customers through a premium-priced renewable energy tariff shall not be counted in determining compliance with this rule.”
- Washington’s recently adopted RPS initiative states that an obligated utility may not count: “(i) Eligible renewable resources or distributed generation where the associated renewable energy credits are owned by a separate entity; or (ii) Eligible renewable resources or renewable energy credits obtained for and used in an optional [green pricing program].”

#### 4.2.3 States in which Green Power Sales Can Count Towards RPS Requirements

There are currently three states in which it appears that counting voluntary demand towards the RPS obligation is allowed.

- The Wisconsin RPS law states, “The commission shall allow an electric utility to recover from ratepayers the cost of providing total renewable energy to its retail customers in amounts that equal or exceed the percentages specified...[A]n electric utility may recover costs under this paragraph by any of the following methods:
  1. Allocating the costs equally to all customers on a kilowatt-hour basis.
  2. Establishing alternative price structures, including price structures under which customers pay a premium for renewable energy.
  3. Any combination of the methods specified in subds. 1. and 2.”<sup>30</sup>

Though seemingly allowed, at minimum, none of the investor owned utilities are currently counting voluntary demand towards their RPS compliance (Vickerman 2007).<sup>31</sup>

- The Texas legislature adopted SB 20 in 2005, updating its RPS, which appears to require that voluntary demand be counted towards the RPS. The legislation includes a clause that states: “Notwithstanding any other provision of law, the commission shall ensure that all renewable capacity installed in this state and all renewable energy credits awarded, produced, procured, or sold from renewable capacity in this state are counted toward the goal.”<sup>32</sup> The interpretation of this requirement is the subject of much discussion, but new rules for this provision of law have not yet been adopted by the Public Utilities Commission of Texas.
- Arizona prohibits using an RPS REC for “any other regulatory requirement,” but it does not have any specific prohibition of using bundled RECs from utility voluntary green power programs to meet its portfolio requirements. In fact, in the 2001 Environmental Portfolio Standard Rules, Arizona encouraged “approved Green Pricing Programs” by offering “extra credit multipliers” for RECs from those programs. Arizona views green pricing or green power programs as just one of many ways to finance the production of renewable energy to meet portfolio requirements (Williamson 2007).

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<sup>30</sup> Wisconsin Statutes 196.378(2)(d). <http://www.legis.state.wi.us/rsb/stats.html> (accessed February 10, 2007).

<sup>31</sup> It is unverified, but some of the municipal utilities and rural electric cooperatives may be counting voluntary sales towards their RPS obligation.

<sup>32</sup> Texas Utilities Code Section 39.904 (m).

## 5. Summary and Conclusions

Renewable energy certificates are increasingly common as a means of verifying compliance with state RPS policies – most states either require or allow RECs for compliance purposes. For this reason, and also to support environmental disclosure policies and voluntary markets for renewable energy, many regions of the United States have created or are creating web-based certificate tracking systems. These tracking systems are useful not only for verification of compliance and substantiation of marketing claims, but also to prevent fraud and double counting of certificates.

This paper has addressed two important policy issues associated with renewable energy attributes and RPS requirements: (1) the definition of which attributes must be included in renewable energy transactions, and the treatment of emissions allowances under RPS requirements; and (2) the interaction between voluntary green power sales and state RPS obligations.

With respect to definitions, we find that many states have not fully defined a REC or specified which environmental attributes must remain with renewable energy transactions for those transactions to count towards RPS compliance. There is little doubt that many state policymakers expect their RPS policies to elicit environmental benefits, including emissions reductions, but the interaction between RPS obligations and cap-and-trade emissions programs have not always been fully addressed. This is, in part, because the critical distinction between primary and derived environmental attributes has not always been acknowledged. It is also a reflection of the fact that renewable energy generators have not, historically, been recipients of emissions credits or allowances, and that environmental regulators – not energy regulators – have domain over allowance distributions.

In particular, many states have defined eligible renewable energy transactions without specifying what attributes must be included, and particularly without stating whether emissions allowances or credits, if any are available, must be retired for purposes of state RPS compliance. General or vague definitions have created uncertainty about whether derived attributes such as emission allowances or credits must be included with the sale of a REC or renewable energy and retired when it is used for an RPS, or whether such emission allowances or credits may be sold separately.

It would be helpful if these states clarified their intent. The real question is whether these two policies (RPS and cap-and-trade) are intended to be additional to one another, each credited with creating specific and quantifiable environmental benefits, or whether the two policies are meant to be combined to meet a single shared environmental target. If they are meant to be additional, then states might be expected to define renewable energy attributes to include any available emissions reductions benefits and require that any such environmental benefits be retired for RPS compliance purposes. If, on the other hand, RPS policies and emissions cap-and-trade programs are intended to meet a shared environmental target, then states might define RPS attributes as not including the derived emissions reductions benefits, and allow any emissions allowances to be used to count towards cap-and-trade compliance.

Even where definitions are clear, states have taken very different approaches, with some requiring that emissions allowances be retired for the purpose of RPS compliance, and others allowing separate sales of renewable energy and associated emissions allowances. Arizona, California, Colorado, New York, and Washington, for example, have included at least some emissions allowances and credits with the RPS-eligible renewable energy transactions. On the other hand, Delaware, and proposed rules in Pennsylvania, would allow these derived environmental attributes to be excluded from RPS compliance, and sold separately. While definitional clarity is to be applauded and the diversity of definitions is based, in part, on differing policy goals, nonetheless, this diversity holds the prospect of further fragmenting the REC market, and restricting liquidity and trade in this new commodity.

As for interactions with the voluntary green power market, we find that state RPS policies have – in many cases – addressed this issue clearly. Thirteen of the 22 state RPS policies in existence in the U.S. explicitly prohibit (sometimes with exceptions) voluntary green power sales from being used for RPS compliance purposes. Six states, however, have not explicitly addressed this question in RPS rules and legislation, while three states – Wisconsin, Texas and Arizona – allow or perhaps even require counting voluntary demand towards RPS compliance.

The primary conclusion of this report is simple: on each of the issues investigated, states that have not been explicit should clarify their intent. Doing so will remove uncertainty in the market. In addition, at least when it comes to definitions of renewable energy attributes, it would be beneficial if states were able to further standardize their treatment of emissions allowances in order to encourage less fragmentation in the RECs market.

## References

- American Wind Energy Association (AWEA). 2005. "Clean Air and Climate Change Policy Position on Emissions Allowances." September.  
[http://www.awea.org/policy/regulatory\\_policy/clean\\_air\\_documents/AWEA\\_CleanAir\\_ClimateChange\\_PolicyPosition\\_9.2005.pdf](http://www.awea.org/policy/regulatory_policy/clean_air_documents/AWEA_CleanAir_ClimateChange_PolicyPosition_9.2005.pdf).
- American Wind Energy Association (AWEA). 2006. "AWEA Comments on Climate Change White Paper by the Senate Energy and Natural Resource Committee." March.  
[http://www.awea.org/policy/regulatory\\_policy/clean\\_air\\_documents/WhitePaper\\_comments\\_AWEA\\_3.13.06.pdf](http://www.awea.org/policy/regulatory_policy/clean_air_documents/WhitePaper_comments_AWEA_3.13.06.pdf)
- Bird, Lori, Edward Holt and Ghita Carroll, 2007. "Implications of Carbon Regulation for Green Power Markets." NREL (forthcoming). Golden, Colorado: National Renewable Energy Laboratory.
- Bird, Lori and Blair Swezey, 2006. "Green Power Marketing in the United States: A Status Report (Ninth Edition)." NREL/TP-640-40904. Golden, Colorado: National Renewable Energy Laboratory. <http://www.eere.energy.gov/greenpower/resources/pdfs/40904.pdf>.
- Bloom, David. 2006. Delaware Public Service Commission, personal communication. December 20.
- Bluestein, Joel, Elizabeth Salerno, Lori Bird and Laura Vimmerstedt. 2006. "Incorporating Wind Generation in Cap and Trade Programs." NREL/TP-500-4006. Golden, Colorado: National Renewable Energy Laboratory.  
[http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/wpa/policy\\_cap\\_trade.pdf](http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/wpa/policy_cap_trade.pdf)
- Grace, Robert and Ryan Wiser. 2002. "Transacting Generation Attributes Across Market Boundaries: Compatible Information Systems and the Treatment of Imports and Exports." LBNL-51703. Berkeley, California: Lawrence Berkeley National Laboratory.  
[http://eetd.lbl.gov/ea/EMS/reports/51703\\_execsum.pdf](http://eetd.lbl.gov/ea/EMS/reports/51703_execsum.pdf).
- Hamrin, Jan and Meredith Wingate. 2003. "Regulator's Handbook on Tradable Renewable Certificates." San Francisco, California: Center for Resource Solutions.  
<http://www.resource-solutions.org/policy/TRChandbook/index.htm>.
- Holt, Edward and Lori Bird. 2005. "Emerging Markets for Renewable Energy Certificates: Opportunities and Challenges." NREL/TP-620-37388. Golden, CO: National Renewable Energy Laboratory. <http://www.eere.energy.gov/greenpower/resources/pdfs/37388.pdf>.
- Holt, Edward, Ryan Wiser and Mark Bolinger. 2006. "Who Owns Renewable Energy Certificates? An Exploration of Policy Options and Practice." LBNL-59965. Berkeley, California: Lawrence Berkeley National Laboratory.  
<http://eetd.lbl.gov/ea/EMS/reports/59965.pdf>.



Leahy, Patrick and Alden Hathaway. 2004. "Renewable Energy Certificates and Air Emissions Benefits: Developing an Appropriate Definition for a REC." Washington, D.C.: Environmental Resources Trust. [http://www.ert.net/pubs/ERT\\_REC\\_Position.pdf](http://www.ert.net/pubs/ERT_REC_Position.pdf).

Vickerman, Michael. 2007. Renew Wisconsin, email communication, March 16.

Williamson, Ray. 2007. Arizona Corporation Commission, email communication, February 23.

Wingate, Meredith and Edward Holt. 2004. "Design Guide for Renewable Energy Certificate Tracking Systems." Washington, DC: National Wind Coordinating Committee. [http://www.nationalwind.orr/publications/rec/rec\\_guide.pdf](http://www.nationalwind.orr/publications/rec/rec_guide.pdf).